

Exploring sense of place in relation to urban facilities: evidence from Lisbon

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Abstract

Urban environments constitute the habitats in which an increasing number of people live. Place-making forms part of this living, occurring in the context of specific urban assemblages made up of facilities that serve different purposes. For example, Soho in London is characterized by entertainment facilities, while large parts of the Ruhr area in Germany are dominated by industrial features. In this article, we explore possible links between exposure to certain urban facilities and sense of place in Lisbon, Portugal. To do so, we use a web mapping-based survey that allows respondents to map and rate meaningful areas. These areas and their assessments are related to points of interest extracted from Google Places in a structural equation model using PLS-SEM. The results show that exposure to everyday urban facilities such as grocery shops is negatively correlated with place identity, while those that represent leisure locations are negatively correlated with place attachment. Both findings suggest that the temporal rhythm of exposure to certain features is an important factor. Methodologically, our study shows that scales differ between place concepts and their associated spatial footprints – an important finding for future studies. We end the article by offering conclusions and policy recommendations.

Keywords

Sense of place; Built environment; Urban facilities; POI; PLS-SEM

1. Introduction

Every human being has their own perception and idea of meaningful places with which they feel emotionally connected (Gieryn, 2000; Montello et al., 2014). This includes making sense of locales in urban environments comprising facilities that enable the pursuit of certain activities, facilitate people to interact socially, and to literally ‘live’ their lives. The term ‘facilities’ is here understood in a broad manner, encompassing publicly accessible establishments that characterize the functional mix of urban environments including shops, places of worship, governmental institutions, and others. Such facilities offering specific functions can have an impact on sense of place, that is, on how humans connect to geographically locatable concentrations of experiences and meaning, also called places (Lengen, 2016). For example, key moments such as a first kiss can make an urban park a special place of a couple (cf. Manzo, 2005). Place-making happens rather quickly in this case, although the bonds that have formed can still change in the course of time. The same park, however, can also be interpreted as a focal point of recurrent nocturnal disturbances by the park's neighbors, in which case the place-making process would be a gradual one and associated with negative sentiments (cf. Manzo, 2005). Places, including their associated urban environments, can thus exhibit at least as many symbolisms, meanings, and memories as there are subjects conceptualising them (Hidalgo & Hernández, 2001). Experiences in places can evoke different meanings not only at various temporal scales (as demonstrated in the example above) but also at different spatial levels including neighborhood, city, country, and even global scale (Hidalgo & Hernández, 2001; Massey, 2005; Zhang et al., 2020). Researchers have studied sense of place in relation to a number of topics including neighborhood ties (Lewicka, 2005), social capital and civic engagement (Acedo et al., 2019; Acedo & Johnson, 2020), wellbeing (Larson et al., 2013), social relations (Simms, 2008), and

affordances (Raymond et al., 2017), to name but a few examples. The results established in such studies and the initial park example demonstrate that urban environments play an often complex role but are indispensable to fully understand the holistic nature of sense of place in a contextualized manner when it comes to understanding places in cities.

Research on sense of place can be divided into two broad categories (Raymond et al., 2017). One of these categories comprises works that deal with sense of place in a holistic way. The dominant paradigm here is qualitative, and the respective analytical traditions are applied to explore the deeper meanings and symbolisms of places and the qualities attributed to them. Notable examples of this type of enquiry, often (but not exclusively) found in human geography, include the humanist tradition (Seamon & Lundberg, 2020), approaches guided by critical theory (Harvey, 1996), and more recent post-structuralist work drawing on assemblages or non-representational theory (DeLanda, 2016; Thrift, 2008). The second line of research on sense of place, into which the present article falls, is to investigate the relationship of certain external characteristics to sense of place. This latter type of study is often conducted quantitatively and is found in environmental psychology and cognate fields. Examples of these kinds of works are found in the literature review below (see Section 2). While this second line of research does not allow for the development of holistic views such as experiences and perceptions of places in their entirety and the meaning people ascribe to them, the former perspective is not able to identify in quantifiable terms the effects of certain environmental conditions on the formation of places. Both perspectives therefore have their justification, and place research should take into account both perspectives in tandem.

The present study investigates whether and how the presence of urban facilities reflecting functional urban aspects is related to sense of place. Such collections of urban facilities form local functional contexts that contribute to the identity of the respective neighbourhoods. Scholars have paid relatively little attention to how functional factors influence sense of place at this meso level, that is, how a functional context formed by a set of points of interest (POIs) affects sense of place. There have been studies investigating external factors relating to the built environment of locales, and personal characteristics in isolation (e.g. Abass & Tucker, 2018; van Vliet & Hammond, 2021; Youssef & Tsenkova, 2016). Also, certain intentional functions of places such as utilizing them for health promotion (e.g. Gesler, 2005; Heinkel, 2018; Kistemann, 2016) or in a marketing context via place branding (e.g. Gieling et al., 2019; Inch & Walters, 2018; Sadeque et al., 2020) have been investigated. However, little is known about how compact local functional contexts as a whole, consisting of a mix of retail, administrative, religious, recreational, and other facilities, influence the meaning people ascribe to places that are relevant to them. In our study, we address the presence of these mixed collections of amenities, shops, and so on at the meso level, an endeavour that is more holistic than the disaggregate, isolated considerations mentioned, but less comprehensive than much of the available qualitative work. The present work is concerned with an intermediary perspective that lies between direct perception and meaning-making, and perceptions of place as results of longer-term cognitive processing, as differentiated by Raymond et al. (2017). We address an urban characteristic the sense-making of which is the result of both immediate, direct and longer-term, cognition-based place-making. A more detailed outline of the contributions of this article is offered at the end of Section 2 where it is motivated by the existing literature.

The case study presented in the following is based on the operationalization of an established environmental psychological concept of sense of place. This concept breaks down sense of place into three subcomponents (Jorgensen & Stedman, 2001): place dependence, place attachment, and place identity. We use the corresponding operationalization in conjunction with partial least squares structural equation modeling (PLS-SEM). This type of modeling allows us to model both the complex subcomponents of the chosen sense-of-place concept and their relationships to urban facilities. The model is fitted using two types of datasets from the context of Lisbon, Portugal: individual-level responses about sense of place from a web-mapping-based survey, and objective information from Google Places describing functional urban facilities in the form of a point dataset. The results obtained show that only certain types of urban facilities are significantly related to sense of place. As an additional and surprising result, the study also shows that our chosen conceptualization of the degree of acquaintance with a place does not significantly contribute to our developed model. Our findings are of interest to empirical scholars from planning, geography, and urban studies, as well as to practical decision makers. We also offer some methodological considerations that we hope will be informative for the emerging field of place-based (or 'patial') analysis.

2. Literature review

Research on sense of place relevant to this study has been conducted primarily in the fields of environmental psychology, architecture and planning, and geography. Due to the interdisciplinary character of the topic of sense of place, however, it is difficult to disentangle contributions along disciplinary lines. The concept of place is also notoriously difficult to grasp methodologically and the transfer of the complex and multi-layered concept of place into place-specific, formal methods still poses a considerable challenge. Initial methodological approaches for the formal and quantitative analysis of places have recently been proposed, particularly in geography and geographical information science. Ongoing methodological research includes place-based counterparts to Geographical Information Systems (GISs) concepts (Gao et al., 2013, Gao et al., 2017), the visualization of places (Bleisch & Hollenstein, 2018; Iosifescu Enescu et al., 2020; Westerholt, Gröbe, et al., 2018), methods for measuring landscape values (including sense of place) (Brown et al., 2015; Bubalo et al., 2019), spatial-statistical discussions (Lai et al., 2020; Lansley & Longley, 2016; Westerholt, 2019), the use of social media (Li et al., 2018; Zhang et al., 2020), the development of place ontologies (Ballatore, 2016; Scheider & Janowicz, 2014), among others (see Wagner et al. (2020), Hamzei et al. (2020), Purves et al. (2019), and Merschdorf and Blaschke (2018) for current literature reviews). These references accompanied by recently established events focusing on place-related information like the PLATIAL symposium series (Mocnik & Westerholt, 2022; Westerholt & Mocnik, 2019; Westerholt, Mocnik, et al., 2018) show a broad methodological interest in the topic of place. However, most of the approaches listed are still in their infancy, although initial attempts to theorize place-related information are the subject of current, ongoing research (Mocnik, 2022). For the present study, due to the lack of an established methodology

specifically adapted to place, we therefore resort to a traditional approach that has already been used especially in environmental psychology.

A number of urban characteristics have been studied in relation to sense of place. Some of these relate to the urban fabric, particularly the built urban environment. Billig (2005) has used ethnography and interviews to find that both administrative boundaries and those imposed by the physically constructed street network influence the ideas that people develop about places. This is particularly the case when these boundaries separate groups of people with different characteristics, highlighting the complex link between physical and social factors. In addition, the structural age of a neighborhood was found to be important for the sense of place. In a similar vein, Youssef & Tsenkova, 2016 found that structural characteristics of neighborhoods matter for sense of place. Using assemblage theory and focusing on two newly developed suburbs of Calgary, Canada, the authors found that sense of place varied significantly across the two suburbs studied and that this was related to land use types, built form, predominant housing typologies, and the connectivity of the areas with the rest of the city. However, it is not only the structure of a city that affects the sense of place, but also the symbolic meanings that people ascribe to the features of the urban landscape. Hull IV et al. (1994) asked residents of Charleston, South Carolina, USA, after a hurricane what meaningful places they lost to the storm. The responses showed that residents mostly lamented the loss of more quotidian urban features such as city forests, churches, public buildings, and even retail shops with which they associated memories and certain deep connections. This is an interesting finding as it has a direct link to our present study. We quantitatively study very similar types of urban amenities, and this early study shows that these can indeed be important to one's sense of place, including place identity. More generally, this study on the loss of

meaningful places refers to changes in the material environment and how these affect sense of place. A number of studies have shown that such changes can both threaten and enhance place-based identities and the ways in which someone connects with places (Devine-Wright, 2009; Devine-Wright & Howes, 2010; Keske et al., 2017; Proshansky et al., 1983; Stedman, 2002). To conclude this paragraph on the links between the built environment and place, it is worth noting that the relationships described are to some extent dependent on social and cultural aspects. Physical factors have been shown to be particularly relevant to the sense of place of higher-income residents (Lewicka, 2011) and at the city level (Scannell & Gifford, 2010). In contrast, social factors such as social capital play a greater role in the sense of place of lower income residents (Lewicka, 2011) and at the regional and local levels (Scannell & Gifford, 2010).

Our research focuses on functional aspects of the urban environment, and a number of previous studies have produced various findings in this regard in relation to sense of place. Two recurring themes in the field of urban functions are blue and green infrastructures. Van Vliet and Hammond (2021) investigated the role of green infrastructures on sense of place in Kingston upon Hull, UK. They show that green infrastructures contribute significantly to residents' sense of place and that most residents cling to a suburban ideal of life, a finding confirmed by previous research (Meier & Karsten, 2012). The presence of green space generally promotes neighborhood attachment and sense of place in both high and low-density urban environments (Abass & Tucker, 2018; Arnberger & Eder, 2012; Kim & Kaplan, 2004; Lund, 2002; Rogers & Sukolratanamettee, 2009). However, it has been found that it is even more effective in evoking a sense of place when urban greenery has a natural character. Knez et al. (2018) show that naturalness (for example, through increased biodiversity or appropriate morphological features of the urban green

landscape) has a very strong effect on fostering a sense of place and place identity. Blue infrastructures can also have an influence on place making and the emergence of a sense of place. Using an Iranian case study, Vaeztavakoli et al. (2018) were able to show that even a small canal can be an important structural element for local residents, who often integrate it into their daily lives. A canal in the city of Isfahan serves as a preferred place for social contact and is associated with personal memories. Residents also described the symbolic value of the canal, which represents a specific part of the city's history. Beyond its function as a historical and social anchor point, blue infrastructures can symbolize additional, more allegorical, water-related concepts such as purity or the water surface as a mirror (Völker & Kistemann, 2011). By physically structuring a space and adding very specific aesthetic qualities that no other type of infrastructure could equivalently provide, blue infrastructures help people make sense of a space and thus support place making. Both green and blue infrastructures are typically engineered (for instance, the canal) and are areal. In a sense, they serve as a backdrop against which urban life can take place in an embedded way. Therefore, to understand their contributions to sense of place, it is conducive to read built urban environments as landscapes, analogous to more rural environments (Braubach, 2007), to which people often feel a strong emotional connection (see Knez et al., 2018; van Vliet and Hammond, 2021). While blue and green infrastructures have an areal extent, people also bond with places that are (mentally) more punctiform.

There are a limited number of studies that examine points of interest in a similar way to what we present in this article. One such study was put forward by Gerlach and Apolinariski (1997). In that study, the influence of institutions that form a social and cultural infrastructure on people's place identity is investigated. Social and cultural

infrastructure thereby includes educational institutions such as schools, cultural centres including theatres and museums, along with other types of social institutions. The authors conclude that the presence of these types of facilities, operationalized as shares of available facilities, favors the formation of a positive place identity, the building of social capital, and the promotion of a sense of community. The study by Gerlach and Apolinarski complements earlier research by Esser (1987), who also focuses on functional aspects of urban spaces in the German Ruhr area. Using the proportion of mixed uses (residential and commercial) and the proportion of space occupied by public buildings and public open spaces, it was shown that these aspects are positively correlated with socialization and identification with a place. Cheshmehzangi and Heat (2012), in a recent study in Nottingham, UK, confirmed some of the earlier findings also for temporary spatial arrangements such as regular weekly markets. Using ethnographic and behavioral approaches, they conclude that even temporary points of interest such as stalls have the potential to transform a space into an identity-forming space. This adds an important temporal perspective to the influence of points of interest on sense of place. The periodicity with its implied memorability of the weekly market is likely to play a role in place-making, including the associated 'place ballet', that is, the routines and practices that turn the square into a market (Seamon & Nordin, 1980). In a very recent work focusing on the influence of everyday environments on place identities from the point of view of the socialization opportunities offered by these environments, Timm (2021) uses OpenStreetMap as a data source for points of interest. The points of interest used include those conducive to cultural and/or social life, such as cafés and theatres, but also less obvious sites such as wayside crosses because of their cultural symbolism. Operationalization then involves calculating heat maps from the point features, but also conducting a survey asking about residents' sense of place, happiness, well-being and

other domains. Conclusions include the finding that the local availability of the outlined points of interest is important for people's sense of place, but that the intensity of this relationship depends in part on the wider spatial embedding of everyday activity spaces. In this case, the focus has been on two peri-urban municipalities near Cologne, Germany. The more independent of the two towns studied shows a stronger relationship between points of interest and sense of place, presumably because residents of the other town feel more connected to the nearby major city. Looking at these studies discussed, it can be argued that there is a correlation between sense of place and the presence of urban, public facilities.

The research that follows in this article extends the findings from the above studies. Our work deviates from the outlined studies in a number of aspects: instead of asking residents about their everyday environments in a spatially rather unspecific way, we establish a specific link between the presence of points of interest and the places residents indicate as significant, which they have drawn on a map; instead of limiting the points of interest tested to specific domains such as cultural or social facilities, we test the presence of a variety of domains in combination, thus including mobility hubs, authoritative facilities such as police stations, and others; and we position our work in the tension between direct, immediately experienced sense of place and this as the result of a long-term, cognitive place-making process. The latter is a distinction introduced by Raymond et al. (2017). We argue that exposure to certain functional mixes in the urban areas of Lisbon considered below often includes, on a day-to-day basis, elements of both immediate sense-making through the direct perception of opportunities for action in the urban landscape, including the actualization of certain affordances, and longer-term understanding of the same areas through the establishment of certain routines. The

remainder of this study takes these assumptions as a starting point and adds to the literature in the ways described.

3. Methodology

The following sub-sections first explain the conceptual choice of the place model. Building on this, the survey conducted and the resulting dataset are presented. Finally, the methodology and the model used are introduced.

3.1. Conceptualization of place

The first step is to identify a suitable place concept for the scope of the research task at hand. Our treatment of place is reduced to the aspect of sense of place and considers the latter as a compound reflection of the feelings, attitudes, and behaviors that people associate with specific geographical areas. We use a widely adopted environmental psychological notion of sense of place offered by Jorgensen and Stedman (2001) that considers the latter as composed of place attachment (the emotional bond that people develop to places), place identity (the appropriation of a place as part of the self), and place dependence (the surplus of affordances offered by meaningful places for meaningful activities). The usefulness of this concept has been validated in previous empirical studies (Acedo et al., 2019; Pretty et al., 2003). This choice for a concept of sense of place has implications for the interpretation of results and we shall thus briefly set our conceptual choice in relation to other place notions. Humanistic notions take a phenomenological position, are rooted in existentialism and naïve realism, and focus on what makes the essence of immediate place experience (Seamon & Lundberg, 2020; Tuan, 2006). Critical-geographical approaches draw on conflict theory and concentrate on normative socio-political or economic suprastructures like capitalism or feminism

driven by internal conflicts to explain place-making (Bartos & Wehr, 2002; Harvey, 1996). Structuration-theoretical approaches like non-representational ones (Thrift, 2008) combine the micro and macro perspectives inherent to humanistic and critical-geographical concepts in that the micro level is considered a reproduction of the macro level reified through everyday practices (Giddens, 1984; Harrison & Anderson, 2010). The last type of assemblage-based place concepts is characterized by a chaotic ‘thrown-togetherness’ (Cresswell, 2015) of coexisting and co-evolving structures that are characterized by fluidity and change (DeLanda, 2016). The way we collect place-related data (see below) focuses on people's assessment of their current affective ties to areas, but does not take into account their possible embeddings in normative suprastructures. Therefore, our place concept employed resembles closest the humanistic notion of place though we employ a very different methodology.

3.2. Web mapping based survey

Our sense of place-related information has been collected via a web mapping based survey carried out in the Portuguese capital city of Lisbon. The survey engine used is the Place & City platform.³ This open-source web mapping platform is tailored to mapping and detailing places, broadly understood as outlined in Section 3.1. The interface is user-friendly and thus suitable for a broad target audience. In addition, it can be easily adapted to different scenarios and thus also to the present study. All respondents were invited to the platform via email by the Lisbon City Council, which sent invitations to people already involved in participatory activities, for instance, the participatory budgeting initiative (Naranjo-Zolotov et al., 2018). An incentive was created to participate by giving vouchers worth EUR 50 to the 10th, 50th, 100th, and 200th participants. The advantage of working with Lisbon City Council is that we have access to a large pool of potential respondents who actually live in the city. A constraint associated with this is that we have

little control over the already existing database of email addresses and thus over the target group. For that reason, the responses collected form a convenience sample comprising data of 230 people. The participants were first introduced to the web mapping platform, the survey questions, and our place concept. Then, all participants were asked to name, map, and characterize their meaningful places.

The mapping involved a topographic base map, initially centered on the extent of the city of Lisbon. Mapping sense of place has been conducted using both mental mapping and sketch mapping approaches. Capitalizing on the hypothesis that mental representations are map-like (Blumson, 2012), mental mapping focuses on capturing people's representations of geographical areas (Gould & White, 1986) and thus on a slightly different aspect of sense of place than the one of interest in this article. Examples of mental mapping utilized in sense of place research include research on juvenile sense of place (Bellino, 2020; Trelle & van Hoven, 2010), sense of place in the context of tourism (Potter, 2015), and links between greenspace and sense of place (Haase et al., 2021; Otto et al., 2020). Our approach uses sketch mapping, which are hand-drawn maps of features that can be associated with topographic features of physical space (Zare Zardiny & Hakimpour, 2021). The latter characteristic is important for us because we want to relate the hand-drawn maps to physically located urban facilities. The participants drew polygons without any spatial or other technical limitations. In principle, it would also have been possible to record points instead of polygons. However, we ask respondents to draw polygons in order to define spatial footprints, which form areal spatial units that we can use to identify urban amenities within the enclosed areas (see below). The target scale of our analysis also favors polygons, as we do not ask respondents about point-like structures such as trees or benches in a park (although the latter can also be charged with

rich meanings). The polygons collected are relatively uniform in terms of size. The interquartile range of the areas of the polygons is 0.79 km², but the mean (1.09 km²) and median (0.16 km²) differ noticeably. The latter is due to some outliers, including one large park (Parque Florestal de Monsanto) and the entire coastal strip. Overall, most of the sense of place polygons are small to medium sized and thus locally confined. Since the polygons overlap spatially and therefore do not lend themselves to informative 2D mapping, we offer them as interactive 3D web graphics.⁴

After mapping, all participants were asked to characterize the areas they mapped in terms of their perception of (i) sociability, (ii) uses and activities, (iii) comfort and image, and (iv) accessibility (all rated on a five-level Likert scale ranging from ‘Strongly disagree’ (score of 1) to ‘Strongly agree’ (score of 5); adapted from Cilliers and Timmermans (2014)). This data is used to operationalize individual perception as a latent component feeding into sense of place. The next step was for everyone to select their one most important area for better comparability. In order to partly operationalize place attachment, place identity, and place dependency beyond the latent perception-based component, all respondents assessed nine different aspects for their most important area, details of which are given in the online supplementary material. Again, we used a five-level Likert scale and a procedure adapted from Jorgensen and Stedman (2001). Socio-demographic information including age, gender, and income are summarized in Fig. 1. The majority of our respondents is between 25 and 64 years old and earns between EUR 1500 and EUR 3000 per month. The age groups reflected in our sample broadly correspond to the age distribution in Lisbon in general (cf. Pordata, 2021a). However, as our survey approach only targets adult responses, our demographic characteristics differ with regard to young, especially juvenile age groups. The (binary) gender distribution is evenly balanced, which

corresponds to the general gender characteristics in the city of Lisbon, but with a very mild tendency towards males (cf. Pordata, 2021b).

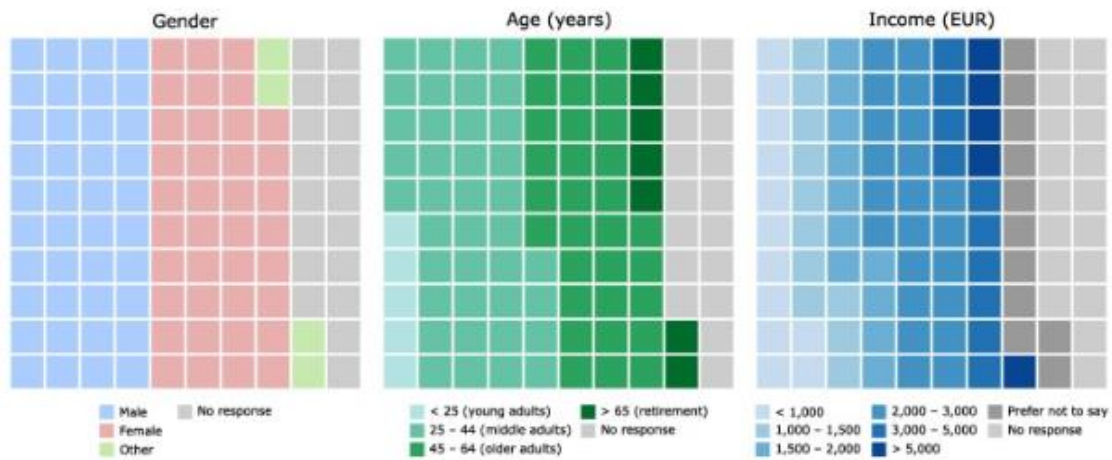


Fig. 1. Summary of gender, age, and income groups of our sampled respondents. Each box stands for one percentage point of the respective characteristics.

The approach taken largely reduces the geometries of places to their spatial footprints. Yet, this allows us to combine the answers with spatial data on urban facilities. The latter were collated using the Google Places REST API service ‘Nearby Search’.⁵ The retrieved features were reclassified into a function-based, reduced typology, partly following the approach of Sen and Quercia (2018) (see online Supplementary material). All the features used have visible characteristics of the built environment through salient buildings, signposts, or publicly displayed advertisements. They hence contribute to the characteristic of an area even if they may not be utilized in functional terms by people visiting respective areas.

3.3. Structural equation modeling

The main methodology used in this article is partial least squares structural equation modeling (PLS-SEM). This method follows a two-step procedure: First, outer models are evaluated for latent, composite predictors, so-called constructs, which are related to

measured indicators (Petter et al., 2007). The next step is to evaluate the inner model, which estimates path coefficients between latent constructs. The PLS approach to structured equation modeling is preferred here over the competing covariance-based approach (CB-SEM) for four reasons: First, no restrictive distributional assumptions are imposed on the data (Hair et al., 2012), which is important in our case of mixed ordinal and ratio-scaled variables. Second, PLS-SEM is well suited for exploratory theory development due to its predictive nature, allowing us to propose causal relationships in situations where theoretical guidance is lacking (Hair et al., 2016). Third, PLS-SEM has been shown to have more favorable power characteristics than CB-SEM in many situations, meaning that it is more likely to disclose significant paths when those actually exist in the population (Reinartz et al., 2009). And fourth, PLS-SEM yields reliable results even for models evaluated with small sample sizes. As rule of thumb, the sample size should be at least ten times the largest number of structural paths directed to any latent construct (Hair et al., 2016). Other authors suggest that with a sample as small as 100 observations the statistical power is still acceptable (Reinartz et al., 2009). The full model specification is given in Fig. 2.

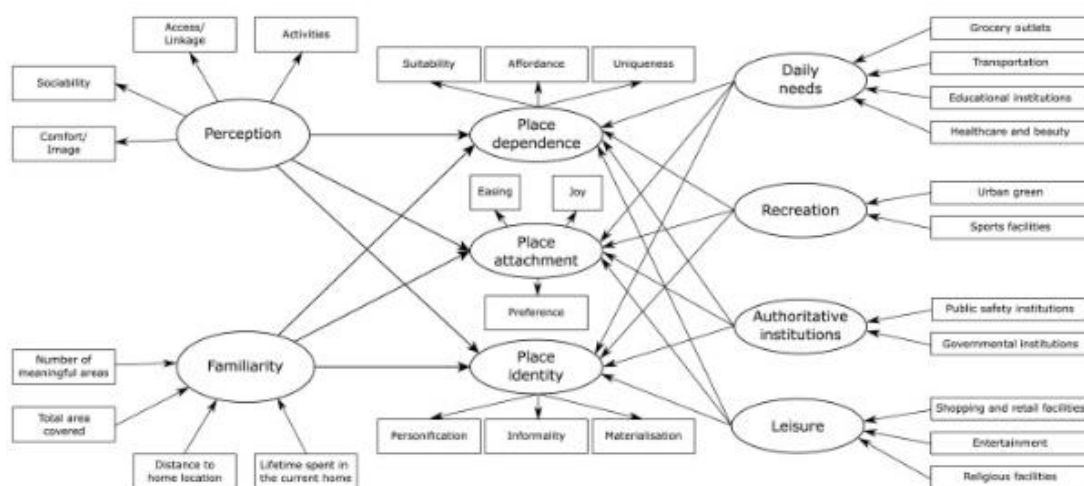


Fig. 2. Overview of our initial PLS-SEM model. Ellipses represent latent constructs; rectangles indicate manifest variables; and the arrows point in the direction of assumed causality.

The dependent variable 'sense of place' is represented in the model by three endogenous latent constructs: 'place dependence', 'place attachment', and 'place identity'. These operationalize the three main dimensions of our chosen sense of place concept. The outer models for these constructs relate to the responses to the nine survey questions regarding sense of place (see Online supplementary material), which enter the model as reflective indicators. The reflective nature of these indicators means that the direction of causality is assumed to be going from each sense of place dimension to the respective indicators. For example, a sense of 'joy' about a place is assumed here to be caused by an existing strong attachment to that place; or that someone views a place as 'unique' in terms of performing certain activities is based on someone having previously developed a dependency relationship with a place. Apart from these survey-based indicators, all three sense of place dimensions are also related to six exogenous latent constructs. Two of them, namely 'perception' and 'familiarity', relate to results of our survey. Four other exogenous constructs represent different types of urban facilities derived from the retrieved Google Places data.

Two exogenous latent constructs that reflect important aspects of the humanistic concept of place and the concept used here are 'perception' and 'familiarity'. The 'perception' construct is composed of the results of the four perceptual survey questions. The 'familiarity' construct, in turn, is set into relation with the total number and area of polygons drawn, the number of years someone has lived in their home (measured in four categories 1: '< 1 year', 2: '1–3 years', 3: '3–6 years', and 4: '> 6 years'), and the distance between a respondent's home and their reported most important places. In terms of causality assumptions, we model 'perception' in a reflective manner analogous to the sense of place dimensions. People's assessment of sociability, comfort, image, and other

such characteristics is thus considered to be strongly influenced by how people perceive a place. Therefore, these indicators are considered as outcomes of perception in this study instead of the other way around. The construct ‘familiarity’, on the other hand, is modeled in a formative way. We assume that the familiarity of a place is caused by characteristics such as how long someone has been living in a place (Lewicka, 2011; Zenker & Rütter, 2014), and how far away their favorite place is from someone's home (Hasanzadeh et al., 2017). We therefore believe that the formative mode of outer model evaluation is more appropriate than reflective modeling in this case.

The main relationship of interest in this paper is that between sense of place and urban features. Eleven indicators are included to account for urban features and their associated functions. Ten of these indicators are counts of features extracted from Google Places as they occur in the mapped areas. We converted all feature counts into rates representing the shares of the respective categories in the total local feature counts. These rates are utilized to reflect the extent to which an area is characterized by certain feature types. We have no prior knowledge informing us on how to relate these variables to sense of place in our model. We have therefore formed four latent, formative constructs covering the outlined rate-based indicators and, in addition, the amount of greenspace available. The latter is normalized in the same spirit as the rates but using the areas of polygons. Greenspace is included to take account of the link between life satisfaction and the amount of urban green (Houlden et al., 2019, Houlden et al., 2018), which may affect one's choice for a preferred place. Regarding the formative mode used with all urban feature variables, we assume, for example, that the presence of urban greenspace and of sports/outdoor facilities constitute the recreational aspect of an area. Other categories

such as 'leisure', satisfaction of 'daily needs', and availability of 'authoritative institutions' are modeled with the same intention (see Fig. 2).

3.4. Model diagnostics

The various sub-models involved in our PLS-SEM specification are based on different technical assumptions and thus require different diagnostics. Reflective outer models are based on the regression of each indicator on its respective construct (Sarstedt et al., 2017). These types of external models should meet the following criteria: (i) a sufficient proportion of the indicator variance should be explained by the construct for internal reliability; (ii) the indicators should correlate with each other; and (iii) the constructs should be empirically distinguishable from other constructs. Criterion (i) is assessed with Cronbach's α (Cronbach, 1951) and by calculating the composite reliability using Jöreskog's ρ (Jöreskog, 1971). Criterion (ii) is evaluated using the average variance extracted AVE. Criterion (iii) is evaluated using the Fornell-Larcker criterion that the square root of AVE should be greater than the highest correlation with any other construct (Fornell & Larcker, 1981).

Formative outer models are estimated using multiple linear regression (Sarstedt et al., 2017). Low multicollinearity between indicators is thus required. Since our data are spatial in nature, we need to address this in two ways. First, we test for spatial autocorrelation with Moran's I (real-valued) and k-colour-maps join count statistics JBB, JWW, and JBW (multinomial variables) (Cliff & Ord, 1969). Spatial effects are then filtered out with spatial eigenvalue filtering if necessary (Griffith, 2000), considering the residuals of the filter specification as the spatially decorrelated variables. The spatial weights are modeled via double-power distance relations with the scale parameter set to

2 and a maximum distance of 2000 m. Second, we estimate variance inflation factors VIF to assess the indicators' ability to explain each other's variability, which we support by calculating Pearson correlations. Finally, the outer weights of the indicators should be significant to ensure that they make a meaningful contribution to the construct.

The evaluation of the inner model based on the construct scores determines the strengths of the paths between the latent constructs. Again, as in the formative modeling step, we assume uncorrelatedness between the constructs and therefore calculate variance inflation factors. Our further aim is to discover significant and relevant path relationships. Significance is assessed using the p-values attached to the t-scores and by examining the bootstrapping confidence intervals from the inference procedure. The relevance of the path relationships is assessed using R² of the overall model (total variance explained), via the assessment of the total effects (sums of direct and indirect effects) and by examining effect sizes of the individual constructs. Equations for all model diagnostics are provided in the online supplementary material (Appendix A).

4. Results and discussion

The following subsections report the results of our PLS-SEM modeling. First, an overview of the model diagnostics is given. The final results in terms of loadings and weights for the outer, and path coefficients for the inner model are then presented and discussed.

4.1. Model diagnostics evaluation

The first step in our model diagnostics is to check for spatial autocorrelation in the manifest variables involved in the formative modeling. Table 2 gives the computed spatial statistics I and J. Most variables are significantly spatially autocorrelated. Only ‘grocery outlets’, ‘public safety’, ‘shopping’, and ‘religious facilities’ are exceptions, which is likely caused by their relatively homogeneous occurrence across Lisbon. However, despite their significance, most of the observed autocorrelations do not have high magnitudes and remain close to $E[I] = -0.004$. The only exceptions are the variables ‘healthcare/beauty’ ($I=0.203$) and ‘entertainment’ ($I=0.199$), which we hence filtered using Moran eigenvector filtering. This step reduced the autocorrelation levels to values of 0.025 and 0.037, which are close to those observed for other variables. The ordinal categorical variable ‘lifetime spent at current residence’ is a more complex case. Some types of categorical ties are significantly spatially autocorrelated, but the overall observed autocorrelation in adjacent categories is acceptable at $\alpha=0.05$. We therefore decide not to filter this variable and to use the original values.

The next step is to check all formative sub-models for possible multicollinearity problems. Looking at the Pearson r correlations between jointly used variables, we find that ‘grocery outlets’ and ‘healthcare/beauty’ are significantly correlated with the category ‘everyday services’ (with $r=0.19$ and $r=0.32$). Based on the reported correlations and because we believe that the feature types subsumed under this category, such as electricians and locksmiths, do not contribute much to characterising an area in terms of sense of place, we omit ‘everyday services’ for further analysis. All other correlations are below 0.15 and can thus be considered acceptable even when using quite conservative measures. Apart from this, all calculated VIF values are below 4, a threshold often used

as a rule of thumb to decide on multicollinearity (Hair et al., 2010). A list of all VIF values is found in Table 1.

Table 1. Values for Cronbach's α , Jöreskog's ρ , and average variance extracted (AVE) for all reflective constructs, as well as the variance inflation factors (VIFs) for the formative models.

Construct	α	ρ	AVE	VIF
Place attachment	0.858	0.913	0.779	
Place dependence	0.860	0.912	0.777	
Place identity	0.895	0.935	0.827	
Perception	0.829	0.887	0.662	
Total area covered				1.030
Number of meaningful areas				1.008
Distance to home location				1.035
Lifetime spent in current home				1.009
Grocery outlets				1.065
Transportation				1.085
Educational institutions				1.113
Healthcare and beauty				1.038
Urban green				1.104
Sports facilities				1.104
Public safety institutions				1.015
Governmental institutions				1.015
Shopping and retail facilities				1.037
Entertainment				1.049
Religious facilities				1.012

Table 2. Results of spatial autocorrelation analyses for all manifest variables that enter into formative models. The results reported for the ‘lifetime spent’ variable are given for all possible spatial joins of categories 1–4 as outlined in the methods section. *, **, and *** indicate significance at $\alpha=0.1$, $\alpha=0.05$, and $\alpha=0.01$.

Variable	Moran's <i>I</i>	Join counts <i>J</i> ^a	<i>p</i>
Grocery outlets	0.002		0.55
Transportation	0.024		≤ 0.01***
Educational facilities	0.045		≤ 0.01***
Healthcare/beauty	0.203		≤ 0.01***
Urban greenspace	0.069		≤ 0.01***
Sports facilities	0.052		≤ 0.01***
Public safety	0.001		0.72
Governmental	0.036		≤ 0.01***
Shopping/retail	0.001		0.62
Entertainment	0.199		≤ 0.01***
Religious facilities	−0.007		0.74
Lifetime spent: 1—1		3.781	≤ 0.01***

Variable	Moran's <i>I</i>	Join counts <i>J</i> ^a	<i>p</i>
Lifetime spent: 2—2	0.943		0.35
Lifetime spent: 3—3	0.696		0.49
Lifetime spent: 4—4	-2.002		0.05**
Lifetime spent: 1—2	4.087		≤ 0.01***
Lifetime spent: 1—3	3.990		≤ 0.01***
Lifetime spent: 1—4	2.046		0.04**
Lifetime spent: 2—3	0.878		0.38
Lifetime spent: 2—4	-1.017		0.31
Lifetime spent: 3—4	-0.544		0.59
Lifetime spent: total	1.717		0.09*

^aThese values are reported as z-scores.

Table 3. Outer weights and loadings for the assessed PLS-SEM model. The abbreviation Std. Dev. stands for standard deviation. *, **, and *** indicate significance at $\alpha=0.1$, $\alpha=0.05$, and $\alpha=0.01$.

Variable	Weight	Std. dev.	<i>p</i>
Outer weights			
Familiarity ← Total area covered	0.574	0.340	0.09*
Familiarity ← Number of meaningful areas	0.712	0.248	≤ 0.01***
Familiarity ← Distance to home location	0.260	0.346	0.45
Familiarity ← Lifetime spent in current home	0.193	0.341	0.57
Daily needs ← Grocery outlets	0.615	0.288	0.03**
Daily needs ← Transportation	0.751	0.317	0.02**
Daily needs ← Educational institutions	-0.086	0.298	0.77
Daily needs ← Healthcare/beauty	0.310	0.298	0.30
Recreation ← Urban green	0.293	0.520	0.57
Recreation ← Sports facilities	0.870	0.446	0.05**
Authoritative institutions ← Public safety institutions	-0.661	0.577	0.25
Authoritative institutions ← Governmental institutions	0.835	0.619	0.18
Leisure ← Shopping/retail	0.697	0.394	0.08*
Leisure ← Entertainment	-0.086	0.441	0.85
Leisure ← Religious facilities	0.669	0.391	0.09*
Outer loadings			
Perception → Sociability	0.781	0.041	≤ 0.01***
Perception → Activities	0.866	0.021	≤ 0.01***
Perception → Comfort/image	0.802	0.032	≤ 0.01***
Perception → Access/linkage	0.805	0.033	≤ 0.01***
Place dependence → Suitability	0.924	0.014	≤ 0.01***
Place dependence → Uniqueness	0.783	0.055	≤ 0.01***
Place dependence → Affordance	0.929	0.012	≤ 0.01***

Variable	Weight	Std. dev.	<i>p</i>
Place attachment → Easing	0.889	0.022	≤ 0.01***
Place attachment → Joy	0.923	0.015	≤ 0.01***
Place attachment → Preference	0.832	0.029	≤ 0.01***
Place identity → Personification	0.869	0.031	≤ 0.01***
Place identity → Informality	0.933	0.011	≤ 0.01***
Place identity → Materialisation	0.925	0.021	≤ 0.01***

Table 4. Path coefficients for the assessed inner model including β , f^2 , and p -values. *, **, and *** indicate significance at $\alpha=0.1$, $\alpha=0.05$, and $\alpha=0.01$.

Variable	β	f^2	p
Daily needs → Place attachment	0.087	0.010	0.32
Daily needs → Place dependence	0.028	0.001	0.77
Daily needs → Place identity	-0.123	0.018	0.09*
Familiarity → Place attachment	0.046	0.003	0.43
Familiarity → Place dependence	-0.005	0.000	0.96
Familiarity → Place identity	0.028	0.001	0.57
Leisure → Place attachment	-0.125	0.022	0.08*
Leisure → Place dependence	-0.102	0.012	0.16
Leisure → Place identity	-0.079	0.008	0.24
Perception → Place attachment	0.604	0.521	≤ 0.01***
Perception → Place dependence	0.471	0.254	≤ 0.01***
Perception → Place identity	0.527	0.375	≤ 0.01***
Recreation → Place attachment	0.014	0.000	0.77
Recreation → Place dependence	-0.001	0.000	0.99
Recreation → Place identity	0.062	0.005	0.12

Looking at the reliability of the reflective constructs, we find that all of them perform well. Table 1 shows both Cronbach's α and Jöreskog's ρ . The values for ρ are all above 0.7, indicating that common underlying factors (i.e. the respective components) can reasonably be assumed. However, since we observe weak but significant spatial autocorrelation for some variables, we additionally consult Cronbach's α . All α values are above 0.8, which is a conservative threshold recommended by Nunnally and Bernstein (1994) for applied research and empirical studies. Both reliability scores used thus provide an encouraging diagnosis. Regarding the correspondences between the indicators and their underlying reflective constructs, the calculated AVE values are all well above 0.5. The highest value obtained indicates an average explanatory power of 82.7% for Place Identity, and most of the other constructs achieve similarly high values. The

Fornell-Larcker criterion is fulfilled for all tested constructs. In summary, we can therefore assume with some confidence both sufficient reliability and good discriminability of the constructs.

4.2. Outer model evaluation

The evaluation and interpretation of the outer models can be seen as a preparatory step to understanding the inner model. Table 3 gives the outer weights (formative constructs) and outer loadings (reflective constructs) including their p-values for all assessed constructs. Looking at the three constructs used to model sense of place, all outer loadings are highly significant. The three types of survey responses used to model Place Attachment and Place Identity respectively show p-values lower than 0.01. Moreover, their magnitudes (which are essentially correlations) are high, ranging from 0.832 to 0.923. The construct Place Dependence shows similar behavior, but it is worth noting that the (also highly significant) variable Uniqueness performs slightly weaker than the other two, with a loading of 0.738. A possible reason for the weaker performance of the latter could be a partial conceptual overlap of uniqueness with identity-related variables, that is, an artefact of the chosen survey questions. Overall, the outer models for the sense of place dimensions perform reasonable and do not require further adjustment.

The outer models for the two exogenous latent constructs used to control for typical place-related aspects provide a more mixed picture. For Perception, all external loadings are highly significant and sufficiently high in magnitude. Only the variable Sociability is slightly weaker correlated with the construct, but the deviation is not pronounced. In general, the magnitude of the loadings for Perception is about 0.1 lower than those for the sense-of-place variables described above, which could be an effect of the broader

definition of Perception. The latter includes dimensions like social, visual, and other attributes. In contrast, there are three different constructs for sense of place, which are therefore narrower in scope. Since we are aiming for a broad definition of Perception, however, the still high, significant, and similar magnitudes across a range of different variables can be considered adequate.

The Familiarity construct requires subsequent modifications before the internal model can be assessed. Two variables show significant outer weights: Total Area Covered and Number of Meaningful Areas. However, the other two variables Distance to Home Location and Lifetime Spent in the Current Home do not contribute significantly to Familiarity. The temporal variable is probably influenced by our classification into four categories. Our category '> 6 years' obfuscates potentially interesting details regarding long-term residents compared to medium-term residents, and we suggest avoiding such categorization in future research. The variable Distance from Home is a more interesting case. All mapped areas are spread across the city and our selection of survey respondents was spatially random in the sense that no particular area was favored over others. We thus do not expect methodologically induced bias. However, Lisbon, like many European cities, offers an efficient public transport system that favors intra-city travel. In such a context, our result could indicate spatial polycentricity in terms of the distribution of meaningful places. In summary, we have omitted the latter two variables for the following steps, sacrificing them for higher reliability and keeping only the other two.

The construct Daily Needs is dominated by Grocery Outlets and Transportation. Both variables carry high outer weights and are highly significant. Healthcare and Beauty contributes moderately but the contribution is not significant. In contrast, the presence of

Educational Institutions has not only been found to be non-significant, but also has a weak negative magnitude close to zero. The significant variables for groceries and transport are interesting in terms of their spatial characteristics. Grocery retailing in Lisbon is characterized by many small shops that are not concentrated in large shopping centers but scattered across the city. The resulting map pattern is therefore a rather fragmented and uniform one. The transport facilities, on the other hand, appear more spatially clustered and on a coarser scale. Many tram stops are located in the southern part of the city and a ring of railway lines surrounds the city center. The two variables Grocery Outlets and Transportation thus seem to reflect two different spatial scales for frequently visited, everyday urban facilities. In contrast, the two other non-significant variables do not seem to contribute much to these dominant categories, probably also because they are less quotidian in terms of their temporal scales.

Leisure is also dominated by two variables. Both Shopping and Retail Facilities and Religious Facilities have strong positive external weights that are highly significant. The third variable studied, Entertainment, does not contribute much to the Leisure construct. These results are interesting and show a striking similarity to those found for Daily Needs. Like grocery outlets, religious establishments are scattered across the city and are not highly clustered. In contrast, the types of leisure retail assessed here are mainly concentrated in the city center and in a few other locations. Again, we see a similar distinction between fine and coarse-scale features, but this time operating on a different temporal scale than those of Daily Needs. The Leisure construct therefore reflects differently spatially structured urban features, which, compared to the everyday facilities from above, are visited only occasionally. Daily Needs and Leisure are thus complementary and reflect the characteristics we actually aimed for when forming them.

The remaining constructs Recreation and Authoritative Institutions are not as clear-cut as the other two outlined. None of the individual variables for Authoritative Institutions are associated with significant outer weights. Although they conceptually match, Public Safety and Government Institutions do not appear to be related in terms of their joint presence. We therefore decided not to include this construct in the evaluation of the internal model. For Recreation, it is notable that only Sports Facilities is rated as a significant component of the construct. Urban Green has a medium weight, but is not statistically significant. It is of note that Lisbon does not have much urban greenspace. There are some large parks, and one of them, Parque Florestal de Monsanto, was mapped as a meaningful place several times. However, although this park covers a large area, the overall number of meaningful places assessed in relation to urban greenery is low. Furthermore, our greenspace dataset is not complete and only includes managed greenspace, which to some extent may impact our results. Nevertheless, we think that future research should look closer into greenspace in relation to places, as research has shown links between wellbeing and urban greenness (Houlden et al., 2019, Houlden et al., 2018). For the remainder of this study, we exclude Urban Green for the reasons stated above and only retain the Sports Facilities variable for Recreation. Fig. 3 shows the final model with all the changes discussed in this section, which is used to evaluate the inner model in the following.

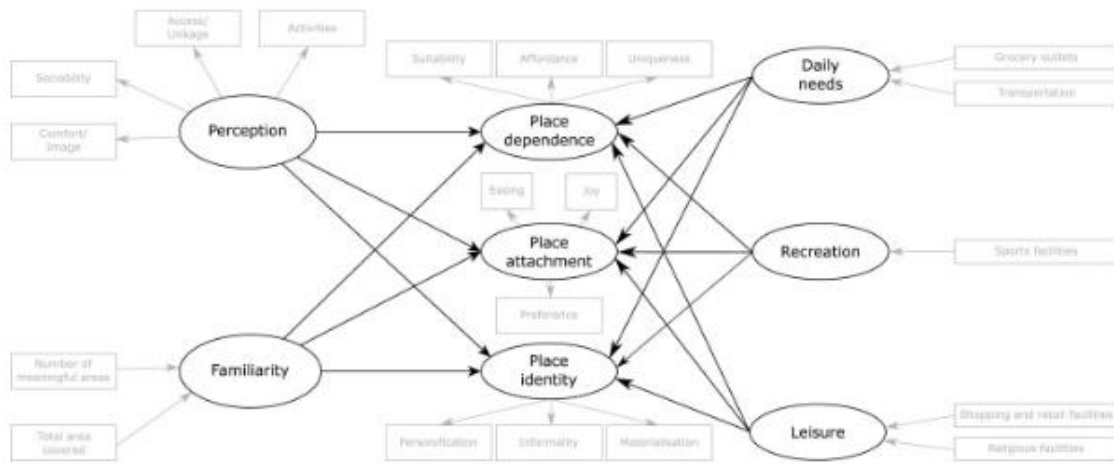


Fig. 3. Overview of the revised PLS-SEM model after incorporating the outcomes of the model diagnostics. The outer models are given in grey and the inner model is given in black colour.

4.3. Inner model evaluation

The inner model describes the relationships between the exogenous constructs and those formed to represent sense of place. Table 4 shows all the path coefficients representing the strength of these connections. A majority of the paths are not significant. However, some paths are significant and show informative associations. A very influential construct is Perception. All the links between this construct and the three dimensions of sense of place are significant. The strongest relationship is the path from Perception to Place Attachment. Looking at the operationalization of the latter, we find that Place Attachment here is associated with ease and joy, but also with place preference. At the same time, as mentioned earlier, Perception is a fairly broad construct that captures a range of perceptual domains. The correspondence between the characteristics of place attachment and those of our modeled perception might explain why this particular relationship is stronger than any other path in the model. However, the path coefficients between Perception and Place Attachment and Place Identity are also very high, highlighting the importance of broadly defined perception for sense of place. After all, aspects such as sociability, aesthetics, and affordances touch upon sense of place in various ways. Furthermore, the strong connections revealed also reflect our choice of place concept, which in geographical terms is similar to a humanistic notion of place focusing on immediate experience.

Unlike Perception, the Familiarity construct is not significantly related to any of the sense of place dimensions, with all path coefficients remaining close to zero. Recall that this construct is limited to the area covered and the number of meaningful places mapped. Both reflect spatial characteristics such as scale, but these may be constituted differently in the place domain. The lack of significant paths in relation to Familiarity may therefore point to an interesting methodological problem of interest to anyone attempting to operationalize the concept of place through spatial means. This is clearly reflected in the constitution of the mapped meaningful places. For example, the Parque Florestal de Monsanto occupies a large spatial area, but in terms of meaningful places, however, it could have a similar extent in the associated conceptual space as, say, a pub or a shop. Further methodological research for more appropriate operationalization and collection of place-related information is clearly needed.

Daily Needs is negatively related to Place Identity. The more facilities for daily needs are found in an area, the lower the rating of the identity-forming characteristics of a place. The construct of Daily Needs is dominated by grocery shops and transport facilities and thus by features that are often characterized by anonymity and standardization. In addition, everyday facilities like those mentioned are also associated with repetitive activities that are often perceived as tedious. It is quite similar with the construct Leisure, which is, however, negatively associated with Place Attachment. One of the driving forces of Leisure is shopping, which is often located in rather busy and thus stressful areas. Lisbon in particular, with its narrow inner city streets and the high number of tourists visiting the city, is probably very much affected by this stressfulness. These aspects are naturally unfavorable for achieving high values for the variables we use to measure Place Attachment, which includes allowing people to unwind. The two results we obtained for Daily Needs and Leisure thus seem rather plausible.

It is interesting that the negative path coefficients uncovered for Daily Needs and Leisure concern different sense of place dimensions. This supports the interpretation outlined above that these constructs share spatial characteristics but are associated with different temporalities and thus

ultimately reflect very different underlying types of urban facilities. Furthermore, this modeling also shows that sense of place is indeed a holistic concept. Leisure behavior actually has positive connotations and also contributes accordingly (though not significantly) to other modeled dimensions. However, individual dimensions of sense of place can be negatively affected. Only when viewed together is a consistent picture obtained.

4.4. Limitations

The research presented in this article is not without limitations. One limitation is that our findings are only representative of an urban area (and in this case even the capital of a country), but could be different in more rural settings. Places like supermarkets, grocery shops, or even a bus stop could well serve as regular social meeting places in rural areas or fulfill the role of an informal community center if there are not many other options available. This perspective is supported by the findings of Timm (2021) showing that the more self-contained especially smaller municipalities are the more these social aspects matter. For instance, residents of a smaller town that is not well connected to neighboring urban centers might attribute more of those additional meanings to the quotidian facilities mentioned. In contrast, in Lisbon there are many opportunities to form connections to places, so these types of facilities may not be high on the list and are therefore found to be confounding factors for place identity and place attachment in this study. It would be instructive to repeat the present study in a different setting and compare our findings with those from small and medium-sized towns. Closely related to the above aspects is another limitation, namely the choice of operationalization of place. We follow an approach from environmental psychology. This is reflected in relatively individually oriented questions that ask about very personal place characteristics. If we had instead used, for example, the idea of non-places (Augé, 1995) as a conceptual framework, we might have obtained different results, but also a somewhat different research focus. Future research may pay more attention on socio-cultural norms and practices and how these relate to sense of place in relation to urban facilities. The often-cited example of airports as manifestations of supermodernity, for example, is ultimately strongly linked to globalization and thus to the alignment of aesthetic, functional, and other norms. These aspects go beyond everyday life as they concern a more general level of sense of

place. In contrast, most of the questions we asked respondents are more closely related to people's concrete everyday lives and how a place fits into their own identity over time. These ultimately reflect the psychological concept of place used, and this would be different if the study were applied using a different notion of place. That said, our findings and the subsequent conclusions should be interpreted against the backdrop of these general limitations.

5. Conclusions and policy recommendations

This research has investigated possible relationships between the presence of urban facilities and different dimensions of sense of place in the Portuguese capital, Lisbon. Data were collected from 230 respondents using a web mapping-based survey. All respondents were first asked to draw polygons reflecting their meaningful places. They then answered a series of questions reflecting three dimensions of sense of place: place attachment, dependence, and identity. The results were combined in a modeling step with locations of urban facilities retrieved from Google Places. The modeling applied was based on PLS-SEM, for which the urban facilities were previously grouped into semantically coherent categories. The model assessment led to a number of interesting findings. Based on this research we formulate both academic conclusions and policy recommendations, which are given below.

5.1. Conclusions

One main finding of our research is that temporal rhythm, that is, the nature of the recurrent interaction with and at places, seems to play a central role in the relationship between urban facilities and sense of place. Everyday and leisure-related facilities are both significantly negatively related to sense of place, but to different dimensions of the concept. While quotidian urban facilities are found to negatively affect place identity, leisure-related facilities are negatively related to place attachment. The main difference between these two types of urban features is the temporal rhythm of their embeddedness in everyday life. While people frequently visit grocery shops and transport facilities, they may only occasionally visit shops offering clothes, jewellery,

and the like, as well as religious places. This is an important finding because it shows that places offering a quotidian functional mix of POIs that people encounter regularly and in ordinary situations may be perceived as anonymous and thus not identity-forming; and that occasional, leisure-related activities do not necessarily support place attachment. This finding is related to the work of Cheshmehzangi and Heat (2012). The authors also explore a temporal aspect in relation to a shopping-related facility (a weekly market) and conclude that market stalls can also contribute to sense of place. It seems instructive to compare the types of everyday and leisure-related facilities we have studied, such as supermarkets and churches, with the related but somewhat different market stalls. The latter are constitutive of a rather unusual composition and experience of an open-air weekly market, while grocery shops and the like are embedded in functionally more mixed, less unusual environments that are also not always defined through those quotidian facilities. Furthermore, the example of the weekly market combines our two related categories of facilities under investigation (i.e., Daily Needs and Leisure). Markets serve as a daily supply, but, in the European context, are often also visited for enjoyment and would thus fall into our leisure category. Our findings suggest that it is important to consider the contribution of POIs to sense of place in a functionally contextualized way, as it is likely to be the atmosphere and character of a non-permanent market, and thus a specific, leisure-related context, that led Cheshmehzangi & Heat (2012) to their results though stalls can also be seen as alternatives to grocery stores. A general separation between daily and infrequently visited places (with similar spatial coverage) as well as an interaction between temporality and overall functional context can thus be concluded. This establishes an interesting link between works from environmental psychology (which strongly inspired the present work at hand) and the human-geographical notion of place ballet as developed by David Seamon (Seamon & Lundberg, 2020; Seamon & Nordin, 1980).

A second important finding is that people consider places meaningful even when they are negatively associated with certain sense of place dimensions. Everyday and leisure facilities that are negatively related to certain sense of place domains are nevertheless indicated as meaningful by many respondents. This shows that there may be complex relationships between the often positive characteristic of meaningfulness and the negative attributions of stressfulness and

anonymity. Notions such as 'negative sense of place' exist (Shamai & Ilatov, 2005), but are mostly associated with strongly negative experiences like domestic violence (Tyner, 2012). The latter, however, are different types of negative senses of place than those that we expect to have disclosed in this research, although ultimately we did not inquire in detail into the deeper reasons why someone identified a particular area on the map as meaningful. People may view busy high streets as unpleasant, but do find positive aspects, too. This might be the reason why some meaningful places are negatively connected with only certain sense of place dimensions but not all of them in combination.

The third conclusion that we draw from our findings is that notions of supermodernity, non-places (Augé, 1995), and placelessness (Relph, 1976) do not occur in their extreme forms in our results. Anonymous, everyday urban facilities are included as part of meaningful places in this study, too. Thus, even such places including transport facilities (that have been described by Augé (1995) as transit spaces and thus as antithesis to places) have certain place-making qualities, which calls for a more nuanced consideration of terms such as placelessness, as well as reflecting the holistic nature of place as a concept. These results are also relevant for spatial planning and decision-making processes (see Section 5.2 below).

A fourth conclusion drawn is that meaningfulness in terms of sense of place also has a very momentary element. In our study, it was the very mundane facilities that showed a strong (albeit negative) effect on various sense of place dimensions. Many of these facilities are a natural part of our everyday lives and/or the European cityscape (e.g. places of worship, supermarkets, etc.). However, if we place our results next to those of Hull IV et al., 1994, we find a discrepancy. The latter authors have shown that when meaningful places are lost, it is precisely those with a distinctly quotidian character that weigh particularly heavily. So it seems that a certain, presumably subconscious, taken-for-grantedness coupled with a certain attitude of expectation led the people in our study in the immediate urban context rather to an indifferent to rejecting attitude towards these functions. In contrast, many people seem to become aware of the important significance of the functionalities associated with these facilities only when they are lost, as the findings of Hull IV et al., 1994 suggest. The mixture of spatial functionalities to which our subjects

are exposed seems to lead to a certain hierarchy of meaning attributions. In a direct comparison, supermarkets and similar everyday facilities appear less identity-promoting or meaningful than other, less mundane places. However, since the functionality of these facilities cannot be adequately replaced when lost, the corresponding attributions of meaning move up the hierarchy in those cases. This conclusion represents an important component for understanding momentary place making in terms of the affordance-based approach put forward by Raymond et al. (2017), as it provides further explanations for both direct and indirect place making.

The fifth conclusion we draw is a methodological one. We started this article with the sentence: “All human individuals have their own perception and conceptualization of meaningful places”. If we take this statement seriously, it means that an obstacle not only for this study but also for related studies operationalizing place is that it remains unclear to what extent the underlying processes of place-making are comparable between individuals. We may in fact be studying very different processes together. Nevertheless, we are convinced that our results, at least in sum, provide useful indications of overall trends. Another methodological aspect is one of representation. We have used spatial footprints of sense of place as units of study. The main reason for us to use spatial concepts to represent place is a pragmatic one and is rooted in the lack of viable place-based counterparts. As a result, it remains unclear to what extent the use of spatial geometries to capture meaningful places affects the results of our research. Both outlined problems also emerge in other contexts, for example in the analysis of user-generated information from social media or in geolocated in-situ survey responses (Bluemke et al., 2017; Westerholt, 2019). Overcoming such limitations for place-based research should be high on the list of place-based methodological and empirical research. Further, and unlike previous works, this study establishes unequivocal spatial links between meaningful places and their characteristics at city scale. Previous studies have referred survey participants to everyday points of interest in very specific ways and a priori. A fully neutral assessment of the contribution of everyday facilities to sense of place has thus been difficult to achieve (e.g. Cheshmehzangi & Heat, 2012; Hull IV et al., 1994; Timm, 2021). Our study, on the other hand, did not specifically point out certain types of points of interest to the participants, but asked them in general about personally meaningful places including drawing them on a map, and only made the connection to the presence of POIs

post-hoc. It is therefore possible, that many of the responses obtained in previous studies were geographically rather unspecific and not particularly linked to actually meaningful places but to the wider activity spaces of the respondents. Our study adds to the literature by establishing a link between urban functional contexts and meaningful places using spatial footprints as a mediating method.

5.2. Policy recommendations

Policy makers should address the complex nature of sense of place in an integrated, holistic manner rather than understanding urban facilities and their context in isolation, or mainly in terms of their aesthetic or functional qualities. Sense of place forms part of the interactions between people and their environments (Manzo & Perkins, 2006) and as such should be taken into account in planning decisions that affect everyday urban processes (Devine-Wright, 2009). Our results show various practically relevant implications for the three components studied regarding points of interest. Urban recreational facilities seem to have only a limited influence on sense of place overall. However, this result must be considered separately from studies on the related topic of wellbeing (e.g. Houlden et al. 2018, 2019), which assess greenspaces in particular as very beneficial. Our results regarding this type of point of interest should therefore be viewed in a very differentiated way with regard to practical recommendations. Planners should consider recreational facilities when health promotion is in focus. However, they seem to have little relevance for strengthening sense of place. In contrast, occasionally frequented urban recreational facilities have shown a negative impact on perceived and realized affordances and thus on place dependency. Planners and policy-makers should consider the latter negative references before formulating zoning and policy proposals when planning such facilities, which are often not intended for local citizens (who have been investigated in the present study). At the same time, however, there is a strong positive relationship between the perception component we formulated, which in part also includes functional and affordance-related aspects (e.g. sociability). The latter probably have a greater significance for local residents. Taken together, our results suggest that place branding (Zenker & Erfgen, 2014) and city marketing (Hospers, 2010) strategies should emphasize the characteristics of these places such as sociability, use and activities, comfort, and image as well as accessibility and thus strengthen this positively connoted component. Furthermore, our results also suggest that urban facilities that serve to satisfy

everyday needs should not be too concentrated near residential areas. The negative relationship that emerged for these everyday facilities in terms of place identity suggests that their presence might otherwise have a disadvantageous effect on residents' ability to form strong bonds with their immediate living environment. The latter adds a new dimension to previous planning recommendations and advocates for functionally mixed environments (e.g. Dovey & Pafka, 2017; Vorontsova et al., 2016).

Credit authorship contribution statement

René Westerholt: Conceptualization, Investigation, Formal analysis, Methodology, Software, Visualization, Writing - original draft, Writing - review & editing.

Albert Acedo: Conceptualization, Data Curation, Investigation, Methodology, Software, Writing - original draft, Writing - review & editing.

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