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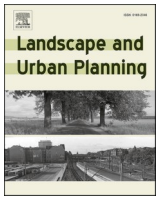

Prioritizing participatory planning solutions: Developing place-based priority categories based on public participation GIS data

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HIGHLIGHTS

- Place-based prioritization model based on frequency of use and the perceived quality places was developed.
- Development priority -category places found most often in transportation settings and in continuous urban fabric.
- High share of the Development priority places was associated with lower quality of life of individuals.
- The development priority areas overlapped with the existing planning areas of the city of Espoo.

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ABSTRACT

Prioritization of knowledge produced in participatory planning has been approached mainly from the perspective of *whose perspectives* are most in need of consideration. We ask, whether it is also possible to consider *which locations*, based on the knowledge from participants, should be prioritized. We developed a place-based approach to inform spatial decision making especially when the prioritization of limited resources is necessary. In the place-based prioritization model frequency of use and perceived quality of everyday places were used to identify various priority categories. We argued that especially places that are perceived negatively but used often in daily life pose a risk to wellbeing and the quality of life and should thus be prioritized in development. Such places belonged to the *Development priority* category, but also three other categories, *Development potential, Management potential* and *Management priority* were identified. The prioritization model was tested empirically by using place-based knowledge about inhabitants everyday and quality networks collected in the Finnish city of Espoo. According to the results, the *Development priority* category was represented only in about 5% of places, most often in land associated with road and rail networks as well as in continuous urban fabric. As hypothesized, high share of the *Development priority* places in everyday networks reduced individual's quality of life. We also found that a rather high share of these places was located within existing planning areas of the city.

1. Introduction

Despite intensive development of participatory planning methods and processes, the practice of participatory planning still suffers from lack of approaches that promote influential participation, workable solutions, and mutual understanding and trust between the public and practitioners (Brown & Chin, 2013; Brown et al., 2020). In general, practitioners acknowledge the challenges to engage and involve citizens (Jansson et al., 2020; Fors et al., 2021) and cities trying to develop participatory practices are still struggling to find ways to effectively use data produced in participation processes (Jankowski et al., 2022). New, digital tools in participatory planning like online participatory mapping, visualization tools, mobile applications or crowdsourcing and collaboration platforms can facilitate ways to produce and share data on how people use the city, and thus contribute to how they would like to develop their living environment (Hasler et al., 2017; Svännel et al.,

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2020). Examples from public participation processes demonstrate that extensive knowledge bases from participants can be collected (Brown & Fagerholm, 2015; Kahila-Tani et al., 2019; Rall et al., 2019; LeBrasseur, 2022) and that a variety of usable traditional and digital methods are available (see e.g. https://participatory.tools/).

It is, nevertheless, still challenging for planners to decide, how the abundance of data collected via digital tools should inform practical planning and management of urban spaces (Brown et al., 2020; Fagerholm et al., 2021; Kahila-Tani, 2015; Randrup et al., 2021). Thus, questions related to *prioritization* emerge: how to choose the most relevant information or the most urgent improvement solutions among the many suggestions by participants? How can limited resources for planning and development of public areas be employed to produce impactful well being and quality of life outcomes, rather than developing areas citizens are already satisfied with?

Valuation is a basic part of planning, where different forms of knowledge must be assessed in relation to the strategic goals set for planning (Vigar, 2017). Valuation and prioritization are ideally made at each stage of the (participatory) planning process, from the selection of the site to the selection of methods used in public participation and questions to be asked, to the evaluation of information and perspectives in the planning solutions themselves. For example, various valuation approaches have been developed for early stages of planning to define which themes various groups of participants prioritize (Ulengin, Ulengin, & Guvenc, 2001; Abdalla et al., 2016).

So far, prioritization of knowledge produced in participatory planning has been approached mainly from the perspective of *whose information* is most relevant, *whose perspectives* are most in need of consideration and which are the *vulnerable groups*, who should be prioritized (Fainstein, 2010). According to Satterthwaite and Bartlett (2017) groups that are particularly vulnerable to specific risks should be considered when thinking about the distribution of risks in urban areas. If the risk or hazard to which these groups are vulnerable is removed, they are no longer considered vulnerable. In urban planning, children, women, older people, people with functional limitations, people with low socioeconomic status, racial minority groups, and migrants have been included as vulnerable groups (Cassarino et al., 2021).

While this classic approach to prioritization is extremely relevant, we argue that it is also relevant to consider *which locations*, based on the knowledge from users, should be prioritized in planning, design, and management practices. In conservation research, prioritization from spatial perspectives has been used to help allocate limited resources in space and time: Multilayer, spatial datasets have been used to identify spatially e.g. ecological values and network connectivity (Jalkanen et al., 2019), vulnerable ecosystem regulation service areas (Lee et al., 2022) and priority areas for flooding risk mitigation (Li et al., 2020). Special decision support tools have also been developed to assist the complex prioritization analysis (Lehtomäki & Moilanen, 2013). In urban planning, spatial approaches have been used e.g to identify priority areas occupied by vulnerable groups and facing the most severe environmental problems (Fernández & Wu, 2018).

In participatory urban planning prioritization from spatial perspective has been addressed mainly through identifying the clusters of future land use preferences and improvement suggestions given in participatory mapping projects (Kahila et al. 2016; Brown et al., 2022). In a study by Jelokhani-Niaraki et al. (2022), participants of a public participation GIS (PPGIS) survey were asked to prioritize their preferred land uses and an aggregation method was developed to determine the group level consensus. When social perspectives have been more generally considered to inform planning and management prioritizations, human safety and health have been among the most important perspectives for prioritization (Wing Chong et al., 2019).

We argue that in addition to the views concerning future urban development, it is also essential to collect and utilize knowledge concerning people's daily lives and everyday activities related to the place, that does not drive private or political agendas (Rydin, 2007). Prioritization approaches for this kind of local knowledge should also be developed and knowledge from people be collected at a sufficiently early stage in the planning process when it can become influential and when the agendas have not yet been set (Vigar, 2017; Kahila-Tani, 2015). Participation is often seen as a right to express one's views on the development in an official participation process rather than as a wider production of base knowledge for planning**.** Public participation is thus seen as part of a linear process, the main objective of which is to produce a plan, a statutory blueprint for execution. We agree with Wallin (2019), that a new paradigm of participatory planning is needed, so called *expanded urban planning* (EP), that not only includes the formal public participation processes but also can cope with the local realms including self-organized initiatives and the understanding of everyday life practices. Still, the question remains on how planning should be informed by the local knowledge concerning the diverse realities of people and their everyday life practices and which methodological approaches best support this (Wallin, 2019). Concerning prioritization, can a place-based approach be developed that helps prioritize local knowledge from everyday life?

1.1. *Various types of place-based knowledge from people*

Knowledge from people can be collected in public participation processes using a variety of methods, traditionally with surveys and interviews, or in focus group meetings and public hearings (e.g., Fors et al., 2021). Often a combination of several methods provides datasets with higher quality than any single method alone (Thoneick, 2021). The data collected with traditional methods are qualitative or quantitative by nature but may not refer to specific places, and thus the links between the preferences, values, or behavioral patterns of an individual and the physical, social, and cultural characteristics of the local environment remain unclear.

A transactional approach on person–environment relationship highlights the mutually dependent, active role of both human actors and the physical & social environment (Hartig, 1993). Although playing an active role in this relationship, the environment does not have a deterministic role, but rather a probabilistic one (Altman & Rogoff, 1987). Transactional person–environmental research anchors individual experiences and behavior strictly within the physical, social, and cultural context of the time and place in which they occur (Kyttä et al., 2013).

Anchoring the human experiences to specific places can also be seen as fundamentally important from the perspective of knowledge-production within a participatory planning process. When place-based, experiential knowledge is attached to specific planning, design, and management solutions, the produced knowledge is potentially more usable for responsible practitioners than knowledge without explicit references to places (Brown & Kyttä, 2014; Kahila-Tani et al., 2019). This is because maps and map-based tools are embedded in the culture and practices of planning (Van Herzele & van Woerkum, 2011) and in policymaking more generally (Sieber, 2006). Map-based visualizations also offer a good way to increase public debate (Van Herzele & van Woerkum, 2011). Additionally, the place-based approach helps operationalizing the transactional study of person-environment interaction: it introduces new opportunities for the study of the associations between environmental characteristics and human behavior and experiences. The resulting diagnostic knowledge, the new social metrics that can be integrated with the other register based and administrative GIS data layers (Brown, 2012), is not only scientifically interesting but can benefit planning practice as well. Understanding how the specific planning solutions are associated with ways people use and experience places, forms a sound basis for ex-post evaluation of planning solutions (Kyttä, 2011).

Public participation GIS (PPGIS) methods are among the most widely used place-based participatory planning methods. These are online, digital, map-based surveys that have been applied by hundreds of cities to realize large-scale public participation and to collect place-based

knowledge from individual people in large numbers (e.g. Babelon et al., 2021; Kahila-Tani et al., 2019; Kyttä et al., 2022; Brown & Kyttä, 2014). There is also evidence that vulnerable groups of participants like children and young people (Broberg et al., 2013, Kyttä et al., 2018) and minority language groups can be reached with this approach (Cao et al., 2015). The collected knowledge has proven to produce high-quality, versatile localized information related to future planning, design, and management situations (Kahila-Tani et al., 2019). This local knowledge typically relates to (1) describing current or historical connections to place, (2) identifying place qualities, values, or conditions, (3) identifying current behavioral patterns or everyday practices in particular settings, and (4) identifying preferences for future land use planning and management (Brown & Kyttä, 2014).

Knowledge from participants is not easy to translate into planning solutions that corresponds to the ideas given. The knowledge of the fourth category - preferences for future land use - often drive political agendas and produces rather straightforward ideas for local environment that are relatively easy to visualize as clusters of developmental suggestions. When PPGIS has been used in participatory planning in urban contexts, participants have most often been asked to locate on a map their future land-use or development preferences (Jankowski et al., 2016; Kahila et al., 2016).

It is more difficult to translate the knowledge of categories 1——3 into workable planning solutions (McCall, 2021). The input of everyday citizens regarding their daily behavior patterns and individual experiences, is underutilized in urban planning and management practices as background knowledge (Wallin, 2019), while in regional, rural, and environmental planning this kind of knowledge has been more widely used (Brown, 2012; Kantola et al., 2023). There are few projects where data representing all four categories of place-based knowledge have been collected, the project presented in this article being one such example.

The first two categories of knowledge from people, the historical connections to a place and the positive and negative place experiences of participants, have been operationalized as landscape values in projects concerning natural settings and as perceived environmental quality in urban settings (Brown & Kyttä, 2014). Some scholars have used the concept quality network to describe the place-based knowledge representing these two categories (Kyttä & Kahila, 2006). This network consists of places that are especially meaningful for individuals for a variety of reasons and thus we will call it *special place network*. A person may not visit these places very often, but they arouse strong positive or negative feelings.

In parallel, the category 3 knowledge can be described as *everyday life network* and include mappings of places relevant for everyday activities, e.g. take your child to daycare, walk your dog and visit a grocery store (XXX, 2006; XXX, 2011, masked for blind review). The distinction between everyday and special place networks resembles the notion by Jan Gehl regarding necessary and optional activities (Gehl, 1987). By using the concept "network" we emphasize the settings where activities happen and/or are special to people. Together the special place and everyday life networks form an individual's activity space, that can vary in size and orientation (Hasanzadeh et al., 2018).

The places included in both special and everyday place networks can be visited with a varying frequency. Visitation frequency is a strong predictor of place attachment (Rushing et al., 2019). The more frequently the place is visited, the stronger attachment and emotional links we build with the place and the more exposed we are to the physical characteristics of the setting and potentially also to the related impacts on health or quality of life (Laatikainen et al., 2018). Visiting frequency has been shown to predict both the positive health outcomes of an environment, e.g. how often green areas (Stigsdotter et al., 2010) or favourite places (Korpela et al., 2010) are visited as well as negative health outcomes like how often fast food restaurants are visited (Bhutani et al., 2018). From management perspective, a high visiting frequency entails increased wear and tear and the health and well-being outcomes can also be dependent on the space being well-kept (Nam & Dempsey, 2019).

Thus, knowledge of the environments that urban residents are the most exposed to in their day-to-day lives and the quality of these environments is crucial for spatial decision-making promoting healthy and livable cities. It is possible that the places where the necessary activities happen, that are part of our everyday network, would be visited more often than places belonging to the special place network, e.g. an opera or a highly valued green area far away from home where we recreate or perform other types of optional activities. It is, nevertheless, also possible that a high quality environment provides special places also near homes of inhabitants and they thus can visit them often. Or some people, e.g. health-minded or nature-centric individuals may choose to spend more time in special places even if they locate further away from home.

Moreover, the special and everyday places can also be personally experienced either positively or negatively and thus the perceived environmental quality of each place can be assessed. Empirical research has shown that participants typically map positively perceived places more than negatively perceived places (Kyttä et al., 2013). It is likely that the places that are part of the special place network would be perceived more positively than places belonging to the everyday network. This is because the special places can be chosen by individuals and they have special, personal meaning like a place with specific positive or negative memory. Everyday places are often more fixed, less optional, like a daycare centre that is the only nearby option. Like visiting frequency, perceived environmental quality is also associated with place attachment (Bonaiuto et al., 1999) as well as perceived health and quality of life. Both the perceived quality of green areas (Marselle et al., 2015) and built environment (Kyttä et al., 2016) have been shown to predict perceived health and quality of life.

The two dimensions discussed above, (a) perceived environmental quality and (b) frequency of visits can be combined to form the axes of a fourfold model (see Fig. 1), that integrates the information from special place and everyday life networks. Each place that belongs to either the special place or everyday network of an individual, can be located to the framework of the fourfold model. It is noteworthy, that places belonging to the everyday and special place networks can also overlap: sometimes an everyday place is also a special place. In this paper, our interest does not focus on the differences between the places belonging to the two networks: the aim is merely to gather as rich knowledge of places belonging to categories 1–3 (Brown & Kyttä, 2014) from people and find ways how to use that knowledge in planning.

1.2. Towards a place-based prioritization model

When taking steps towards a place-based prioritizing model in participatory planning and development, the fourfold model of Fig. 1 can be used as a starting point. The applied version of the model drafted in Fig. 2, is based on the idea that the four categories of the model can also be seen to represent different planning and management prioritization strategies. It is important to recognize that the stated opinions might not only stem from planning relevant aspects, but from an array of foci, from development needs to maintenance complaints.

The model's four categories in Fig. 2 are: *development priority, development potential, management priority* and *management potential* categories. Places that are visited often and yet perceived negatively can be understood to represent places that should be prioritized in future planning and management activities, so we call this category for a *development priority* category. High exposure through frequent visitation in day-to-day life can pose a risk to wellbeing and/or quality of life (Kyttä et al., 2016), therefore we propose places in this category as a potential development priority.The existence of negatively perceived places in the immediate home surroundings can also be problematic seen from an ecological perspective: negatively perceived places can discourage the use of local services and immediate routes and encourage

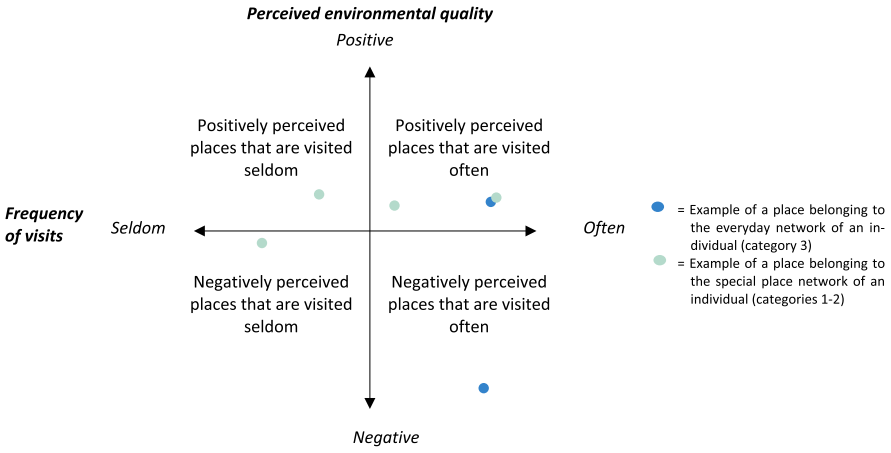

Fig. 1. Integrating special and everyday place networks to a fourfold model.

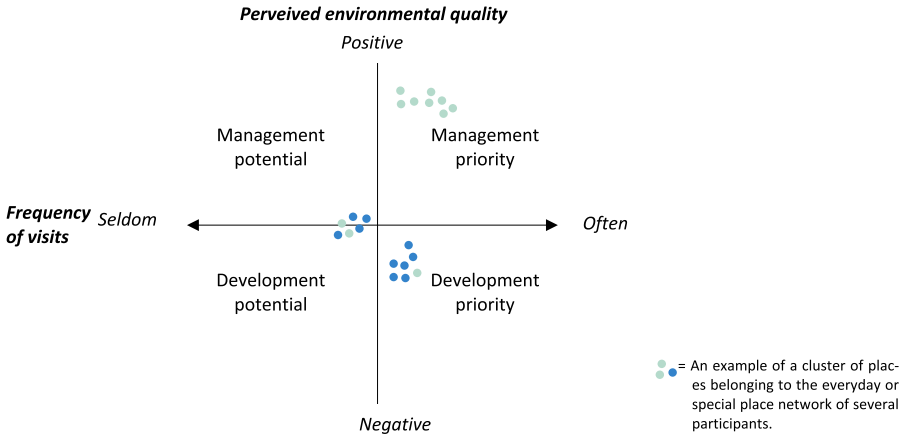

Fig. 2. Four-fold model developed for priority categorization.

the use of further away places that are accessible only by private car. The mere availability of local services does not guarantee their usage and popularity, but rather their desirability, accessibility and usability (Golicnik & Ward Thompson, 2010; Laatikainen et al., 2015).

Here it is, nevertheless, essential to critically evaluate the quality and representativeness of the collected knowledge and to understand that different groups of inhabitants can have different opinions of the same place. For example, if negative place experiences are examined, it is possible that an area is labelled negatively by people who do not live in the area or use it. Some inhabitant groups like immigrants are often underrepresented in surveys and a place can be important for them even if the place is negatively perceived by the majority (Hewidy, 2021). It is also possible that negatively perceived places are unevenly distributed within the urban realm. Raymond et al. (2016), for example, noticed that places by the water with perceived problems and unpleasant experiences were associated with more vulnerable user groups. This finding raises environmental justice concerns.

In addition to the above discussed first priority category also other priority categories can be defined and specific development strategies identified. Special attention should be given to the management of the positively perceived places that are visited often: *management priority* should be given to these places to protect and preserve the qualities contributing to their attractiveness and use (Dempsey & Smith, 2014). Places positively appreciated and visited seldom can be seen as places that should be part of the city's *management potential*. The ambition to make places relevant and attractive is perceived as a common task for managers (Randrup et al., 2021), but doing so without frequent use by inhabitants, may become an issue when resources are allocated.

Finally, places that are negatively perceived and visited seldom can be seen to possess *development potential* as the development of these places probably does not cause wide opposition among inhabitants. It is, however, noteworthy that these places may contain other important values beyond social values (e.g., ecological values), but such places will be important to distinguish in times with strict budgets and related needs for prioritization of resources. Thus, such places may actually need as much planning and management focus than places representing other categories but the justification for the importance of the places is not social but rather originates from other points of view.

In the applied model of Fig. 2, the focus is moved from the everyday or special place network of an individual to the spatial clusters of everyday or special places of groups of individuals. We propose that from a planning perspective, the identification of areas where similar place experiences by diverse individuals cluster provides one potential prioritization criteria. Such clusters can then be interpreted as sites that demand various planning and development strategies. The identified prioritization categories can further be compared with development areas defined by city planners and management categories identified by e.g. a green space or park organisation. In a space with several overlapping categories, dominant views should be taken into account, but minority voices should be also included and analyzed to create a full context description.

The two axes of the model, perveiced environmental quality and frequency of visits both have been associated with human health and wellbeing by previous studies. Therefore, we assume that the

combination of these two aspects would potentially also have outcomes related to the health and quality of life of individuals. We assume that e. g. a high share of places belonging to the first priority category, development priority, would predict the health or quality of life of an individual.

In this study we will use PPGIS methods to study the Fourfold prioritization model in the Finnish city of Espoo. Our more specific research questions comprise four sets of questions:

- Are places belonging to the everyday network visited more often than places belonging to the special place networks? Are places representing special place networks preferred more than places representing everyday networks?
- Which priority categories do the places marked by participants represent? How are the places belonging to the four categories located geographically? Do the places in these categories differ by their land use? How far from home have people marked places representing the four categories?
- Are there associations between individual health and/or quality of life and the composition of the individual's everyday and special place network following the priority categorization model? Are places in the development priority category (i.e., the place category with hypothesized negative impacts on health) overrepresented among certain population groups?"
- Do respondent-mapped places in the four priorization categories share spatial overlaps with the development areas identified by the city planners of the study area?

2. Methodology

2.1. Context

The study was carried out in the city of Espoo, Finland. Located in the Helsinki metropolitan area, Espoo is the second largest city in Finland with about 292,800 inhabitants (in 2020). The city of Espoo has actively developed its participatory planning practices for many years. This has included investing in large-scale public participation, the active use of various public participation methods including digital tools, and the development of influential participation where the knowledge produced by people is systematically analyzed and stored and actively shared and used by various sectors of the city. As part of the NordGreen research project funded by NordForsk (see: https://nordregioprojects.org/nordgreen/), Aalto University and the city of Espoo realized the MyEspoo survey in 2020. The survey represented the early initiation of a public participation process, where inhabitants shared their personal experiences about various parts of the city as background knowledge for planning, even before the planning process had officially started.

2.2. Sampling, survey design and responses

The study utilized public participation GIS (PPGIS) methodology to gather localized experiential information about residents' everyday environments and place networks. The survey was developed in close collaboration with a team consisting of university researchers as well as urban planners and communications experts from the city of Espoo to provide material for both research and planning and development/management. The My Espoo on a Map -survey (Fig. 3) was open on the Maptionnaire survey platform between 8/2020–10/2020, and was available in three languages: Finnish, Swedish, and English.

The parts of the survey relevant for this study were the following four sections: **1) background information** (year of birth, native language, gender, education, occupation, family situation and respondent-mapped home location); **2) mapping of everyday networks** (categories: work or study place; shopping place; place for recreation; personal matters and services like bank, health services; child's school or daycare or other place of care; second home; other everyday place); **3) mapping of special place network** (instruction: In addition to the everyday places, we all have places that evoke very strong, positive or negative feelings in us. What places are especially important to you? What places cause negative feelings for some reason?) and 4**) reporting about the perceived health and quality of life** (3 questions: How is the quality of your life? How would you like to describe the status of your health? Do you have health issues that restrict your activities and mobility?). Similar question have been used before by Kyttä et al. (2013), Kyttä et al. (2016). For the mapping tasks 2 and 3 the respondents were asked to: "Think of the places that you have visited regularly during the past year, excluding the exceptional circumstances caused by the coronavirus pandemic. Mark at least ten places that are a part of your day-to-day life, if you visit that many places regularly". The health and quality of life questions were answered using 5-point Likert scale ranging from Very good to Very poor (also "prefer not to answer -option was available). In the survey, the respondents also made suggestions for the future of the city and marked potential locations for infill projects, as well as reported their previous experiences concerning participation in urban planning

Fig. 3. The front page (right) and the mapping page of the everyday places (left) of the "My Espoo on a Map" survey.

projects. The data of these parts are not included in this paper.

After the mapping of everyday and special places, three additional questions were asked: (1) frequency of visits (How often do you travel there? Radio button options: daily or almost daily, once a week or more often, a few times a month, about once a month, several times a year, once a year or more often), (2) travel mode (How do you usually travel there? Check box options: On foot, by bicycle, by public transportation, by car, some other way, how?) and (3) perceived quality of the place (How do you feel about this place? A slider bar from 0 = very negative to 100 = very positive).

Two complementary sampling strategies were employed to reach participants. Firstly, 15,000 Espoo residents between the ages 18 and 80 were selected from the Finnish census register via random sampling and were invited to participate in the survey. Secondly, a separate survey with identical questions was open for the public on the Espoo municipality website and marketed through the city's official communication channels and social media accounts. The randomized survey resulted in 2,066 participants who marked 1,944 home locations and 31,042 other location mappings. The open marketing reached 2,132 participants with 1,717 home locations and 22,768 other locations mappings. Altogether 4,198 respondents participated and mapped a total of 53,810 places (other than home locations) in their everyday and special place networks. Mapped places with missing data on visiting frequency and perceived place quality were excluded from the analysis.

Of the 4,198 respondents, 3,430 marked some locations on the map pages. The respondents marked on average 11 locations and the most common number of markings was six. 72 % of the respondents marked six or more places.

The representativeness of the sample varied according to the data sampling strategy (see Fig. 4). Regarding the age of the respondents, in the open survey there was an overrepresentation of middle-aged respondent groups while the random sampling produced an overrepresentation of the older age groups. The youngest generations (under 30 years) were underrepresented in both samples. Female respondents were overrepresented in the open sample and in the random sample the gender representation was satisfactory. Finnish speaking respondents were overrepresented, and the Swedish speaking group was well represented in both samples. Inhabitants speaking other languages than Finnish or Swedish (18% in Espoo) were underrepresented both in the open (10%) and in the random sample (9%). The representativeness of various occupation categories in the open sampling was safisfactory except for students who were slightly overrepresented. In the random sample retired people and students were overrepresented while employed respondents were underrepresented. In terms of education, groups with higher levels of formal education were overrepresented in both samples. In the compiled sample, 66% of respondents had completed a university-level degree compared to 43.5% in the Espoo population (Espoo residents aged 20 to 74 years, Statistics Finland, 2020). With regard to the geographic representativeness of the sample in the study area, the survey reached 1.2 to 3.4 percent of the adult population in all City of Espoo postal code areas. On postal code level, areas with higher socioeconomic status tended to have somewhat higher participation rates.

2.3. Analysis

2.3.1. Statistical analysis

The data were statistically analyzed with IBM Statistics SPSS v28 software. Differences between the four priority categories were studied with Kruskal-Wallis H-tests for continuous variables and Chi-square-tests for categorical variables and differences between means of two groups of inhabitants were studied using t-tests and Mann-Whitney U-tests. Ordinal logistic regression analyses were used to study associations between priority categories and perceived health and quality of life measures. In these models, answers on the 5-point Likert scale were treated as ordered outcome measures.

2.3.2. Spatial data analysis

All spatial analyses were conducted with ArcGIS Pro 2.5. Fig. 5 shows the locations of the mapped everyday and special places. Points located outside Espoo were excluded from the analysis. Distances between the mapped locations and the respondents' home locations were calculated as network distance. The land-use around the places marked by respondents was studied using CORINE Land Cover 2018 data. Following several prior PPGIS studies (e.g., Broberg et al., 2013; Kyttä et al., 2013), the land use was calculated within a 50-meter buffer around the mapped location. Spatial overlaps between the four planning priority categories and the current active planning project areas of the City of Espoo were

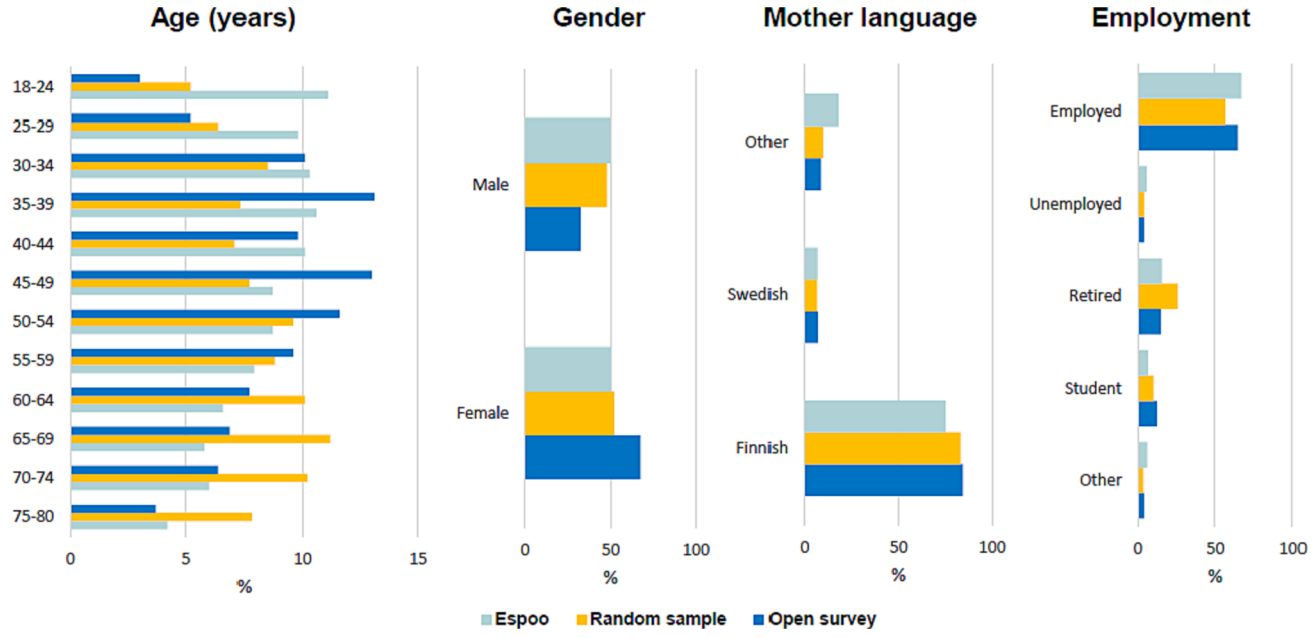

Fig. 4. The comparison of various background variables of the survey respondents recruited through open survey and random sampling with the population demographics of the city of Espoo.

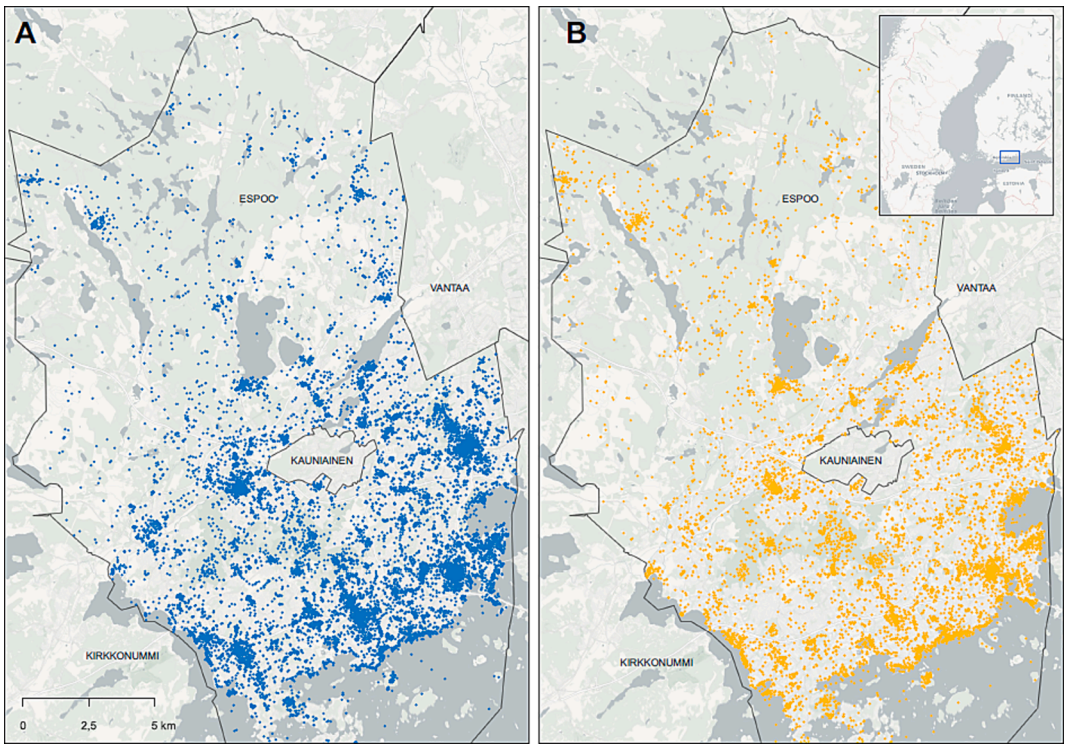

Fig. 5. Everyday places (A) and special places (B) mapped by survey respondents.

analyzed. These included active detail planning areas and areas identified as future development areas (City of Espoo, 2021). The former consist of areas with current detail-planning level activities, while the latter include areas identified at the master plan level as areas of interest. For visualization purposes, we formed spatial clusters of points in each priority category. Clustering was performed as density-based clustering with a minimum cluster size of five features and a distance band of 200 m.

To empirically test the priority category fourfold of the Fig. 2, the two dimensions of the model were operationalized in the following ways:

- The frequency of visits were scored as "often" if the respondents visited a place once a week or more. Visits were scored as "seldom" if they took place **less** often than once a week.
- Personal experience was operationalized as perceived quality of a place and was measured on a scale from 0 to100. For this study, scores of 51–100 were coded as positive and scores of 0–50 as negative.

3. Results

We first tested whether a) places belonging to everyday network would be visited more often than places belonging to special place networks and b) places representing special place networks would be preferred more than places representing everyday networks.

It appeared that both assumptions hold true. There were highly significant differences in visiting frequency (χ^2 = 860.9, df = 1, p <.001), when visits once a week or more often were compared between the two types of places: everyday places were visited clearly more often, 47.2% of everyday places were visited at least once a week while the same percentage for special places was 30.8%. There were no significant differences between the visiting frequency to positively and negatively perceived places (χ^2 = 0.004, df = 1, p =.952). The perceived quality of everyday places was significantly lower (mean = 66.7) than that of special places (mean = 69.3) (t = −9.17, df = 18562, p <.001). Overall, positive places were marked clearly more (88%) than negative places (12%).

These results shed light to the basic differences of the places representing everyday and special place networks. It should, nevertheless, be noted that the closer study of places belonging to the two networks or the possible related health outcomes, is beyond the scope of this paper. Here the two types of places were queried to guarantee a high enough number of mapped places and to get enough variation in the two axes of the prioritization model.

3.1. Various priority categories in the mappings of participants

Respondent-indicated visiting frequency and perceived place quality were used to create a categorization of the mapped places following the proposed planning priority categorization. This initial categorization shown in Table 1 resulted in 6.7 % of places identified as places with *Development potential*, 5.1 % as places with *Development priority*, 50.1 % as places with *management potential*, and 38.1 % as places with *Management priority*. The differences between the categories were statistically significant (χ^2 = 831.2; df = 4, p <.001). Also, the shares of everyday and special places that belonged to the different categories were significantly different in all four categories. The share of special places was higher than the share of everyday places in *Development priority* and *Development potential* categories. The share of everyday places was, on its part, higher in *Management priority* and *Management potential* categories.

The places marked by people tend to form spatial clusters, which can be seen from the maps in Fig. 6, with examples from two areas in the city of Espoo. The mappings were concentrated in core urban areas and the clusters often contained all four categories.

Next, we studied in a more fine-grained level how the places of the four priority categories differed in terms of urban fabric and different land use categories. Here we used a 50-meter buffer around each place and calculated the land use within the buffers. A series of Kruskal-Wallis H-tests revealed that the places representing various categories differed significantly (p <.001) in terms of all land use types. Places representing

Table 1
Categorization of respondent-mapped special and everyday places (mappings within Espoo).

	Special places	%	Everyday places	%	The difference between special and everyday places*	All mapped places	Total %
Development potential	638	9.7	667	5.1	$\chi^2 = 149.3$, df = 1, p <.001	1,305	6.7
Development priority	437	6.7	557	4.3	$\chi^2 = 51.8$, df = 1, p <.001	994	5.1
Management potential	3,694	56.3	6,133	47.1	$\chi^2 = 150.4$, df = 1, p <.001	9,827	50.1
Management priority	1,788	27.3	5,677	43.5	$\chi^2 = 490.6$, df = 1, p <.001	7,465	38.1
	6,557	100	13,034	100		19,591	100

*Pearson Chi square test.

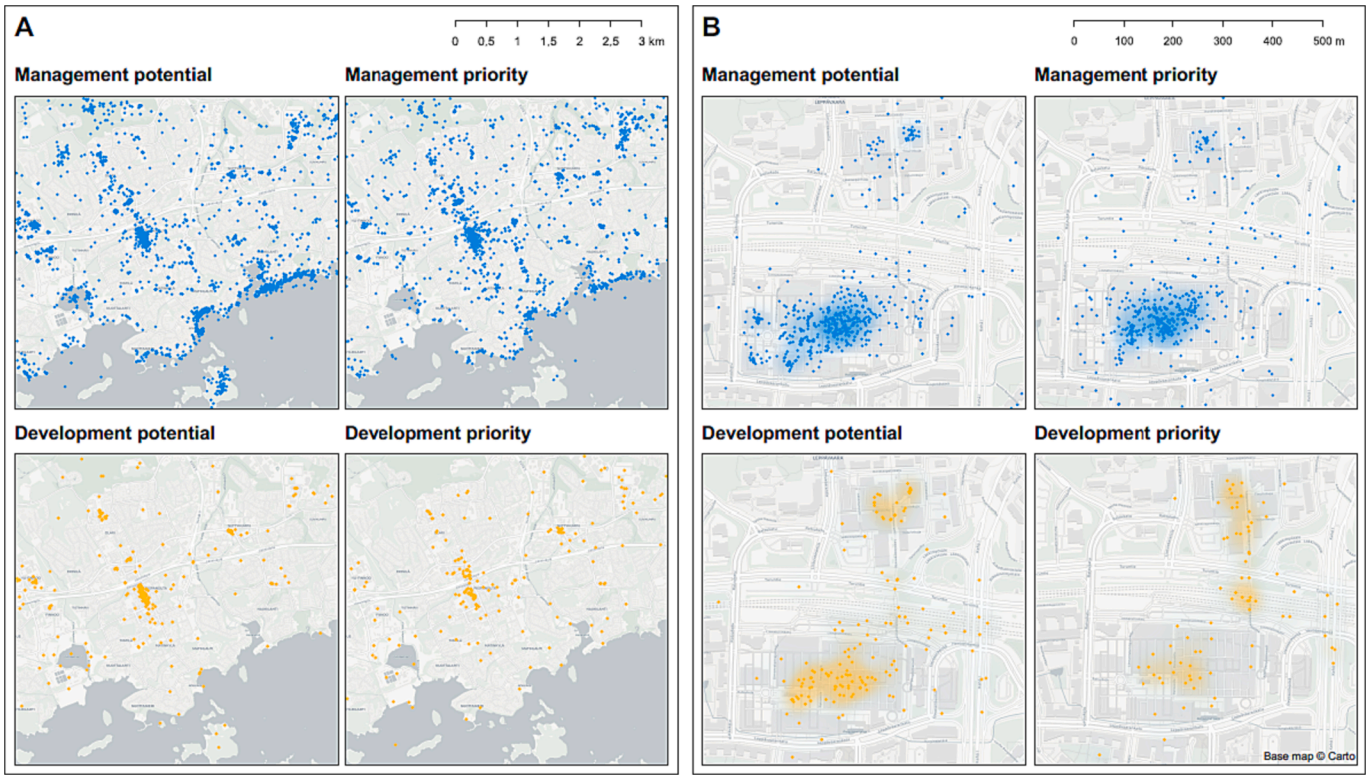

Fig. 6. Distribution of mappings in different planning priority categories on two spatial scales around the local centers of Matinkylä (A) and Leppävaara (B). Smaller analytical scales (A) probably serve better urban planning (master planning) and larger scales (B) detailed planning and management.

Development priority and *Development potential* categories were, for example, clearly more often in land associated with road and rail networks and within a continuous urban fabric. On the other hand, places in *Management priority* and *Management potential* categories located typically in green urban areas. (See Table 2).

Also distance from home varied significantly among places of various categories ($H(3) = 1815.65$, $p < .001$). The median distance to places that were visited more often, *Development priority* (median 2.13 km) and *Management priority* (mean 2.28 km) categories was clearly shorter than to places that represented other categories, *Development potential*

Table 2
Built environment characteristics of respondent-mapped places in the four planning priority categories.

	Average distance from residential location, km, median (SD)	Land-use within a 50-m buffer (%)[a]					
		Urban fabric	Commercial areas	Green and blue infrastructure	Traffic areas	Sport and leisure areas	Industrial areas
Development potential	4.66 (5.11)	15.10	39.03	14.05	14.45	3.32	2.74
Development priority	2.13 (4.37)	17.92	33.5	17.39	16.98	3.38	3.67
Management potential	4.82 (5.86)	12.6	36.24	35.57	5.54	6.68	2.39
Management priority	2.28 (4.20)	15.48	35.80	28.95	7.45	6.93	2.69

[a] Including the following CLC 2018 classes: Urban fabric: L2 11; Commercial areas: L4 1211; Green and blue infrastructure: L1 3, 4,5, and L3 141; Traffic areas: L4 1221; Sports and leisure areas: L3 142; Industrial areas: L4 1212.
SD Standard deviation.

(median 4.66 km) and *Management potential* (median 4.82 km). When distance to positively and negatively perceived places were studied separately, it was found that the distance to positively perceived places was significantly longer (median 3.52 km) than to negative places (median 3.31 km) (U = 1839578,5, p =.041). Everyday places were significantly closer to home (median 3.23 km) than special places (median 4.39) (U = 116544867,5, p =.001).

3.2. Various priority categories on the individual level

Ordinal logistic regression models were constructed to study whether mapping places falling to the various priority categories had an association with perceived health or quality of life measures. The analysis revealed that the only significant association (p <.05) was found between perceived quality of life and the respondent having mapped places in the *Development priority* category (OR = 0.06; 95% CI 0.50–0.84, p <.001, for full model see Appendix A). This result was found after controlling for age, gender, language, and occupation. The observed negative association signifies that visiting often negatively perceived places is connected with lower perceived quality of life.

In comparison to the other three development categories, places in the *Development priority* category were more often mapped by respondents with university level education ($\chi2 = 11.27$, df = 1, p <.001), that were fully employed ($\chi2 = 8.20$, df = 1, p =.004), and that were on average younger (H(1) = 9.24, p =.002). There were no differences regarding gender.

3.3. The relationship between development priority places and existing prioritized areas in planning

In the final analytical phase, we identified spatial overlaps between the four planning priority categories and the current active planning project areas of the City of Espoo.

Fig. 7 presents the existing active detailed planning and general planning areas of the city of Espoo. The same map also shows the locations of the clusters of the *Development priority*- category identified in this study. It can be seen that almost all *Development priority* clusters are located in close vicinity of the existing development areas but often not overlapping entirely with them.

To more systematically compare the locations of all mapped places representing various priority categories with the existing planning areas, we calculated the shares of points in each priority category located within these areas. The results of this analysis suggested that the four priority categories differed significantly ($\chi2$ = 348.7, p <.001) by the proportion of points falling within the borders of the existing planning areas, with most such points found in the *Development priority* and

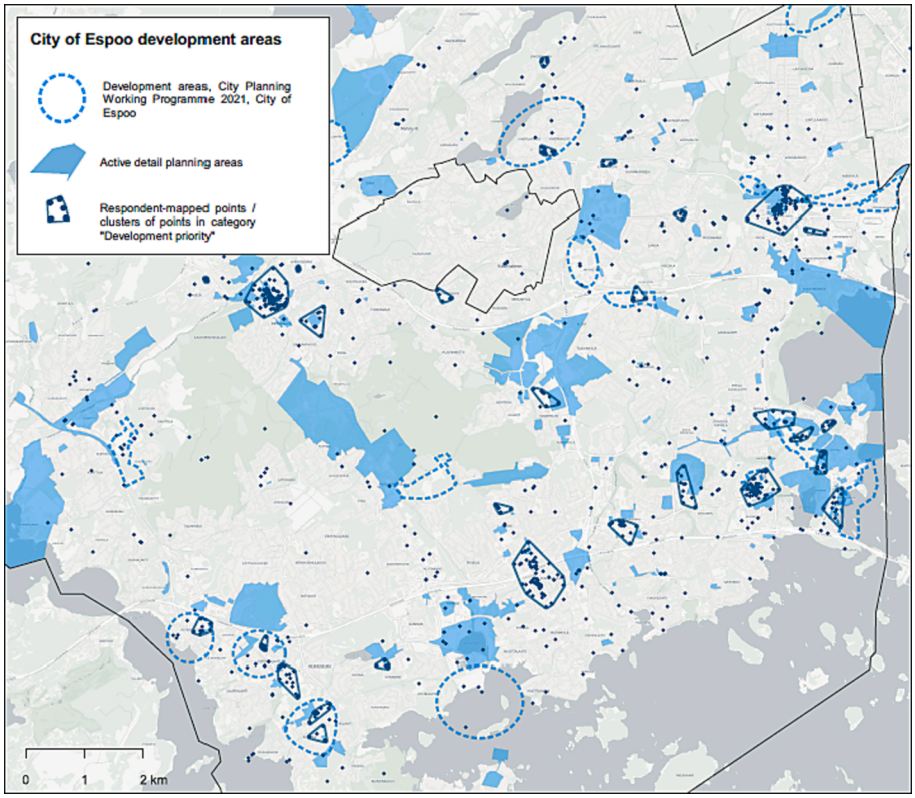

Fig. 7. A spatial comparison between the *Development priority* clusters identified in this study and the existing active planning areas of the city of Espoo in southern Espoo.

Table 3
Respondent-mapped places in the four planning priority categories by spatial overlaps with the existing City of Espoo development areas.

	City of Espoo development areas	City of Espoo development areas, 100-m buffer
Development priority	34.0 %	57.8 %
Development potential	37.0 %	62.4 %
Management potential	18.0 %	35.8 %
Management priority	22.4 %	43.5 %
Total	22.1 %	41.6 %

Development potential categories. (Table 3).Thus, the places that respondents perceived negatively are located more often in the existing planning areas than the positively perceived places.

4. Discussion

The prioritization model presented in this paper aimed to consider which locations, based on the local knowledge from users, should be prioritized in planning, design, and management practices. This kind of knowledge can be seen to excemplify knowledge that does not drive clear private or political agendas (Rydin, 2007), because individuals are commenting on their daily, habitual use of places as well as on place experiences that are especially meaningful for them. The public participation GIS methodology applied in this project is well suited to the place-based collection of local knowledge, concerning values, experiences or behavioral patterns related to the current settings as well as ideas related to future plans and development solutions (Brown & Kyttä, 2014). Our aim was to identify new ways to integrate the large knowledge pool nesting within local inhabitant's everyday life as a base for future prioritization of urban planning and management.

Our finding that only about 12% of places marked by inhabitants represented the *Development priority* or *Development potential* categories may appear as positive, because it indicates that the number of places that urgently need development is rather limited in our study site, the Finnish city of Espoo. The low number of places in these two categories of negatively perceived places could also be interpreted as people in Espoo being mainly satisfied with the quality of their living environment. In earlier PPGIS surveys the positive place-based markings have typically dominated. For example, in a study in the Helsinki metropolitan area 63% of markings concerned positive perceived quality (Kyttä et al., 2013). Our result that 88 % of places were perceived positive suggests that Espoo seems to be perceived by people even more positively than the neighbouring city Helsinki. We can, however, critically ask whether people just avoid places they do not like and therefore do not often map negative places. Positively perceived urban places, at least urban parks, are visited by people more often than negatively perceived parks (Lau et al., 2021; Fongar et al., 2019). In this study positively and negatively perceived places were, however, visited equally often. So, it seems that differences in visiting frequency do not explain our findings. It is notable, that we were interested in both special and everyday places and the latter ones were visited more often even when they were more negatively perceived. To be able to truly estimate to what degree people avoid negatively perceived places, a specific mapping task should be included where people would be asked to map places they avoid in their daily life.

The places that represented *Development priority* and *Development potential* categories were most often found in land associated with road and rail networks as well as in continuous urban fabric. Similar results were found by Kyttä et al. (2013) in Helsinki metropolitan area, where negative places were located predominantly in transportation, public and housing areas, that were perceived negatively especially in terms of the negative atmosphere, appearance, and social unsafety. In the current study, the *Management priority* and *Management potential* categories were located typically in green urban areas, a result that again echoed the findings of the earlier Helsinki study, where positive places were most often found in green areas (Kyttä et al., 2013). The concentration of negative experiences in transportation areas encourages us to think about how to create more attractive mobility environments especially where sustainable and active transport modes dominate. An obvious way to improve the perceived quality of transportation settings include the increased use of green infrastructure also in tranport areas (Kazmierczak et al., 2011), to provide incidental exposure to "vitamin G" that can bring along positive health benefits (Beery et al., 2017). The positive effects of green infrastructes on both mental and physical human health and well-being is well documented (see e.g. MEA, 2005; WHO, 2016), and such measures are already implemented in practise in the improvement of transportation areas (Hansen et al., 2016; Lippert, 2016). More research is, nevertheless, needed to understand how each type of area can be developed and what kind of public participation process is needed to find context-sensitive solutions that address the issues identified by the users.

When distance from home to positively and negatively perceived places were studied separately, we found that the distance to negatively perceived places was on average significantly shorter than to positive places. This finding is in interesting contrast with the earlier evidence about the association between subjectively perceived distance to positive and negative places that has been found to be clearly shorter to positive places (Schipperijn et al., 2010; Alter & Balcetis, 2011). Two earlier studies from Finland concerning the distance to positively and negatively perceived places revealed mixed findings: a study in small town contexts found the distance to positive places shorter (Kyttä et al., 2011) while another study in Helsinki metropolitan area found - like in this study – that the distance to negative places was shorter (Kyttä et al., 2013). Because the current study was realized in Espoo, which is located in the Helsinki metropolitan area, it seems that this is a context-spesific matter. The finding can possibly be explained by arguing that people especially in large metropolitan areas are ready to travel further to reach positive places. Urban planners and developers in Espoo could critically evaluate whether it is possible to aim to also bring positive special places closer, within walking distance. This is corroborated with the fact that in the current study the distance to both positive and negative places were overall longer than in some earlier Finnish studies. This may reflect the functionalistic city planning tradition of the city of Espoo. Urban densification can be a way to increase the accessibility of positive places in the urban fabric, at least if realized sensitively and with the help of datasets produced in public participation processes to protect the green areas that are important to people (Randrup et al., 2021).

Higher share of mapped places represented potential than priority categories both in development and management categories and in both subcategories of everyday and special places. This means that people mapped a lot places that they do not visit that often. This result is counter-intuitive because visitation frequency is a strong predictor of place attachment (Rushing et al., 2019) and we might assume that people mark more places they are attached to. In our dataset, the respondents marked on average 11 locations: among them are a lot of places that are visited less often than weekly. Places representing potential categories were also located further away from home than places on priority categories. These findings can possibly be explained with the fact that the city of Espoo is very sparsely built city (997 inhabitants/km^2) compared with other Nordic cities: Helsinki 3073, Stockholm 5260, Copenhagen 7302 inhabitants/km^2 (https://www.citypopulation.de). Everyday and special places of residents are probably more scattered and further away from home in the city of Espoo than in other Nordic cities and therefore fewer inhabitants in Espoo are able live 15 min lifestyle with amenities close to home.

The finding that the presence of mapped *Development priority* places had a negative association with individual's quality of life is important. Earlier studies have found positive associations between quality of life and overall perceived environment quality and negative associations between quality of life and environmental stressors like noise (Evans et al., 1998) and air pollution (Fleury-Bahi et al., 2015). Our finding that frequent exposure to negatively perceived places has a negative association with quality of life is to our knowledge novel. To further understand if this finding relates to certain inhabitant groups will be highly relevant. If vulnerable groups are more likely to be exposed to negatively perceived places, it can mean that our prioritization discussion is in line with the traditional approach where the prioritization of the needs of these groups is highlighted (Fainstein, 2010). In Espoo, however, inhabitants with high education and full employment marked the most places in the *Development priority* category. Therefore, it seems that our place-based model offers a different perspective to the prioritization discussion compared with the tradional discource. Although it can be

argued that the experiences of well-off people do not need much attention, cities are, however, obliged to consider the needs of all inhabitants. Moreover, since many mappings fell into traffic zones, the more deprived part of the population may not enjoy the comfort of a private car in these areas, but rather may travel by bike or on foot and experience the discomfort of the negative environment even more directly than the well-off respondents. Conversely, the green areas that were experienced positively are in Finnish context open for all, regardless of societal status.

When comparing the spatial overlaps between the four prioritization categories and the development areas identified by the city planners, we found that 58 % of places representing *Development priority* category were located within the existing planning areas of the city of Espoo or within a 100-meter distance from these areas. This reflects a rather high match between the prioritization of the inhabitants and those of the city administration, and indicates that the city planners in Espoo are capable of choosing development sites in accordance with the inhabitants' (spoken or unspoken) priorities. This dataset, if used wisely in the city organization, can be a helpful tool in prioritizing the most impactful projects (yearly programming of detailed plans on city level) and to extend the planning area or boundaries, if necessary, and e.g. do a public/green area development adjacent to a private development, if the data indicates high development priority. As discussed above, city planners should still study closely the collected data to learn where the negative place experiences concentrate at microlevel, and include perceptions shared by inhabitants into future planning and management programming. The re-development of existing areas has been expressed as place keeping (Dempsey & Burton, 2012) or strategic green space management (Randrup & Jansson, 2020). Both concepts argue for a long term and continuous development of spaces, accomodating different societal trends and challenges, e.g. related to climate change, biodiversity loss or human health and well-being. Future research could elaborate in more fine-grained ways the different situations that emerge through the co-variation of the priority areas by citizens and by the city.

The limitations of the study include some compromises in the representation of various inhabitant groups. Young people were underrepresented and Finnish-speaking people with higher education overrepresented in the sample. The online mapping tool is also prone with some mapping errors. When Laatikainen et al. (2018) studied the spatial accuracy of a PPGIS dataset based on aging population (who face greater difficulty in mapping than other user groups), they found that the overlap between the data from GPS tracking and participatory mapping using the Maptionnaire software was 79% when estimating everyday place mappings of participants. The indicators for health and quality of life were subjective, which can mean that they a less reliable than objective measures of health. Although perceived health measures can mean different things to various individuals, they have been found to predict e.g. mortality rather well (Cleary, 1997). In a study where the dataset is partly collected directly by a planning sector of a city, it would be very difficult to use objective health measures, but future studies might be able to overcome this difficulty.

While the prioritization model can be used to identify and focus urban development in areas that currently negatively impact citizens' quality of life, the model does not take into account other aspects which impact planning and management, such as land ownership, ecological conditions, or predetermined political goals which may or may not be aligned with current citizens' wishes. In a city like Espoo, where a majority of the land is privately owned, the model can be used to inform collaboration is cases where the development priority category mappings are located on private land.

The findings of this study are promising in helping cities to allocate their limited resourses to areas that most urgently need improvements and to plan for developments and management efforts more strategically. From an organisational perspective, planning and management are often considered separate issues, while citizens do not regard these administrative borders, mainly perceiving the changes to the environment. The four-fold model puts planning and management in a continous spectrum, acknowledging that changes to the environments are perceived and affecting citizens regardless of their scale or the responsible department. A relevant finding here is that citizens are relatively satisfied with a large part of their environment, meaning that sensitive management is required to maintain and further refine the existing qualities, a notion that would potentially be lost in a planning-only perspective. Further, the model offers a systematic way of treating the multiple and dispersed views on the urban environment, from general opinions to maintenance complaints and ideas for improvements. However, practical testing and evaluation is needed to further develop its use and full cross-departmental implementation within the city.

The spatial data including the planning priority categories and the subsequent spatial analyses have been shared with the City of Espoo to support knowledge informed planning (Davoudi, 2006; Kahila-Tani, 2015). The survey data and selected analyses have been uploaded to the map service, LocusCloud, used by planners and other sectors in Espoo. This data repository can be an important way to combine "soft" and "hard" geographic datasets, active and passive sensing, and use them in a balanced manner (Grêt-Regamey et al., 2021). By taking the experiential knowledge produced by people seriously, social capital can be strengthened, individuals and the local community empowered and eventually urban sustainability transformation fostered.

5. Conclusions

In this paper we developed a place-based prioritization model where frequency of use and the perceived quality of everyday and special places were used to identify focus areas for urban development and management to support the use of large-scale participatory data strategically in urban planning and management. The prioritization model consisting of four categories was tested empirically by applying it to place-based knowledge about inhabitants everyday and special place networks collected in the Finnish city of Espoo. Only about 5% of places marked by inhabitants represented the *Development priority* and about 7% *Development potential categories,* that represent negative place perceptions by inhabitants and can be found mainly in transport areas and in continuos urban fabric. The categories with positive place perceptions *Management priority* (38%) and *Management potential* (50,1%) categories were located typically in green urban areas. The identified development priority areas overlapped often with the existing planning areas of the city of Espoo, which reflects a rather high match between the prioritization of the inhabitants and those of the city administration. The development of a model was justified with an idea that the frequent exposure to places perceived negatively can pose a risk to individual's perceived health or quality of life. From this perspective the finding that the presence of mapped *Development priority* reduced individual's quality of life was important. The prioritization model hopefully helps cities to allocate their limited resourses to areas that most urgently need improvements and to plan for developments and management efforts more strategically.

CRediT authorship contribution statement

Marketta Kyttä: Conceptualization, Methodology, Formal analysis, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition. **Thomas Randrup:** Writing – review & editing, Supervision, Project administration, Funding acquisition. **Anna Sunding:** Writing – review & editing. **Saana Rossi:** Software, Data curation, Writing – review & editing. **Eveliina Harsia:** Writing – review & editing. **Johanna Palomäki:** Writing – review & editing. **Anna Kajosaari:** Methodology, Data curation, Formal analysis, Writing – review & editing, Visualization, Supervision.

Declaration of Competing Interest

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.

Data availability

Data will be made available on request.

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Appendix A

Appendix A: An ordinal logistic regression on the associations between *Development priority* mapping and the perceived quality of life.

	p-value	OR	95% CI
Mapped places in "Development priority" category (Yes, ref. no)[a]	< .001	0.65	0.50–0.84
Age (In years)	.181	0.99	0.98–1.00
Gender (Male, ref. female)	0.27	0.79	0.64–0.97
Occupation (Employed, ref. other occupation)	< .001	0.69	0.56–0.86
Language (Other, ref. Finnish)	.962	0.99	0.74–1.34
R^2 (Nagelkerke)	0.24		

Ordered outcome variable "Quality of life" measured on a 5-point Likert-scale (1 "Very poor" to 5 "Very good")

OR Odds Ratio, CI Confidence Interval.

[a] Respondent mapped at least one place categorized as "Development priority"

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