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Neo-spaces for urban livability? Urbanites' versatile mental images of green roofs in the Helsinki metropolitan area, Finland

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ABSTRACT

Within the context of enhancing sustainable and livable urban environments, one aim is to establish multifunctional green infrastructure (GI). We argue that in order to successfully plan and manage the development of GI, an inclusive and future-oriented stance concerning the needs and expectations of urbanites is required. By using green roofs as an example, the aim of this paper was to offer insights into how people envisage novel GI in urban environments and to reveal the scope of meanings and values people attach to these kinds of green infrastructure. We present results based on 149 stories collected with the method of empathy-based stories. Respondents were asked to use their imagination to produce mental images of not-yet-existing green roofs in different urban situations. Our results reflect a rich set of dimensions of green roofs that the respondents vividly imagined. Green roofs may contribute to the livability of urban areas in multiple ways, such as strengthening social cohesion, providing space for everyday renewal and restoration, offering interesting sceneries and multisensory experiences, softening the hard cityscape, showing ephemeral events and making experiences of "height" possible, as well as increasing the "contact with nature" experiences for residents, e.g. through biodiverse nature in the middle of built environments. Furthermore, the need for local, customized solutions that offer different benefits and experiences was expressed. Using both qualitative and quantitative analyses, we idealized four green roof meta-types for understanding the diverse expectations people may have for green roofs in urban area: Urban farm, Oasis, Urban hill and Meadow. Based on our results we suggest that comprehensive experiences and needs of people should be taken into account when designing urban green roofs or urban green in general – not only, e.g. visual pleasure. Also, site- and user-specific solutions should be considered instead of generally applied ones. Our results offer tools for, e.g. urban planners to understand the value of diverse green roof solutions to the user.

1. Introduction

Nature-based solutions to climate change adaptation are considered increasingly important (e.g. Naumann et al., 2011; European Commission, 2015), specifically in urban areas (Gómez-Baggethun et al., 2013). Green infrastructure (GI), defined by the European Commission (2013) as a planned network of natural and semi-natural areas, is suggested to be used in urban planning as a means to offer ecosystem services, protect biodiversity (Tzoulas et al., 2007; Lovell and Taylor, 2013), and to produce livable urban environments (Ruth and Franklin, 2014). A key characteristic of GI is its multifunctionality: the potential of a green space to perform multiple ecological, social and economic functions (e.g. Pauleit et al., 2012). However, evaluating and applying different functions of GI is a complex process (Roe and Mell, 2013) that is intertwined with, e.g. societal values (Sussams et al., 2015). Moreover, achieving multiple objectives simultaneously requires a considerable amount of scientific information at various spatio–temporal, ecological, social and jurisdictional scales (Faehnle, Söderman et al., 2014; Sussams et al., 2015) of both tangible and intangible values and benefits, as well as social questions such as demand and access (Hansen and Pauleit, 2014).

Meijering et al. (2015) showed that experts in landscape architecture globally considered the human dimension of planning and design (i.e. place attachment, landscape perception and human-

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environment interaction) to be an important research priority. Since the future is constructed on decisions we make today, it is not sufficient to consider present spaces and how they are perceived but rather an inclusive, comprehensive future-oriented stance is necessary (cf. e.g. Bell, 2003; Inayatullah, 2011). This calls for exploring possible futures and choosing preferable ones (May, 1996; Daffara, 2011), including both factual information and the emotional side of urban life, community values, wishes and fears (Krawczyk and John, 2006) and using various visioning and scenario methods (e.g. Wollenberg et al., 2000; Lemp et al., 2008; Inayatullah, 2011).

Planning for good quality future GI demands a better understanding of how people might interact with and benefit from urban green spaces (cf. Niemelä, 2014). Theorists of sociology of space and human geography, such as Massey (2005) and Lefebvre (1991), have argued that urban spaces are continuously socially produced according to the meanings given to them. Thus, we suggest that achieving socially and experientially functional GI, information of the various meanings attached to future urban green spaces is important.

The purpose of this study was to give insights into the different meanings, values and benefits that urbanites attach to novel modes of GI. These kinds of solutions are needed in densifying urban areas (e.g. Haaland and van den Bosch, 2015). As even small nearby nature may promote human well-being by, e.g. providing psychological restoration, aesthetic experiences and social cohesion (Kaplan, 2001; Matsuoka and Kaplan, 2008; Peschardt et al., 2012), we use green roofs as an example of GI, with an inclusive, future-oriented and user-centered method of inquiry. Green roofs offer an interesting case for studying perceptions of urbanites towards new kinds of spaces that integrate natural elements into constructed urban environments. Green roofs lack existing symbolism associated with traditional nature, such as forests or lakes and may be viewed from unique perspectives compared with ground-level landscapes (Loder 2014; Lee et al., 2014). For example, in Finland, forests represent an iconic national landscape that is loaded with historic meanings and discourses while green roofs are still rare. Hence, novel associations and experiences concerning urban green and for bringing nature into the urban environment may be found by studying green roofs, or more generally, novel GI.

From the perspective of successful urban planning, meeting the needs and preferences of urbanites is essential for designing functional green spaces (Kabisch and Haase, 2014; Kaplan and Hunter, 2015). This calls for information on what kinds of experiences and benefits people *expect* from green roofs or other novel multifunctional GI. Exploring possible futures involves asking 'what could be' (Bell, 2003, p. 76). Because there are not many green roofs in Finland, we were able to ask: *what if* there were green roofs, i.e. we were interested in how people envisage an environment that does not yet exist using their own creativity (cf. May, 1996, pp. 186–187). We characterized the features of green roofs that respondents indicated as *mental images* that do not necessarily portray existing spaces. Instead, mental images reflect an urban green design that might be meaningful for the respondent if it existed.

By 'green roof' we refer to an intentionally vegetated roof from low-growth vegetation to lush roof gardens. Green roofs constitute a variety of constructed ecosystems providing different technical and ecological benefits (e.g. Oberndorfer et al., 2007; Berardi et al., 2014) that are expected to mitigate the consequences of climate change, such as the urban heat island effect and urban floods (Supporting the Implementation of Green Infrastructure, 2014). However, the potential of green roofs is not fully understood from the perspective of urbanites (see Blank et al., 2013). A few studies in real or photo-based situations have been conducted concerning perceived restorativeness of and people's preferences and aesthetic reactions to green roofs, indicating, e.g. that green roofs are preferred over non-vegetated roofs and that preferences differ according to vegetation characteristics (White and Gatersleben, 2011; Fernandez-Cañero et al., 2013; Jungels et al., 2013; Lee et al., 2014). Yet, there is indication that interesting findings can be gained as regards experiencing green roofs comprehensively, e.g. that multisensory and direct experiences of diverse nature and a close view to green roofs may benefit office workers in multiple ways (Loder, 2014).

We included both explorative/qualitative and hypothetico-deductive/quantitative analysis in our future-oriented approach. We hypothesized that people relate different mental images to roofs situated on different types of buildings (e.g. workplace or housing), in different districts (e.g. city center or suburb), and developed for different purposes (psychological restoration or for biodiversity). Additionally, we hypothesized that people envisage green roofs differently depending on which role they are given (i.e. the designer or a user of a green roof).

Through examining the mental images of green roofs of 149 respondents, this paper argues that green roofs comprise a potential for offering a rich variety of experiential benefits for urbanites and contributes to a better understanding for applying multifunctional GI in cities. This knowledge is helpful for, e.g. urban planners and other stakeholders contributing to urban design such as architects, real estate developers, constructors and companies.

2. Materials and methods

2.1. Data collection: method of empathy-based stories

Data were collected using a passive roleplaying method (Ginsburg, 1979), called the method of empathy-based stories (MEBS; Eskola, 1998; see also Posti-Ahokas, 2013) that has been found applicable for future-oriented research (Hyrkäs et al., 2005). While this method has mainly been used in social scientific exploratory studies and studies concerning experiences (Eskola, 1998; Halttunen, 2003), we also included a hypothetico-deductive approach to test the above-mentioned hypotheses.

The core idea of MEBS is that the respondents are given a short framework (an *a priori* defined script) that orientates them to a certain situation. The researcher instructs the respondents to empathize with the situation and to produce a written story about it by using their own imagination. From these stories the researcher explores the experiences, ideas and visions of the respondents. The stories do not necessarily reflect reality, but are narratives of possible futures: what is meaningful for the respondents.

An essential aspect of MEBS is that different versions of the same script are used to generate data. The aim is to compare the stories according to the variable of interest, i.e. the changing situation that is interesting in the study, here our hypotheses. To test our hypotheses (and also to encourage a broad variety of mental images for qualitative analysis), we used several scripts inspired by previous research on what things might evoke different mental images of green roofs. We used scripts that concerned green roofs 1) on four different types of buildings and properties (cf. e.g. White and Gatersleben, 2011; Loder 2014), 2) in two different city districts (as in Finland suburbs are greener than downtowns, which may affect the need for novel GI), 3) in relation to 'restorativeness' (e.g. relaxation; as green on the roof has been shown to provide psychological benefits; e.g. White and Gatersleben, 2011; Lee et al., 2014, 2015), 4) in relation to the concepts 'natural' and 'promoting biodiversity' (as the level of biodiversity and naturalness has been shown to affect experiences; cf. e.g. Özgüner and Kendle, 2006; Fuller et al., 2007; Carrus et al., 2015), and 5) to be designed by the respondents themselves or as being ready-made (as the way of presenting a question may affect the responses; see e.g. Foddy, 1993, pp. 4–8) (Table 1).

Table 1
Script themes, versions and orientation (how the situation was set in the script). At the end of each script, a short definition was added: "A green roof is a roof with vegetation and the construction materials required for the vegetation".

Theme of the script	Version	Orientation
1 Type of building	1.1 Home	Imagine yourself living in a city with a green roof(s) on your house. Use your imagination and describe what kinds of green roofs they would be and for what purposes? What kinds of plants would grow there? What kind of an atmosphere would there be on the roofs and what kind of experiences would the roofs offer? Describe why you ended up with these choices.
	1.2 Workplace	Imagine that there is a green roof(s) on your workplace building. The workplace is located in an urban area. Use your imagination and describe. . . (otherwise the same as 1.1 above).
	1.3 Large pieces of real estates	Imagine that there is a green roof(s) on really large buildings (e.g. shopping center, trade center, industrial area). Use your imagination and describe. . .
	1.4 Nursing/care or education property	Imagine that there is a green roof(s) on a nursing or education property (e.g. school, nursery, old people's home, hospital). Use your imagination and describe. . .
2 Type of city area	2.1 City center	You are free to design a green roof(s) on buildings in the city center. Use your imagination and describe. . .
	2.2 Suburban area	You are free to design a green roof(s) to buildings in the suburbs. Use your imagination and describe. . .
3 'Restorativeness'	3.1 Respondent designs the green roof	You are free to design a green roof(s) that would help you to relax, feel refreshed and recover from daily pressures/stress. Use your imagination and describe the kinds of green roofs and where they would be. What kinds of plants. . . (otherwise the same as 1.1 above).
	3.2 Entering an established green roof	You have found your way on to a green roof that would help you to relax, feel refreshed and recover from daily pressures/stress. Use your imagination and describe the kinds of green roofs and where they would be. What kinds of plants. . .
4 'Nature and biodiversity'	4.1 Green roof supporting biodiversity	You are free to design a green roof(s) that would enhance urban biodiversity. Use your imagination and describe what kinds of green roofs and where they would be. What kinds of plants. . .
	4.2 Natural-like green roof	You are free to design a green roof(s) that would be natural-like. Use your imagination and describe what kinds of green roofs and where they would be. What kinds of plants. . .

The aim was to achieve a good coverage of different embedded meanings related to green roofs, and test whether the stories differ between versions of the scripts (e.g. do mental images of a green roof at the work place differ from a green roof at home).

After pilot testing, i.e. giving preliminary alternatives of scripts to five persons, interviewing them on how they felt about the task, and reading through their stories, we chose the scripts for the study. We aimed for approximately 15 stories per script version, which has been shown to be sufficient for data saturation (Eskola, 1998). Data were gathered in four publicly accessible locations in Helsinki, Finland, during May–December 2012: a University of Helsinki meeting and exhibition room (in the city center), two botanic gardens (one in suburbia, the other in the city center) and a public exhibition space (city center). The script versions were randomly assigned to the respondents. Primarily, we asked the respondents to *write* stories about their images but we also allowed the respondents to draw pictures (see Fischer and Young, 2007, for using drawings when studying mental constructs of biodiversity).

149 visitors took part in the study, i.e. the data consisted of 149 stories and background information of the respondents. The data included stories from short written notes to several pages of wordy expressions of which 53% were only text, 31% text and drawings, 10% subtitled drawings and 5% only drawings. Two thirds of the respondents were female. 9% of the respondents were under 20 years old, 48% 21–40 years, 31% 41–60 years and 11% 61–70 years old. Living environment, place of residence, education level and expertise are presented in the Electronic Supplementary material, Appendix A.

2.2. Analyses

We analyzed the data by interdisciplinary teamwork using expertise in sociology, biology, environmental psychology and aesthetics to obtain an inter-subjective approach (Miles & Huberman, 1994, pp. 64, 76; Juntunen and Saarti, 2000).

We conducted *a two-phase content analysis*; a) to explore the relevance and saturation of the data, and to quantify and describe the contents of the stories (first level coding), and b) to explore interesting patterns and consistencies in the data (pattern coding) (Miles & Huberman, 1994, pp. 56–72, 239–242; Hyrkäs et al., 2005). In the *first-level coding* we categorized mentions (i.e. meaningful words and phrases occurring in the stories) to main categories and subcategories, in Excel. For example, if a person mentioned 'peaceful atmosphere' it was placed into the main category 'Atmosphere' and to its sub-category 'Peaceful, soothing and calming'. Concerning drawings, we only recorded elements that could clearly be identified in the pictures (e.g. fences, trees, flowers). During this process of categorization the data started to saturate, i.e. mentions began to fit into the existing (sub)categories and new (sub)categories were no more needed. With the coding, we preserved the context of the mentions, i.e. longer sections from the stories revealing the meaning of the mention, using the comment fields of Excel. Altogether 1750 mentions were identified during the first-level coding process, with an average of 12 mentions per respondent (min = 2, max = 27). We ended up with 20 main categories and 168 subcategories that contained 7–389 and 2–62 mentions per category, respectively (see Table 2 in the Results section).

During the second phase, *pattern coding*, we identified consistencies between the categories created in the first-level coding, to reveal themes not recognized in the first-level coding. We formed 1–6 new thematic categories under 20 themes by re-grouping mentions in the dataset (see Table 4 in the Results section).

The two-phase content analysis thus produced two parallel datasets: a detailed categorization based on first-level coding (Dataset 1), and a thematization based on pattern coding (Dataset 2). All categories (in Dataset 1) and themes (in Dataset 2) were discussed and specified in meetings involving experts from different fields as mentioned earlier. Both Datasets were studied qualitatively, and Dataset 1 also quantitatively as explained below.

First, we examined Dataset 1 as a whole, to achieve an overall understanding of the contents of the main- and sub-categories. Then, in order to statistically test whether the mentions (Dataset 1) reflected the scripts and their versions (Table 1), we performed non-metric multidimensional scaling (NMDS). NMDS places participants with similar stories 'closer together' in multidimensional space, while stories that differ substantially are placed further apart. We used the Raup-Crick index as a dissimilarity measure, and permutation tests in the vector fitting procedure (Oksanen

et al., 2013). Additionally, we used a multi-response permutation procedure (MRPP, McCune et al., 2002) to test for statistically significant differences between those script versions differing by only one changing situation in the scripts (see Table 1). The MRPP test statistic *T* describes the separation between groups (here script versions): the more negative *T* is, the greater the difference. Both NMDS and MRPP were performed using the vegan package, version 2.0-10 in the R statistical software (R Core Team, 2013).

Next, we identified which of the 168 sub-categories in Dataset 1 were mostly responsible for the differences. We conducted this in pairs between those script versions that showed statistical differences in the MRPP. The sub-categories that showed greatest differences between script versions (in terms of relative frequency of respondents having a mention in the sub-category) were identified by simple extraction and sorting operations in Excel. Then, we created the so-called *typified stories* for the four versions of script 1 (type of building) because they showed the greatest differences between each other, compared to versions of the other scripts (see Table 3 in the Results section). Typified stories are often used in MEBS to characterize a typical story of a script version and to reflect differences between versions (Eskola, 1998).

Furthermore, we searched for both distinctive and common features *across* statistically different script versions in Dataset 1 by sorting the 168 sub-categories according to the standard deviations in the frequency of mentions.

Finally, by synthetizing all the above results, we qualitatively formulated four *meta-types* of the mental images of green roofs to add understanding of the diversity of these mental images, and therefore make our findings more applicable in practice and in future research (see Miles & Huberman, 1994, pp. 245–256). This procedure is analogous with the concept of *ideal types* of the classical sociologist Weber (1958). Simply put, Weber's ideal types are 'extreme exemplars' that reveal distinctive features among cases, and as such, are not meant to correspond to any particular case.

3. Results

The respondents vividly imagined GI that does not yet exist – the stories reflected diverse uses, benefits, experiential aspects and constructional characteristics of urban green roofs. Meanings and values attached to them included those related to vegetation and greenery, and also to the unique character of the roof as space. According to the respondents, green roofs may offer a range of multifunctional spaces for different significant experiences and activities in the everyday lives of urban residents, such as social interaction, contact with and learning from nature, resting and renewal, growing and harvesting local food and experiencing landscapes, sceneries and seasons, with all senses.

Next, we present all the results based on first-level coding (Dataset 1; Section 3.1) and then the results of pattern-coding (Dataset 2; Section 3.2).

3.1. Results related to the first-level coding

Here we 1) portray the characteristics of Dataset 1 as a whole, and point out interesting features of script versions based on *both the main- and sub-categories,* 2) show results of the statistical analyses (NMDS and MRPP) of comparing script versions based on *the 168 sub-categories*, and 3) define the features (i.e. sub-categories) that separate *statistically different script versions* and the features common to these versions.

3.1.1. Characterization of dataset 1: from variable nature and experiences to practical issues

Within *the 20 main categories* in Dataset 1, 'Nature' composed the largest main category (comprising 22% of all mentions) including mentions from single species (vegetation and animals) to habitats (Table 2). "*A roof formed of curved shapes, all over covered with mosses*", "*a place for nesting, green roof would feed birds and butterflies*". "[In industrial areas] *even simple arctic vegetation would cheer up*." Diverse purposes and uses for green roofs were considered. "*For improving the view from neighboring houses*", "*to increase the communal activity in a block of flats*", "*lie down on a meadow on a green roof*", "*admire scenery and plants*", "*sit under a big lush tree*". Envisaging atmosphere and experiences awakened feelings related to nature and vegetation as well as spatial characteristics, design and views. "*Secret garden, rambling, offering surprises, small details and paths*", "*green, relaxed, rather silent*", "*to see the beauty of nature near oneself*". "*Different colors and scents would wake up one's senses*." "*The atmosphere of a sloped green roof could be felt from the street level*."

Mental images concerned not only nature but essentially also the constructed environment and elements on and around roofs. Practical issues like access and safety, equipment and furniture were considered. "*Safe for children because of no traffic*", "*part of public space, no fees*", "*huts for children, places to hide*". "*Green roof continues from the roof to the ground level as a green ramp: allows also entering with a walker and a baby pram*." The 'Not wanted' category reflected a need for a peaceful place, e.g. no lawnmowers, skateboarders, fitness centers, commercial activities or other "*extra stimuli*".

Exploring *the 168 sub-categories* revealed that the most often mentioned issue (largest sub-category) in the whole dataset concerned growing useful plants (mentioned by 42% of the respondents). "*A possibility to grow herbs and plants for eating*", "*an allotment on a green roof of a shopping center: mini-plots for farming would add coziness and sustain mental health*". "*Bars and restaurants could use their crops for food & drinks; kindergartens and schools would have vegetable gardens for learning and education.*" Other subcategories including mentions by more than 20% (N > 30) of the respondents were 'flowers', 'trees', 'green/greenery', 'places to sit', 'contact with nature' and 'block of flats'. However, variations of single mentions within categories were abundant. For example, the category 'flowers' ranged from single flowering plant species, such as harebells and wild pansy, to characteristics of flowers. "*Flowers tempting butterflies*", "*flowers usually considered as weeds*". The category 'garden' was expressed, e.g. as "*nest-like*", *"butterfly"*, "*moss roof*", "*conifer or broadleaved tree*" or "*hanging*" garden or "*a garden suitable for the cycle of the year*".

Exploring the contents of all main- and sub-categories of Dataset 1 revealed features that clearly characterized some script versions compared with other versions. The amount of mentions in certain main categories (and the division of mentions into their sub-categories) seemed distinctive. First, envisaging green roofs at a working place produced more, and more diverse, mentions concerning nature on roofs than any other version of all the scripts. Second, the stories for a roof in a city center contained various spatial characteristics, e.g. [green roofs would be] "*like meadows*", "*shared backyard of urban residents*", "*parklike common area, yard, garden, open for everyone*". Third, in the mental images of the self-design restorative script version, green roofs were comprehensively envisioned on different types of buildings, particularly on blocks of flats, but also on kindergarten-, old people's home-, youth center-, industrial-, cultural-, commercial-, educational and airport buildings, and on detached houses.

3.1.2. Statistical analysis showed differences between some script versions

The NMDS ordination of *the 168 sub-categories* (see Table 2) revealed that there were statistically significant differences between the 10 script versions of the four scripts ($r^2 = 0.129$, $p = 0.004$; Fig. 1). More specifically, MRPP revealed statistically sig-

Table 2
Categorization of mentions identified in the stories (with the number of mentions per main- and sub-category).

Main categories	Sub-categories
Nature on roof (389)	Designing with plants and other structures (23); Vegetation mentioned in general, not specified (12); Varying, diverse plants (9) *Vegetation, specified*: Flowers (54); Trees (39); Bushes (23); Moss (19); Climbing, hanging (16); (Dry) meadow plants (15); Lawn (15); Special characteristics or requirements of plants, e.g. luminous (15); Native, threatened, rare (14); Grasses (10); Ornamentals (10); Beautiful, lovely, aesthetically pleasing (7); Easy to maintain (7); Durable: drought, heat, wind (6); Lichen (6); Low-rise (6); Mediterranean – tropical (6); Perennials (6); Wild berries (6); Succulents, sedums (5); Rocky plants, rocky habitats (4); Strong, for trampling etc. (4); Fungus, polypore (3); Smelling good (3); Tundra, coastal (3); Aquatic (2) *Wild animals:* Invertebrates e.g. bees, worms (12); Butterflies (11); Birds (10); Place for breeding, nesting, feeding or overwintering for animals (8)
Purpose of the green roof (213)	Growing useful plants (62); Urban landscaping (21); Recreation (18); Relaxation, calming down (18); Learning, teaching (14); Improve air quality, produce oxygen (13); Adding coziness (12); Allotments, community gardening (11); Health & social functions (11); Insulation/temperature, noise (7); Tamed animals (6); Manage storm water (5); Conservation & biodiversity (5); (keep) Bees as productive animals (4); Economic benefits/financial aspects (4); Prolong utilization time of the roof structures (2)
Constructions and elements on roof (180)	Benches, chairs & tables (33); Shade, shelter (from sun, wind, rain, snow) & alike (29); Paths (18); Water elements (15); Cribs for growing plants (12); Fences (12); Substrate/depth, quality (10); Greenhouse, other small constructions (8); Grill, stove, yard kitchen (7); Lighting (7); Electricity, internet, solar panels (5); Natural rocks, sand (5); Playground, field (5); Hammocks, swings (4); Bird equipment (3); Sewer, drainpipe (3); Chimney (2); Heat lamp (2)
Activities (153)	Hang around, knock about, do nothing, laze around, repose & alike (20); Eat, have lunch/picnic, barbeque & alike (14); Socialize, neighborhood (12); Make food on the roof of the crops grown on the roof, harvest for nibbling & alike (12); Conscious relaxing, rest, calm down, take a breath (10); Hobbies (10); Sitting (10); Sunbathe, enjoy sun (10); Take a break (9); Look (around), admire (7); Walk, stroll (7); Events, parties (6); Reading (6); Drink coffee etc. (5); Outside/fresh air, outdoor recreation (4); Be without shoes (3); Have meetings (3); Team games (3); Pick flowers (2)
Atmosphere (117)	Peaceful (24); Natural (14); Being/getting away (12); Positive feelings e.g. happy (9), Spatial definitions e.g. garden-like (9); Cozy, attractive (6); Communal (5); Cultural reflections e.g. Mexican-style (5); Quiet (5); Relaxing (5); Other mentions e.g. spacious (5); Fascinating & alike (3); Order (3)
Type of building (80)	Blocks of flats (30); Education, cultural (14); Commercial (10); Nursing (10); Small yard buildings e.g. garbage shed, garage (8); Industrial, airport & alike (5); Detached house (3)
Colors (76)	Green, greenery (38); Other colors of plants (23); Colorful (9); Different shades of green (6)
Technical characters (72)	Flat roof (20); Terraced/split-level roofs, roof terraces (18); Large roof (8); Small roof (8); High/above other buildings (7); Sloped roof (6); Durable/weight (3); Direction (2)
Spatial characteristics (65)	Garden (23); Common/shared space (11); Park (9); Oasis (8); Forest (5); Yard (5); Meadow (4)
For whom/actors (59)	Residents of a building or city (26); Children, youth (18); Old/elderly people (7); Personnel, students (4); Visitors (2); Patients (2)
Season, sun (58)	Summer (16); Changing seasons, (for) all seasons (10); Winter (10); Autumn (9); Sun, sunny place (8); Spring (5)
Maintenance (44)	Responsibility of and involvement in maintenance of green roof (13); Easy to maintain (11); Responsibility of maintenance/ownership of urban farming sites (11); Equipment for maintenance (5); Activities for maintenance (4)
Experiences (47)	Contact with nature, incl. observing nature (30); Uplifting experiences e.g. wonderful experience (10); Learning/teaching/illustrating of/from nature (7)
View (47)	Quality of/experience concerning the view (15); From roof to surrounding scenery (13); From building e.g. through window (7); On-roof (5); From ground-level to the green roof(s) (4); From above (3)
City area/location (40)	In the middle of a city/city center (16); Entire city/possibilities of green roofs in cities (14); Suburb (6); Near home etc. (4)
Access, safety (35)	Public access (14); Entering the roof, technically or otherwise (11); Safety (8); Easy access (2)
Senses (26)	See, look at (8); Smell, scents (7); Hear, listen to (5); Touch (3); Senses in general (3)
Not wanted (25)	Certain: Character of place, design e.g. not a mess (9); Activities e.g. no smoking (6); Plants, animals (5); Materials/structures e.g. concrete (3); Maintenance e.g. no lawnmowers (2)
Services (17)	Cafe, restaurant, ice cream kiosk (12); Library, art (3); Meditating as organized activity (2)
Problems (7)	Winter/duration, overwintering, snow, wind (4); Maintenance (3)
Total (1750)	

nificant differences between the four versions within script 1 (type of building), and the two versions within script 3 (self-designed vs. ready-made). Furthermore, statistically significant differences were found between the self-designed green roof for restoration (script version 3.1) and green roof for supporting biodiversity (version 4.1), and between the self-designed green roof for restoration and a roof located in the center of a city (script version 2.1) (Table 3).

3.1.3. Pairwise comparisons revealed typical features of script versions

The most distinctive issues (sub-categories of Dataset 1, Table 2) mentioned in those versions of scripts that differed statistically significantly from each other are shown in the Electronic Supplementary material, Appendix B. The typical features of building types are shown through typified stories below, provided with quotes from the respondents' stories.

- A green roof of a **home building** is a peaceful and sheltered space for social interaction and growing useful plants, offering possibilities for relaxed activities. "[Atmosphere on the green roof] *encouraging for social interaction, people are sharing experiences of plants and otherwise socialize on the roof.*"
- A green roof on a **working place** offers a space for relaxing and becoming energized during breaks, full of diverse nature: on the one hand a natural environment with wild plants and animals, on the other hand designed and lush with vegetables and herbs for nibbling. "*It would be great to have a space at work for breathing and for stopping one's thoughts. This is because there are calming plants, outside air and it is high, which would guarantee peace from traffic and noise.*" See also Fig. S1 in the Electronic Supplementary material, Appendix C.
- A green roof on a **large building** is a public, rather natural green space with paths and small-scale services, adding coziness in the city, and offering possibilities for urban farming. "*Reading in a hammock a novel borrowed from a rooftop library.*"
- A green roof on an **education or nursing building** is a nearby, garden-like and safe place, offering close contact with wild nature during all seasons. "*Groups of children would be guided along a path*

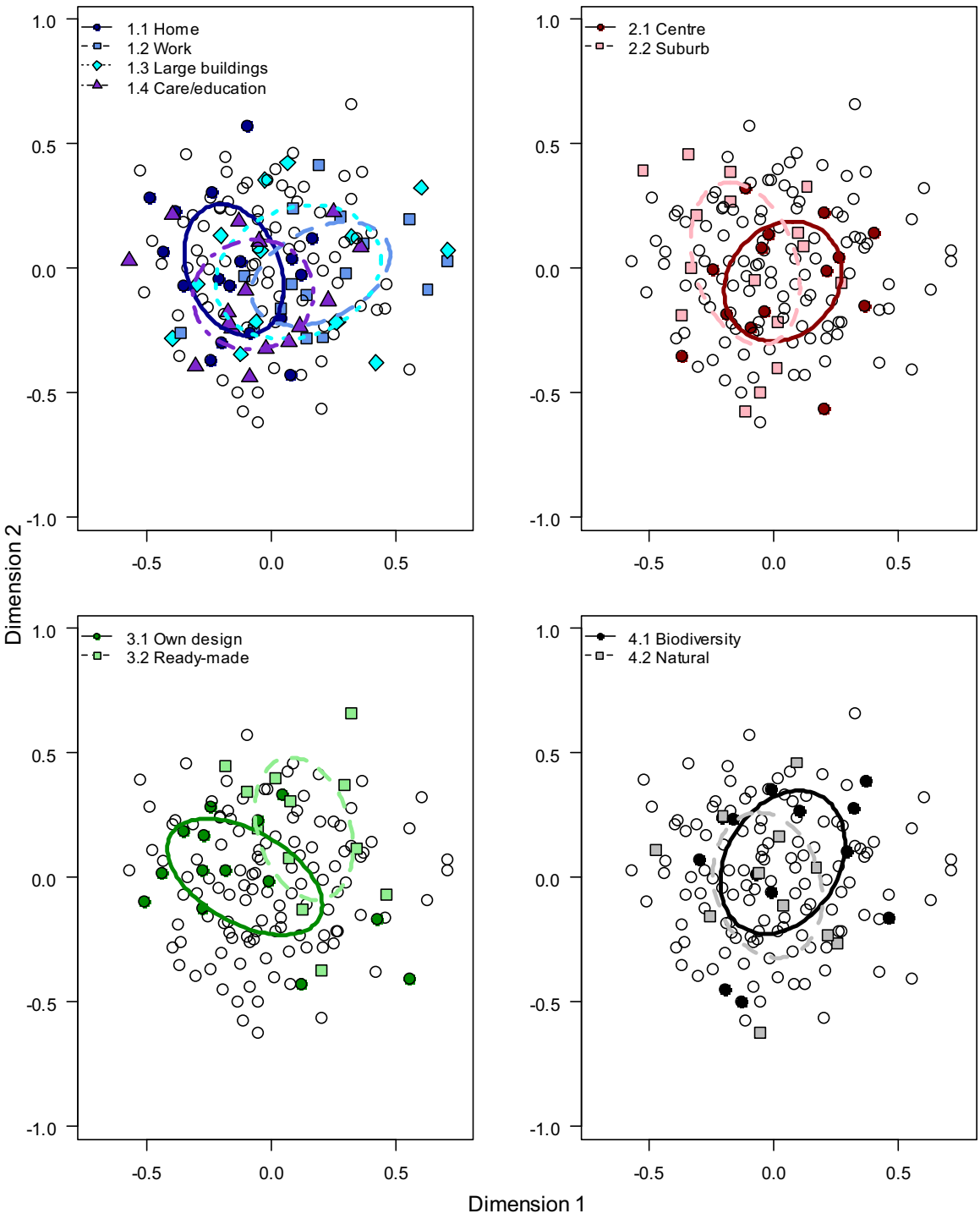

Fig. 1. NMDS ordination plots based on Dataset 1 highlighting differences between versions within each script (see Table 1). Ellipses represent standard deviations of the particular version of the script in question. Two-dimensional NMDS plots are presented here for visual clarity.

with different hotspots and they would get to know the loveliest flowers."

The two script versions concerning restorative roofs (script 3; self-designed vs. entering a ready-made green roof) differed from each other: the self-designed green roofs were more often seen as part of urban landscaping and adding coziness to the whole city. "*Landscaping grey concrete suburbs.*" In stories concerning the ready-made restorative green roofs, a high, relaxing place for escaping the city and views from the roof to the surroundings were emphasized. "*One could look at city life and at the same time withdraw from it and relax.*"

According to the stories, green roofs in the city center (version 2.1) would improve air quality and provide learning and teaching opportunities. *"It would be good to have green roofs in the city center for having more green and for better air quality", "thematic roofs for representing certain species or other themes*". The distinctive properties of biodiversity roofs (version 4.1), compared with restorative self-designed ones, included native, threatened and rare species

Table 3
Results of the MRPP concerning differences between comparable* versions of the scripts. *T* and *p*-values are shown in bold if *p* (in parentheses) ≤0.05. *T* describes the size of the difference between versions of scripts. The more negative is T, the greater the difference. Versions and scripts are explained in more detail in Table 1.

	1.2 work	1.3 large buildings	1.4 care/education	2.1 center	2.2 suburb	3.1 self-design	3.2 ready-made	4.1 biodiversity	4.2 natural
1.1 home	**−4.180 (0.002)**	**−2.247 (0.029)**	**−3.765 (0.003)**						
1.2 work		**−3.012 (0.010)**	**−4.420 (0.002)**						
1.3 large b			**−3.310 (0.007)**						
1.4 care/edu									
2.1 center					−0.368 (0.333)	**−1.990 (0.030)**			−1.044 (0.154)
2.2 suburb						−0.911 (0.189)		0.061 (0.485)	0.404 (0.623)
3.1 self-design							**−1.878 (0.048)**	**−2.321 (0.016)**	−0.346 (0.364)
3.2 ready-made									
4.1 biodiversity									0.302 (0.612)

*Script versions with similar orientation (e.g. "you are free to design. . .") are comparable across scripts. The 3rd script tests whether orientation has an effect on mental images.

and wild animals, and sloped roofs. "*Good succulents and endangered plants, which would benefit bees and other threatened buzzers.*"

3.1.4. Comparisons across scripts manifested differences and similarities

The exploration of Dataset 1 for differences in mentions across the eight versions of scripts that showed statistical differences in the MRPP mostly confirmed findings from the pairwise comparisons, i.e. distinctive features of these versions, but additionally we noticed that green roofs promoting biodiversity were especially considered for viewing from different angles, and located in city centers. As regards similarities, all eight script versions were abundant with mentions concerning growing useful plants, flowers, trees, places to sit and green/greenery. Other mentions occurring constantly across the scripts but at lower frequency were bushes, other colors of plants (than green), hanging around (and alike) and water elements.

Table 4
Description of the 20 themes and 39 thematic categories (Dataset 2). The themes reflect the experiential needs of the respondents and desired features related to green roofs.

	Theme	Thematic categories	Contents/examples
Experiences	Social interaction	Shared space; Shared maintenance; Social activities; Social functions	Social aspects that stand out in the dataset
	Relaxation	Peace; Quiet; Relaxation	Peace(ful), being away, noiseless, relax(ed), rest, laze around & alike
	Everyday renewal	Renewal; Recreation	Adding/getting energy, sense of renewal
	(Other) positive expressions	Positive expressions	Happy, pleasure, enjoy, admire, smile, joy, awaken positive images & alike
	Relaxed spending time	Relaxed spending time	Unhurried and relaxed activities: e.g. sunbathe, sit, read, pick up flowers, stroll
	Urban farming	Grow useful plants; Tamed animals	Experiences of and possibilities for rooftop urban farming
	Food	Food	Eat, drink, cook (incl. activities, furniture for cooking etc.)
	Contact with nature	Contact with nature	Subjective relationship with nature (incl. e.g. observing, memories)
	Learning from nature	Learn/teach	Learning/teaching/illustrating (of/from) nature (incl. as purpose and as experience)
	Changing seasons	Changing seasons	Experience all seasons and annual change
	Multisensory experience	Multisensory	Hear (e.g. purl of water, chirp of grasshoppers), touch, smell (plants and e.g. scent of sea)
	Views, scenery & landscape	View; Landscaping	Experience green roofs from different angles (in the context of single buildings and wider urban landscape)
	High experience	High experience	Special experiential dimension of roofs, e.g. views from high to distance
Features	Wild (Finnish) nature & biodiversity	Native; Wild berries; Wild plants; Wild animals	E.g. threatened, rare (species), conservation, biodiversity, natural-like, plants becoming extinct; worms, mosses, lichens*
	Lush	Rich vegetation; High vegetation	E.g. trees, bushes, climbing/hanging plants, jungle-like
	Barren	Barren; Low-rise	E.g. arctic/rocky habitats, drought, heat and wind tolerant plants
	Green within dense	Dense	Mentions referring to densely built areas (e.g. in the middle of city)
	Scale	Small-size; Large roofs	Continuum from small green patches to larger green areas (incl. e.g. small yard buildings, large-scale activities)
	Designed	Constructed; Paths; Shade; Plants as elements; Small on-roof constructions; Water elements	Deliberately ordered, 'gardened' or restricted, constructed space
	Let it grow	Let it grow	'Free', not restricted or manicured (e.g. spatial definitions of free and wild, easy to maintain)

*Concerning mentions of single species (plants and animals), researchers defined and decided what mentions of nature could reflect wild nature/biodiversity, based on their biological and ecological knowledge.

3.2. Pattern coding revealed experiential needs and desired features

The 39 thematic categories produced during pattern coding (Dataset 2) reflect the 20 larger themes that we present under two umbrella topics, 'experiences' and concrete 'features' (Table 4). These results are qualitative and are not based on counting single mentions as with Dataset 1 above.

3.2.1. Experiential needs for green roofs

An apparent theme was that urban green roofs were frequently (e.g. in the contexts of purpose, activities, experiences and atmosphere) envisaged to enable social interaction, e.g. meeting friends and neighbors, having parties and cooking and eating together. 'Sharing' came to the fore in the stories: share the rooftop space and, e.g. maintenance and crops of common allotments. Mutual learning was seen as a benefit. "*Shared green roofs would offer experience of gardening and the feeling of collective activity.*" Green roofs were envisaged to offer a combined living room, kitchen and backyard for residents in a block of flats or even more widely in the neighborhood. "*Now garden parties are not exclusively for private houses.*" "*Rooftop yoga classes would attract people from the neighborhood.*" Separate roofs were imagined to be connected with bridges. Public roofs were imagined to serve as vantage points and tourist attractions or learning environments.

Varying mentions revealed the need for rest and peace, retreating from the fuss of the city to a peaceful and relaxing environment, and also for finding new energy for daily routines. "*A small water element and natural atmosphere would calm (someone) down.*" "*One could go on the green roof for a while to sit down, calm down and think – meditate, breathe knowingly peacefully, solve problems.*" "*Plants create refreshing energy.*" "*Green roof would be a stimulative place for brainstorming.*" "*Green roofs would be refreshing and soothing oases.*" The envisaged relaxed pace of on-roof activities and the array of positive feelings expressed in the stories support the image of a peaceful and enjoyable oasis in the middle of the city. "*On the green roof one can breathe and take a breath; no need to either play or do anything (one can go to a park for playing).*" "*Everything that is living and green brings positivity and good feelings.*"

The need for close contact with, and experiencing nature through all senses and during all seasons, was described in various ways. "*Loveliness of looking at the nesting of birds*", "*a turf made of different grass species for sense of touch: soft and rougher feeling under bare feet*", "*follow the changing of the roof according to seasons and get a grasp of time*", "*to sense movement of plants in the wind*", "*look at a moss roof and admire the color and softness of the moss*", hear "*purl of water*" or "*chirp of grasshoppers*", "*when storming,* [green roof would be] *a place to watch and listen*".

Green roofs were also connected to positive memories, e.g. from childhood or an experience from another place with a similar atmosphere, deriving from the closeness of nature or natural environments. "*Elderly people in old people's homes with green roofs could sense familiar things from earlier in their life* [vegetation, like a meadow]." For one respondent, envisaging a green roof reminded of a drawing class at school, long time ago, with organic materials like seeds and soil.

A specific feature was enjoying the height and also a feeling of spaciousness and freedom, and being separated from the surrounding urban structure and everyday life. "*High buildings with green roofs so that one could take a walk around the block high in the air*", "*a noiseless park experience*". "*On the roof the visitors would feel to be nearer to the sky and forget hurry and stress for a while.*" These images relate to a larger theme of enjoying views, sceneries and landscapes. "*One's eye would rest on the scenery extending far away from one roof to another*", "*surprising view, different from familiar street level view*". In addition to admiring sceneries from the roof, respondents envisaged experiencing green roofs from other locations: on the roof, from ground level and from other buildings, through a window and from above. Furthermore, people envisioned green roofs at multiple scales: greening the urban landscape as a whole, a building with several different green roofs and a single roof with various elements. "*Green roofs would bring liveliness and another type of surface to a grey concrete building.*" Figures reflecting these dimensions are presented in the Electronic Supplementary material, Appendix C.

3.2.2. Desired features of green roofs (vegetation, construction, design)

The respondents indicated a general need for vegetation in dense, constructed areas. "*Green roofs would nicely bring meadows into the middle of the city.*" Green roofs were envisaged from small-scale green patches to park- or forest-like larger areas. "*Small vegetable gardens*", "*a small green yard*". "*There are many big flat roofs in the city which could be greened.*" Vegetation descriptions varied from barren or low-rise to lush and rich. "*Conifers, flowering small trees, bushes.*" "*The garden would hang down from the other side of the building.*" "*Arctic hill-like vegetation might be suitable for dry and sunbaked roofs.*" "*Roof gardens could vary from groves to low plantings.*"

We also recognized a continuum from natural, wild, 'let it grow' environments reflecting acceptance of wild nature on green roofs to more constructed and restricted designs. "*Genuine feeling of nature: the plants are left to grow, they are not maintained.*" "*On the green roof there should be plants from Finnish nature (meadow, dry meadow) which have declined in nature and which attract butterflies and insects.*" "*Atmosphere of a sleek green garden, 3-dimensional scenery with farming cribs of different heights.*"

3.3. Meta-types for urban green roofs: four conceptual dimensions

To conceptualize the diversity of results produced with different analyses, we created four meta-types of urban green roofs: 'Urban farm', 'Oasis', 'Urban hill' and 'Meadow' (Fig. 2).

These meta-types reflect the diverse meanings and possibilities for urban green roofs, through purposes, atmospheres and experiences, as well as level of activity, maintenance and construction. Meta-types abstract both frequently mentioned and otherwise interesting and distinctive mental images of the respondents. For example, 'Urban hill' reflects a unique set of characters recognized in the stories through different analyses, however not referring to how typical this issue was in the stories.

4. Discussion and practical implications

The European Commission (2013) emphasizes the conscious integration of GI into the planning and development of urban environments. Solid scientific knowledge is needed (Blank et al., 2013) and should consider not only technical-ecological solutions but also well-being of urbanites. Ruth and Franklin (2014) suggested that the concept of livability, understood as "fit to live in" or "inhabitable", thus referring to the needs and wants of urbanites, could be developed, e.g. on the basis of a better understanding of the meaning of subjective perceptions, the city's environmental elements and features and their interactions. Ruth and Franklin argued that this is essential as at present, 'livability' is guiding urban planning alongside the more elusive concept of sustainability (see also de Haan et al., 2014 of the meanings and use of these concepts in planning policy). Furthermore, Ruth and Franklin (2014) remarked that moving from basic needs of urbanites (such as housing) to more experiential ones, subjective judgments of livability arise, and thus,

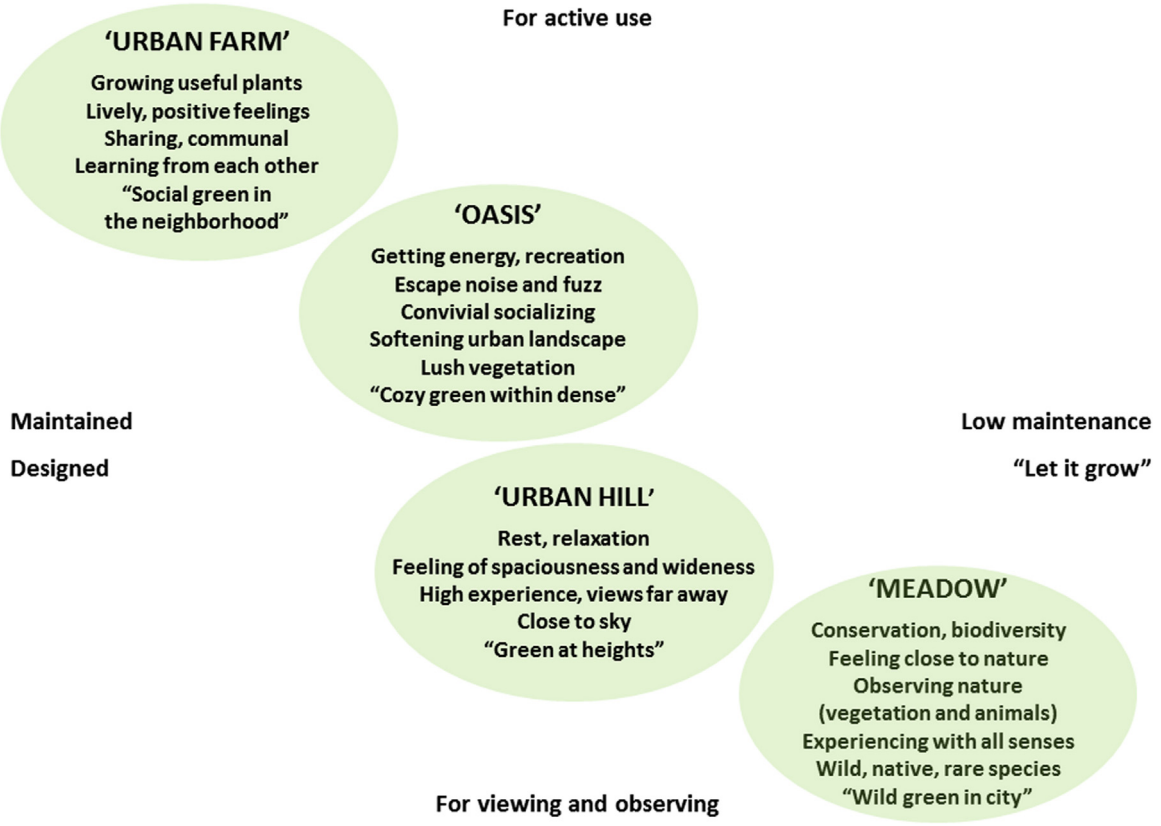

Fig. 2. Meta-types reflecting the richness of mental images of urban green roofs in this study. Characterizations in the ovals are integrative summaries of all the results presented in the manuscript, i.e. they are not exact sub-categories or mentions from the datasets related, e.g. to script versions. Meta-types fall on different dimensions that are indicative and refer to activity of use and levels of maintenance and construction.

the diversity of local solutions may become the characteristic of livable cities.

When exploring local needs and values concerning urban GI, in-depth user-centered methods that allow for creativity may be needed (cf. Vierikko and Niemelä, 2016). A combination of qualitative and quantitative assessments, and inputs from both ecological and social sciences will be needed to produce knowledge for successful applications of GI to achieve livable urban environments (Multifunctionality of green infrastructure, 2012; Ruth and Franklin, 2014).

Within the above framework, we tested a comprehensive approach to the experiential possibilities of new GI, using green roofs as an example, and provided knowledge on the uses and benefits urban residents may expect green roofs to offer. The results of this study indicate that the benefits, values and meanings attached to green roofs were similar to those related to other urban green spaces, such as forests, parks and allotment gardens, especially when it comes to the pleasure of experiencing nature (e.g. Tyrväinen et al., 2007; Breuste and Artmann, 2015; Carrus et al., 2015). Contact with nature is a universal need of urban residents (Matsuoka and Kaplan, 2008) that ran through the mental images of respondents in our study. However, green roofs as spaces possess special characteristics that deserve attention. Next, we discuss important aspects in respondents' stories that, according to our results, should be taken into account in the future planning and design of green roofs. At the end of the section, we also consider the usefulness of MEBS for inquiring about possible and desirable futures, and discuss methodological issues.

4.1. Green + roof: everyday amenity near urbanites

4.1.1. Strengthening social cohesion and community identity

Our study revealed that green roofs were envisaged to support social interaction in multiple ways. This is in agreement with the notion that social cohesion is one of the most relevant cultural ecosystem services in the urban context (see Gómez-Baggethun et al., 2013). Green spaces in general provide local meeting places and may thus develop and maintain neighborhood ties (Kazmierczak, 2013), specifically in areas with low-level socio-economic status (Maas, vanDillen et al., 2009). Hadavi et al. (2015) offer evidence of urbanites' preference for small green that provides opportunities for both socializing and growing plants. Allotment cultivation may contribute to the creation of shared common places that, e.g. sustain tolerance among different groups of citizens (Corcoran and Kettle, 2015), and offer opportunities for interactive experiences and learning about nature (Breuste and Artmann, 2015). Sense of place identity, uniqueness and difference from ground-level green spaces were important factors of roof gardens in Yuen and Hien's study (2005). An interesting opportunity might be to support the sense of community identity by creating specific outdoor design characteristics for neighborhoods by using green roofs suitable for the people, character and history of that area (cf. Matsuoka and Kaplan, 2008).

4.1.2. Interesting scenery for observation

In the minds of our respondents, benefits of viewing green roofs from a distance were related to being in contact with nature by

observing green roofs for example through a window, offering also visual relief in cities as suggested by Lee et al. (2014). Kaplan (2001) recognized that looking out of a window with a view containing natural elements may provide opportunities for restoration, satisfaction with neighborhood and contribute to a sense of well-being of residents. In a study with university students, Lee et al. (2015) showed that even a brief, 40 s glimpse at a flowering meadow green roof scene was associated with better sustained attention. On the grounds of a photo-based survey with office-workers, Lee et al. (2014) concluded that visual access to roof vegetation through a window has the potential to provide psychological restoration, improve mood and attention as well as reduce stress, especially if vegetated by tall, green, grassy and flowering plants. Similarly, in our 'ready-restorative' script version, flowers and trees were particularly mentioned (see also Pearce et al., 2015, for diverse meanings people attach to urban trees). Also, Fernandez-Cañero et al. (2013) showed that colors, plant diversity, shrubs and trees were valued over more monotonous or formal designs such as a lawn. Loder's (2014) study of office workers' perceptions of green roofs indicates that, for example, low-growing sedum-roofs offer only neutral reactions as details cannot be seen from a distance. This is in line with our results concerning green roofs in working places, as the role of versatile spaces, including accessible to non-accessible areas and natural to gardened vegetation were important attributes together with relaxation and spaces for everyday renewal.

Furthermore, according to our results, following seasonal change was a desirable feature, especially in stories concerning education and nursing buildings. Loder (2014) discovered that a close watching over time may influence aesthetic perception, and offer a cue to seasonal change for office workers. Thus, constantly changing green roof scenery, allowing seasonal variation in the landscape, such as evergreens and snow on roofs, is worth considering in places with strong seasonal change. According to Huang (2013), 'ephemera', i.e. environmental change related to seasons or weather (e.g. change in vegetation color or water, the presence of crops, animals or activities), is one of the important visual characters of a landscape.

Besides visual, multisensory aesthetics also arouse from the responses. The respondents mentioned a set of different types of experiences reflecting multi-sensory aesthetic experiences (such as scenery, scents, smells, to touch, hear, uplifting experiences, different colors, attractiveness, spacious and order). Multisensory aesthetic experiences have not been empirically studied much in the literature, although some scholars have emphasized the multidimensional and multisensory nature of experiences of green spaces (see e.g. Carlson, 1979; Chenoweth and Gobster, 1990; Brady, 2003, pp. 123–128; Grahn and Stigsdotter, 2010; Hauru et al., 2014). Furthermore, some studies have highlighted the effects of soundscape on experiences, e.g. Yang and Kang (2005) found that soundscape perception consists of various determinants, and Hong and Jeon (2015) showed that there is a positive relationship between the visual quality and the pleasantness of the soundscape in urban recreational spaces. In line with these studies, our results suggest that besides visual, acoustic and multisensory dimensions are worth considering in green roof designs.

Finally, 'experience of height', as described in the stories of our study, is a feature that could be used for offering an interesting dimension to experiencing urban space, e.g. a feeling of being separated from everyday urban structures. Gehl (2010, p. 41) suggested that above the 5th floor, contact with the city dissipates and changes to, e.g. views and clouds. In this respect, green roofs could represent a mountainous landscape, echoing the idea of 'borrowed landscape' of Japanese garden art, as discussed by Dagenais et al. (2010). In our data, this kind of symbolism was also present in associations concerning, e.g. vegetation or natural environments familiar from previous life, similar to Loder's study (2014) where respondents expressed how green roofs may remind them of a meadow from their happy childhood.

4.1.3. Spaces for everyday renewal

With renewal we refer to a deepening of adaptive capabilities and the building of one's strengths, an effect that can be caused by exposure to nature and that is different from psychological restoration from, e.g. mental fatigue (Hartig et al., 1996; Beute and de Kort, 2014), coming close to 'micro-restorative experiences' (Kaplan, 2001). According to Kaplan, these experiences result from brief sensory contact with nature, and if accumulated over time, may significantly improve people's sense of well-being and provide a buffer against the negative impacts of stressful events. We call this dimension of green roofs 'space for everyday renewal', referring to the possibility of a quick refreshing bath in nature close by, even when experienced through a window. Stigsdotter and Grahn (2003) discussed the qualities of Healing Gardens for people suffering from burnout diseases, and named features such as multisensory experiences, peace and silence, safety, fascination with wild nature, richness of species (animals and plants), feeling of entering another world, open places allowing views and visits, and spaces facilitating fascination with the course of time. Experiencing nature with senses and through activities was considered important in their study. Reflecting this upon our results, similar qualities may be meaningful to many urbanites. Furthermore, small water elements, mentioned in all script versions of our study, may have positive effects on well-being in the middle of a built environment (White et al., 2010).

4.1.4. Soft city

In the stories concerning restorative green roofs, the respondents envisaged spending relaxed free time, escaping the city (noise, rush) to high places with views and natural environments, and that green roofs could improve the overall coziness of the city (urban landscaping). Especially when given the role of a designer, respondents sprinkled green roofs on all kinds of buildings. Thus, dimensions of restorative green roofs seem to relate not only to natural elements but also to other attributes like the feeling of height and the location and amount of green roofs in the urban matrix. Taking into consideration that the design of urban landscapes strongly influences the well-being and behavior of residents (Matsuoka and Kaplan, 2008), we suggest that green roofs could contribute to the creation of restorative urban areas if used at the level of the whole urban landscape, "*softening the concrete*"– not only 'beautifying' single buildings. This assumption is well in line with Loder's (2014) results indicating that green roofs could break the monotony and hardness of the concrete city and offer balance and calming effects, deriving from the mere presence of green roofs. This is interesting from the perspective of integrating green roofs to the broader planning of GI in cities.

4.1.5. Hotspots of natural environments

Psychological benefits such as perceived restorativeness of green space may increase with biodiversity (Fuller et al., 2007; Carrus et al., 2015), and naturalistic landscapes may offer greater benefits for some people than formal ornamental styles (Özgüner and Kendle, 2006). Our findings suggest that naturalness, combined with visibility to the urban matrix, might be meaningful qualities of green roofs, especially in dense urban areas. Natural-like green roofs could offer contact with nature, and simultaneously function as restorative elements, even when non-accessible but still visible. Physical or close visual access may add understanding of the value of naturalistic green roofs (Loder, 2014). Our suggestion is that on accessible rooftops, inaccessible biodiversity hotspots or specific nature trails could be constructed, and be useful for increasing opportunities to contact with nature, education and research.

Furthermore, green roofs may serve as small patches of green and as large areas on top of big buildings. In addition to benefits for people, these kinds of networks could offer habitats for a number of species (Braaker et al., 2014; Gabrych et al., 2016; see however Williams et al., 2014, for a critique against placing too much hope on biodiversity effects of green roofs).

4.1.6. Local solutions for local needs

Montalto et al. (2013) pointed out that decentralized GI, such as green roofs, have emerged as an alternative for centralized solutions, e.g. when managing storm waters in urban areas, but should be customized to meet various local needs. We suggest that green roofs ought to be regarded as multidimensional elements, not as a few standardized solutions routinely installed when a green roof is required. We argue that green roofs comprise a potential for creative solutions, to make cities more interesting.

Our results indicate that green roofs can provide public, semi-public and private spaces for different purposes, meeting multiple needs of citizens regarding nearby green spaces. Coolen and Meesters (2012), looking at the differences between public green spaces and private domestic gardens, suggest that the value of domestic gardens is that of private leisure and freedom, whereas public green spaces contribute to the livability of the dwelling environment and to experiencing nature, and therefore these two are not substitutes of each other. The stories of our respondents included ideas, e.g. of a semi-public space where the advantages of private and public green spaces could (at least partly) be combined. A rooftop of a block of flats, accessible to the neighborhood, enlarges the idea of 'a common living room', a function often linked to parks in densely built areas. Equality and socio-environmental justice in cities are partially mediated through access and the level of privacy that at a very concrete level are related to questions of, e.g. how to provide enough safe and cozy spaces in urban parks for picnicking with appropriate equipment such as shade and seats (Kabisch and Haase, 2014). Our results suggest that green roofs could afford these kinds of places with easy access and a limited social environment. Previous studies have shown that the health of urbanites can be promoted by providing opportunities to quickly, easily and regularly accessible places that support restoration (see e.g. Hartig et al., 2003; Gidlöf-Gunnarsson and Öhrström, 2007). The proximity of roof gardens is recognized to be a strong primer for frequent use, especially for older age groups and those with lower family income (Yuen and Hien, 2005). According to our results, nearby accessible green roofs may offer local and safe oases for urbanites' everyday recreational use, not only in residential areas but in the whole urban matrix, thus contributing to the provision of easy-access green spaces, e.g. in business districts and dense city-centers. Furthermore, our results revealed that safety and close location were especially associated with education and nursing buildings. Secure and bordered outdoor environments that are protected from disturbance are found to be important for elderly people at nursing homes (Bengtsson and Carlsson, 2005; Bengtsson et al., 2015). Also, since contact with nature by greening schoolyards may enhance pupils' physiological and psychological well-being (Kelz et al., 2015), green roofs might be feasible solutions for schools in densely built urban areas as restorative and learning environments.

Because of the overall diversity of ideas people attached to green roofs, we suggest that it could be beneficial to leave some freedom for the rooftop spaces to take shape over time or to leave some rooftops with minimal predetermined design and construction. This way the roofs can spontaneously take shape over time by the actions of local people i.e. offer "loose spaces" (Franck and Stevens, 2007) where negotiating and sharing meanings and uses (Peters et al., 2010), and even creating new ones becomes possible. Meanings and opinions of, e.g. what kind of a green roof is 'meadow-like' may differ, underlining the importance of mutual understanding of the purpose and aim of the green roof. Comparably, Loder (2014) recommends "loose-fit places", unstructured and unconstrained, open to a multiplicity of uses and users, as a model for urban greening projects.

In order to achieve the benefits green roofs potentially could offer for urbanites, various practical challenges remain to be solved, such as the relatively high costs of green roofs, and the division of costs and benefits between private and public ones (see e.g. Nurmi et al., 2016). Green roofs are nowadays promoted in many cities globally, e.g. as part of climate change strategies (see e.g. Tennekes et al., 2014) and different policy instruments are used to advance the construction of green roofs, including, e.g. financial support (Carter and Fowler, 2008). In order to promote social equity, policies need to take into account access to services provided by green roofs for various groups, such as low-income dwellers (Maas et al., 2006; Maas, Verheij, et al., 2009). As there are not yet many green roofs in Finland, Finnish cities have the possibility to be front-runners of inclusive planning and design for multi-purpose green roofs. Finally, we encourage multisectorial co-operation, e.g. between designers and social scientists, to achieve valid knowledge for the design of livable urban areas.

4.2. Methodological considerations and the usefulness of MEBS

The method of empathy-based stories (MEBS) has been found to widen the context of discovery in qualitative studies. Giving voice to the respondents may offer multifaceted understanding of the subject at hand and generate novel ideas while conducting a study (Posti-Ahokas, 2013). MEBS proved advantageous also in our explorative and future-oriented study, producing rich and multi-purpose data. The process of mixed-method analysis was, on one hand, laborious and time-consuming and required close long-term cooperation between researchers (see also Strang, 2009), but, on the other hand, produced innovative insights into the stories. In quantitative studies it is often the means or sums of categories that are reported, while variation in the datasets gets less attention, and the importance of variability may remain underrated. This is a serious bias, as it may hamper our understanding of all variation that may in fact occur in people's responses in data that are collected to reveal expectations or experiences concerning green infrastructure. We suggest that an increased interest in unraveling the variation in datasets concerning urban green is needed in order to highlight the need for local solutions.

An interesting methodological finding of the differences between the versions of script 3 was that the orientation, i.e. how the situation was set in the script, seems to matter: stories about basically the same issue (a restorative green roof) differed between self-designed and entering a ready-made green roof according to the role of the respondent as a designer or a visitor of the roof. Thus, in participatory urban planning concerning, e.g. resident surveys, we encourage putting people into various roles in order to determine what people want and wish from urban environments. Furthermore, we emphasize that the stories where respondents were asked to design a 'natural' green roof did not differ markedly from stories related to other settings. This may reflect the different ways people perceive 'natural' (Gobster, 2001), for example simply as the opposite of the built-up environment in a city-wide context (Özgüner and Kendle, 2006).

We suggest that MEBS could be developed to be used as a practical tool in user-centered urban planning, as the effective integration of the views of urban residents in urban planning processes is challenging (Horelli, 2013), especially the integration of experiential knowledge, e.g. of urban nature (Faehnle, Bäcklund et al., 2014). We argue that a corresponding variety of mental images that this study revealed, could be recognized for other kinds of urban spaces and elements if respondents were allowed to empathize in different,

specified situations and detach themselves from the constraints of the present reality. MEBS has great potential in studies concerning visions, hopes and ideas for spaces and elements of future cities, as it allows for finding 'looseness' (cf. Franck and Stevens, 2007) for spaces and in spaces. We hypothesize that many kinds of urban spaces could be studied with the method of empathy-based stories, and that these studies might reveal a variety of interesting and fruitful visions and novel ways of interpreting and experiencing urban spaces. These data could then be used as starting points for planning and design for livable cities.

Although visioning techniques, such as the one we used in this paper, are effective in generating scenarios, they do not necessarily consider vision feasibility (Lemp et al., 2008). Thus, our results are not straightforward suggestions for green roof designs but they can be used as inspiration and knowledge-base for planning. The meta-types of green roofs presented in this study can be used for recognizing alternatives and possibilities concerning urbanites' perceptions and needs when, e.g. designing green roofs for a new urban area, designing a building with green roof(s) or drafting a net of urban green spaces containing green roofs.

4.3. Limitations regarding generalizations and implications for future research

In our study, the mental images of the respondents partly reflect the Finnish cultural background, values and shared meanings attached to urban and natural places and spaces, and are in this way connected to the area where the study was conducted. Our results should be interpreted bearing in mind that the meaning environments and landscapes have for people is strongly based on personal and shared experiences of space, not only the explicit or concrete functions the places offer, as suggested by Relph (1976, pp. 1–23). For example, the historical and emotional resonance of a place may shape the way a person experiences it (Anderson, 2009; Duff, 2010; Edensor, 2012).

A limitation when comparing results with studies conducted in different cultures is that some concepts are inherently intertwined with cultural context, and there is no 'perfect' translation for them into other languages. Nevertheless, green roof perceptions of residents in Chicago and Toronto (study by Loder, 2014) mirror in many respects our results, as indicated in Section 4.1, suggesting that some aspects of how people think of green roofs may be extended to other countries and populations.

For future research, studying real-life experiences of residents visiting or viewing different types of green roofs with different qualities and features, and on different buildings would be informative, together with testing whether these experiences are in line with envisioned ones. Regarding the richness of the results of our study, we suggest that on-site roof experiences should be studied from the perspective of multisensory and multidimensional experiences, also in various cultural contexts, to reveal the wealth of possibilities of green roofs for livable urban environments.

5. Conclusions

Our results suggest a wide variety of people's needs and potential to fulfill them, regarding the inclusion of man-made ecosystems in urban areas. Green roofs could be considered as socially and ecologically complementary habitats that afford more green in places that are challenging to be greened otherwise, and offer possibilities that complete the spectrum of existing green areas as regards benefits of experiencing urban nature. Franck and Stevens (2007) suggested that active and conscious recognition of the possibilities offered by a space is fundamental for redefining the meanings and uses of it. Novel meanings in turn yield new insights and inspiration. We argue that this kind of recognition of possibilities is crucial for the successful implementation of green roofs in urban planning. While the 'abandoned land' of roofs awaits a multiplicity of ideas to be realized based on wants and needs now and in the future, planning of the whole green infrastructure could benefit from ambitiously looking at the potential, i.e. at uses, spaces and structures that do not yet exist.

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Supplementary data (Appendices A–C)

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.landusepol.2016.11.021.

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