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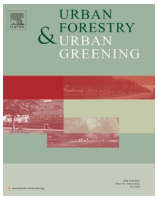

The healthy green living room at one's doorstep? Use and perception of residential greenery in Berlin, Germany

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ABSTRACT

Though the often semi-public green spaces of the residential environment, usually created during the building of the houses, are of a pivotal importance for less-mobile people, after-work recreation and healthy development of children, there has been relatively little research on them. Using face-to-face questionnaires, we explored residents' use and perceptions of local greenery in eight disadvantaged neighborhoods of Berlin that are exposed to high loads of environmental stressors and belonging to four relevant building types of Central European cities. We find that the greenery of housing complexes of modernism is highly appreciated by local residents; that residents visit parks not more often than once a week but benefit daily from residential greenery; that passive use (enjoying the sun, fresh air) dominates active (meeting neighbors, exercising); that residents visit parks once per week but benefit daily from residential greenery; that the baseline for judgement differs among respondents with different perspectives on the city (e.g. car drivers vs. users of public transport; active vs. passive users); and that residents are highly attached to place but not to their neighbors. Co-creative involvement of residents in the design and management of the residential greenery in order to encourage social contacts and neighbor's physical activity on the doorstep can bring about change, making residential greenery the social tissue of 'disadvantaged' neighborhoods.

1. Introduction

By 2050, about 2.5 billion people will be living in cities (UN, 2018). The resulting environmental impacts of urbanization, such as high air and noise pollution or rising temperatures, pose a challenge to human health. Green and blue infrastructures enhance quality of urban life by binding particular matter or reducing heat stress (Bowler et al., 2010; Weber et al., 2014), and encourage citizens to engage in physical activities, with positive effects on the cardiovascular, respiratory and immune system (e.g. De Vries et al., 2013), and on mental health (e.g. Maas et al., 2009). Attractive green space has been found to foster community attachment (Arnberger and Eder, 2012) and physical activity, although the relationship between urban green features and physical activity of the neighbors remains understudied (Schipperijn et al., 2013). In short, design and planning of a healthy urban environment is an effective form of preventive medicine (Coburn, 2015).

At the same time, access to the benefits of urban green is often unequally distributed (Roe et al., 2016; Nesbitt et al., 2018). There is evidence that green space is often rare or poorly maintained in low income neighborhoods, whereas green space in wealthier neighborhoods is mostly more abundant and better maintained (Heynen et al., 2006). The resulting environmental injustice and its health impacts are widely recognized (Jennings et al., 2012), and have become planning and intervention priorities in many cities. However, addressing poor green space conditions in low income neighborhoods can result in green gentrification by excluding and displacing the people the green space was intended to benefit (Benteley et al., 2012; Haase et al., 2017). Consequently, urban green needs to be enhanced inclusively as multifunctional areas for recreation, encouraging physical activity and strengthening social ties (Tzoulas et al., 2007).

Although the urban green on one's doorstep is important for less-mobile people, after-work recreation and the healthy development of

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children, there is little research on it, and it is often only mentioned as a cost item for the real estate management. In this article, we focus on residential greenery (RG) in Berlin, Germany, green spaces usually created during the building of the houses with direct connection to residential buildings and mostly semi-public access, spaces whose design follows different concepts, depending on the epoch of housing development (Battisti et al., 2019). Thus, while previous studies regularly excluded any 'private green spatial entities', focusing instead on public urban parks (e.g. Kabisch and Haase, 2014; Coppel and Wüstemann, 2017; Fischer et al., 2018; Vierikko et al., 2020), we provide novel insights into an often-overlooked part of urban green. These are necessary because studies of privately owned and managed urban green are pivotal for support planning and management strategies of real estate management and housing companies, which are of great organizational variety, and include owners' or housing associations, cooperatives, profit and non-profit or communal companies.

Fig. 1. Study areas and impressions of residential greenery in the four most relevant building types in Berlin: Sprengelkiez, Wedding (A1-3) and Ideal-Passage, Neukölln (B1-3) and General Barby Siedlung, Reinickendorf (C1-3), from the 1870s to 1920s; Paul-Hertz-Siedlung, Charlottenburg (D1-3); Haselhorst. Spandau (E1-3); Alte-Jakobstrasse, Mitte (F1-3), from the 1920s to 1970s; and Marzahn (G1-3) and Gropiusstadt, Neukölln (H1-3), from the 1960s to 1980s. Red lines indicate the limits of the study area. White bars indicate a distance of 200 m. Public green areas are indicated by green colours, adapted from Google. GeoBasis-DE/BKG). Source of photographs: *HealthyLiving* Project (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

While access and availability of urban green is frequently assessed using geographic information systems to generate and link data mostly based on satellite images (e.g. for Berlin urban green space mapping of the Environmental Map of Berlin used in Kabisch and Haase, 2014; Coppel and Wüstemann, 2017), in reality, such green spaces can exist on maps without being meaningful in people's lives (Zhang et al., 2017). Consequently, conclusions based on such studies do not reflect affective attachment of residents, place identity and social bonding so are of limited value.

The aim of this study was therefore to analyze the use and the perception of residential greenery by local residents in Berlin because this is fundamental to identifying use conflicts and the potential to optimize health impacts. We conducted face-to-face questionnaires at eight study sites exposed to high loads of environmental stressors representing the four main building types in Berlin, the modernist housing complexes that provide living space for more than two thirds of Berlin's population: in the dense and closed block-edge developments (1870s to 1920s); in the block-edge development with large green backyards (1920s to 1940s); in parallel and free row development within landscaped residential greeneries (1920s to 1970s); and in large housing estates with towers and high rise buildings (1960s to 1980s).

We explore the following aspects in detail: 1) What role does residential greenery (RG) play in the lives of the neighbors? 2) Do perception and usage preferences differ between different groups of residents? 3) Are there differences between the neighborhoods with regard to the use and perception of RG? 4) Which use conflicts can be identified? 5) Which potentials to optimize health benefits and well-being can be identified?

2. Material and methods

2.1. Study area

Berlin is home to about 3.7 million people. Most people in Berlin rent apartments, and the ownership rate is particularly low (16 % according to the census of 2011), compared to more than 20 % in other German cities, and 46 % in Germany as a whole (Möbert, 2019). Since German reunification in 1989, the socio-spatial disparities have continued to increase in Berlin and have led to increasing gentrification in the inner city (e.g. Häußermann and Kapphan, 2000).

In this study, we assessed eight different neighborhoods of the most disadvantaged areas of Berlin, areas affected by high noise pollution, high air pollution, high bioclimatic stress, low social status indexes and low access to green spaces, all identified based on the Environmental Justice Map of Berlin (Fig. 1; SenStadtUm, 2015; for details see Battisti et al., 2019). For each area, 4 sample plots were randomly chosen to conduct the face-to face interviews to fill in the questionnaires. This methodology has been used successfully in previous studies of perception in urban environments (e.g. Weber et al., 2014; Riechers et al., 2019). The state of the art of the residential greenery was mapped and evaluated for each neighborhood (see details in Säumel and Butenschön, 2018; Battisti et al., 2019).

The Sprengelkiez/Wedding and the Ideal-Passage/Neukölln are classic Wilhelminian style neighborhoods with the dense backyard development typical of Berlin, with mainly block edge and backyard buildings of 5–6 storeys. The Sprengelkiez/Wedding (Fig. 1A) contains some well greened inner courtyards and a little pocket park with benches and a playground. The Ideal-Passage/Neukölln has no pocket park (Fig. 1B). Inner courtyards there are small and serve as spaces for bins and bicycles. Some even have no greenery, or greenery that consists of just a single tree, with no space for recreation. The third neighborhood, from the Wilhelminian era (General Barby Siedlung/ Reinickendorf, Fig. 1C) is classified as a reform-oriented perimeter block development and was built between 1927 and 1938. The neighborhood has extravagant inner courtyards, rich in trees and ornamentals, bee boxes, playgrounds, basketball fields, roofed tables and benches. Gardeners regularly take care of the facilities.

Three neighborhoods have row developments. The 'Reichsforschungssiedlung' Haselhorst (Spandau; Fig. 1E) was built between 1930 and 1938 with 4−5-story terraced houses with nearly 4000 apartments. The RG has no special botanical or design features, but offer plenty of green. Paul-Herz-Siedlung/ Charlottenburg (Fig. 1D) was developed in the 1950/60 s. The RG consists in a lot of shrubs, trees and flowerbeds, where many people engage in gardening. The landscaped RG of the parallel and free row development in the Alte-Jakobstr./Mitte (Fig. 1F) is very attractive, offers many nice spaces to rest and relax, and has large playgrounds and spaces for physical activities. This inner-city neighborhood consists of two social housing areas from the 1950s to 1970s in East and in West Berlin, which were previously divided by the Wall, then by a brownfield. It has a range of art projects and, today, new urban village developments for the upper class (Otto, 2015).

The RG in the large housing estates from the 1960s to the 1980s with high-rise buildings in the Gropiusstadt (Neukölln; Fig. 1G) and Marzahn (Fig. 1H) resemble parks. In addition, Marzahn has the highest number of species and plants in this study, a big community garden and many benches and playgrounds.

2.2. Questionnaires on perception and use of residential greenery

We developed a questionnaire in German and English on resident's perception and use of RG. The questionnaire consisted of 30 mainly closed or semi-open questions (Appendix A). First, we asked about different forms of use of the residential greenery, considering active and more passive uses. Next, we explored respondents' feelings including on safety, health issues and perceptions, such as orderliness, followed by individual preferences, such as with regard to green elements, natural sounds, special activities, and an open question asking for suggestions to improve residential greenery. Finally, we asked for sociodemographic context data such as gender, age, education level, mode of transportation used and time as resident. The duration of an interview was about 10 min. The survey was performed from August to October 2018. We aimed to have 30 respondents per study area. To achieve this number we approached 50 neighbors at each study site. In total 158 interviews were performed: 21 in Sprengelkiez/Wedding, 14 in Ideal-Passage/Neukölln, and 18 in General Barby Siedlung/Reinickendorf; 18 in Paul-Hertz-Siedlung/Charlottenburg; 17 in Haselhorst/Spandau; 20 in Alte-Jakobstrasse/Mitte, 24 in Marzahn, and 26 in Gropiusstadt/ Neukölln. The respondents rate ranged between 30–50 percent.

The participant's level of education was grouped into four categories: primary school; secondary school; high school and university level. Respondents most used mode of transportation was grouped into three categories: public transportation, car and bicycle. Participant's residential time was grouped into four categories: 0–10, 11−20, 21−40, and over 40 years. Weekly park visits were grouped into three categories: 0.5−1, 2−3, and ≥4 times per week. The open-ended question was analyzed using content analysis (Mayring, 2010). A system of categories was developed based on the respondents' statements, meaning that statements with similar content and keywords were mapped to a category (Appendix C). Each individual keyword was assigned to one or more of the categories, transforming them into variables. Respondents were categorized as 'Active Users', Passive Users', 'Order Lovers', and 'Others'; with 'Order Lovers' being those who raised maintenance and order problems with regard to their RG.

The survey data were analyzed using IMB SPSS-Statistics Version 25 (SPSS inc., Chicago. Ill. USA) to test cross-tabulated ordinal data for independence with the chi-squared test.

3. Results

3.1. Characteristics of respondents

Our interviewees represent a typical cross-section of the population

in Berlin neighborhoods. In our survey, 54 % of the respondents were male and 42 % female so, as the gender proportions in Berlin are approximately equal, women were slightly underrepresented (Table 1). Half of the respondents were between 31 and 60 years old, 40 % had finished university and 40 % secondary school (Table 1). Residents had lived on average 18 years in the neighborhood. One third of the respondents lived alone, one third in a two-person household, and one third with more than two persons. Among the women, 43 % indicated having children, as did 20 % of the men. Single mothers were over 6 times more common than single fathers (AfS, 2019). Dogs were owned by 14 % of the respondents, and 15 % had an allotment garden. Most of the respondents did not visit public parks more often than once a week and a quarter usually did not visit public parks at all. More than the half of the respondents mainly using public transport (Table 1). Of all participants, 16 % indicated having some plant allergies (Table 1), with younger residents mentioning plant allergies in the RG significantly more often than other age groups (Tables 2,3). The respondents in the Wilhelminian housing complexes had on average higher education levels than respondents in the other neighborhoods, and academic backgrounds dominated (Appendix B). In addition, on average the respondents of Sprengelkiez and Ideal Passage less often indicated having children. On average, more respondents of the inner-city neighborhoods (Sprengelkiez/Wedding; Alte Jakobstr./Mitte and Ideal Passage/-Neukölln) used cycling as their main transport mode compared to the other neighborhoods. Cycling was the main mode of transportation for distances less than 5 km (AfS, 2019).

3.2. General use of residential greenery

The respondents used the residential greenery (RG) to 'get some fresh air' (94 %), to enjoy the sunshine (61 %), or to escape heat in summer (53 %; Table 2). Of the residents, 64 % walked and sat in the RG but did not, or only, rarely exercised within their RG (76 %). Half of the residents also used the RG during winter (Table 2). Elder people used RG significantly less often than younger people in winter (Table 3). Residents older than 30 years used RG significantly more often to enjoy

Table 1
Overview on socio-demographic characteristics of respondents in the study (N = 158). The education level of the respondents ranged between primary school (13 %; 17 % in Berlin), secondary school (37 %; 28 % in Berlin), high school (12 %; 10 % in Berlin) and university education (38 %; 37 % in Berlin; Table 1 and AfS, 2019). n/a gives number/proportion of respondents who provided no answer to the respective data.

	Number			Proportion			Total	
	Female	Male	n/a	Female	Male	n/a	Number	Proportion
Age								
10–20	3	5	0	2	3	0	8	5
21–30	16	13	0	10	8	0	29	18
31–60	44	30	1	28	19	1	75	47
>60	21	18	1	13	11	1	40	25
n/a	1	1	4	1	1	2	6	4
Education								
Primary School	6	12	2	4	8	1	20	13
Secondary School	38	14	3	24	9	2	55	35
High School	10	8	0	6	5	0	18	11
University Studies	26	30	1	17	19	1	57	36
n/a	5	3	0	3	2	0	8	5
Household								
Single	22	27	1	14	17	1	50	32
2-Persons	29	24	4	25	15	3	57	36
>2-Persons	34	16	0	15	10	0	50	32
n/a	0	0	1	0	0	1	1	1
Having Children								
Yes	68	31	3	43	20	2	102	65
No	15	35	3	10	22	2	53	34
n/a	2	1	0	1	1	0	3	2
Having Dog(s)								
Yes	17	5	0	11	3	0	22	14
No	66	62	6	42	39	4	134	85
n/a	2	0	0	1	0	0	2	1
Having an Allotment Garden								
Yes	15	7	1	10	4	1	23	15
No	69	60	5	44	38	3	134	85
n/a	1	0	0	1	0	0	1	1
Having Allergies								
Yes	17	7	2	11	4	1	26	16
No	67	59	4	42	37	3	130	82
n/a	1	1	0	1	1	0	2	1
Weekly Park Visits								
0	24	16	0	15	10	0	40	25
0.5–1	30	21	5	19	13	3	56	35
2–3	20	21	0	13	13	0	41	26
≥4	11	9	1	7	6	1	21	13
Most used Mode of Transport								
Public Transportation	45	35	2	29	22	1	82	52
Car	17	18	2	11	11	1	37	23
Bicycle	20	13	2	13	8	1	35	22
n/a	3	1	0	2	1	0	4	3
Residential Time								
1–10 Years	34	34	0	22	22	0	68	43
11–20 Years	20	14	2	13	9	1	36	23
21–40 Years	19	11	3	12	7	2	33	21
>40 Years	11	7	1	7	5	1	19	12

Table 2
Survey results of respondent's use and perception of residential greenery, RG, in the four most relevant building types in Berlin: Sprengelkiez/Wedding, Ideal-Passage/ Neukölln and General Barby Siedlung/Reinickendorf from the 1870s to 1920s; Paul-Hertz-Siedlung/ Charlottenburg; Haselhorst/Spandau; Alte-Jakobstrasse/Mitte from the 1920s to 1970s, and Marzahn and Gropiusstadt/Neukölln from the 1960s to 1980s. Questions that were answered in scale (1-4) were clustered into yes (Y) and no (N) answers (N: Strongly disagree, somewhat disagree; Y: pretty much true and completely true; see Appendix A for questions). *We calculated the overall positive perception of RG per study area as the average of the percentage of "yes" statements or respective positive scores (pretty much true and completely true) with regard to the perception of RG (means Y, except 'Natural sounds are non-existent in our RG'). Some questions haven't been responded, therefore the sum of some Y and N answers do not reach 100 %. The difference to 100 % are n/a answers.

Building type			Block-edge development						Row-building settlements						Large housing estates			
			1870s–1920s				1920s–1940s		1920s–1970s						1970s–1980s			
	Overall		Sprengel-kiez/ Wedding		Ideal-Passage/ Neukölln		General Barby Siedlung/ Reinicken-dorf		Paul-Herz-Siedlung/ Charlotten-burg		Haselhorst/ Spandau		Alte-Jakobstr/ Mitte		Marzahn		Gropius-stadt/ Neukölln	
	% (N = 158)		% (N = 21)		% (N = 14)		% (N = 18)		% (N = 18)		% (N = 17)		% (N = 20)		% (N = 24)		% (N = 26)	
I use our RG…	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
to get fresh air	94	6	100	0	71	29	83	17	100	0	88	12	100	0	100	0	100	0
to walk/sit	65	32	57	43	43	57	61	39	44	56	47	53	90	10	88	12	70	15
to enjoy sun	61	39	71	29	29	71	50	50	28	72	12	88	95	5	83	17	81	19
to escape heat	53	47	62	38	21	79	61	39	28	72	29	71	70	30	54	46	65	35
in winter	48	50	42	58	29	71	39	61	33	67	41	59	60	40	63	37	62	27
to meet people	44	54	33	57	36	64	23	66	28	72	53	47	75	35	50	50	46	46
to exercise	20	74	33	67	21	79	0	94	11	72	0	100	30	70	13	79	43	46
for gardening	12	88	10	90	7	93	17	83	22	78	6	94	15	85	0	100	19	81
to get creative	9	88	14	86	0	100	22	72	11	89	15	85	15	80	0	100	4	84
It feels healthy to spend time in our RG	79	21	86	14	36	64	66	34	67	33	88	12	100	0	91	9	80	20
I feel connected to our RG	71	28	76	24	42	58	72	28	67	33	70	30	80	20	75	25	73	23
I feel safe in our RG	61	8	76	0	86	0	100	0	56	17	76	6	40	10	46	8	31	15
I feel safe in our RG just at daytime	30		24		7		0		22		12		50		46		54	
Our RG is a safe place for children	47	17	48	0	23	8	94	0	39	39	30	35	50	25	46	12	42	19
Our RG is clean, orderly and well kept	57	42	57	43	50	43	83	17	39	61	29	71	55	45	75	25	58	42
I like to watch animals in our RG	78	22	81	19	36	64	67	33	83	17	94	6	95	5	75	25	81	19
I enjoy the different plants/trees in our RG	91	9	100	0	93	7	94	6	83	17	82	18	90	5	83	17	96	4
I prefer the air in our RG to that indoors/ on the streets	80	20	86	14	43	50	78	22	72	28	82	18	90	10	79	21	92	8
Our RG is a quiet place within the city	84	14	90	10	71	29	94	6	94	0	59	41	80	15	87	13	92	8
I prefer the natural sounds of our RG to city sounds	91	5	90	0	64	0	83	17	100	0	100	0	90	5	100	0	92	4
Natural sounds are non-existent in our RG	5		10		36		0		0		0		0		0		4	
Overall perception of RG* (%±SD)	75 ± 15		80 ± 15		58 ± 24		86 ± 13		73 ± 21		75 ± 24		77 ± 22		76 ± 19		76 ± 22	

sunshine than younger residents. Older respondents indicated using RG significantly less often to meet neighbors, but were more often interested in gardening. Residents with a high school diploma and residents reported visiting public parks more often, and significantly more often used the RG for a walk during winter (Table 3).

Residents living alone stated significantly more often that their residential greenery is not well kept, clean and orderly (Table 3). Respondents who indicated visiting public parks at least four times a week stated significantly more often that their RG is well kept. Residents visiting public parks every two weeks or once a week and residents living in 2-person household stated significantly more often preferring the air in the RG compared to the air indoors or on the street. In addition, they experienced their RG more as a quiet place within the city compared to others. Those respondents who indicated never visiting public parks stated at least going to RG to enjoy the sun. Residents using public transportation experienced RG more as a quiet place compared to residents who mainly used cars or bicycles.

Of the respondents, 44 % indicated meeting neighbors or other people in the RG. There is no correlation between resident time and this purpose (Table 3). Residents using public transportation or bicycle and residents with dogs and those owning an allotment garden significantly more often met neighbors in the RG compared to those who mainly used cars for transportation, and those without dogs or allotment gardens. The RG was used by 12 % of all respondents for gardening activities. Only 10 of 100 percent of the respondents reported being inspired by RG for drawing, writing or music. Women, cyclists and the middle-aged (31–60 years old) significantly more often indicated using RG for creative purposes (Table 3).

3.3. Differences in use in the neighborhoods

RG use patterns differed between study sites (Table 2). In all sites, most respondents stated using the RG to get fresh air, although at Ideal-Passage/Neukölln about one-third of the residents did not. Residents of Haselhorst/Spandau, Ideal-Passage/Neukölln and Paul-Herz-Siedlung/ Charlottenburg went less often to their RG to escape heat or enjoy the sun. At all sites, respondents very rarely indicated doing gardening activities in their RG. The highest number of gardening activities were mentioned at Paul-Herz-Siedlung/Charlottenburg and Gropiusstadt/ Neukölln. Respondents did not use their RG in order to exercise, except in Gropiusstadt/Neukölln, where nearly half of them stated that they did so. At Sprengelkiez/Wedding and Alte Jakob Str./Mitte, a third of the respondents did exercise. The areas of Alte-Jakobstr./Mitte, Gropiusstadt/Neukölln and Marzahn had the highest proportion of respondents who indicated using the RG for walking and sitting, including during winter. Residents at Alte Jacob Str./Mitte most often indicated meeting neighbors or other people in their RG.

3.4. General perception of residential greenery

More than three quarters of all respondents perceived the RG positively, with 71 % feeling connected to their RG and even more that they spent healthy time there (79 %; Table 2). RGs were perceived as well kept, clean and orderly by 57 % of all respondents. People using cars

Table 3
Correlation between use and perception of Residential Greenery and resident characteristics by chi-squared test. P- value of Chi-square test is given as significant at 0.05 level are bold. χ^2, df and p-values are given in the Appendix D.

	Age	Gender	Education	Residential Time	Household	Having			Weekly Park Visits	Most used Method of Transportation
						Kid (s)	Dog (s)	Allotment garden		
Use RG to exercise	0.322	0.607	0.320	0.717	0.077	0.325	0.880	0.723	0.356	0.366
Use RG to walk and sit/ rest	0.579	0.799	**0.015**	0.354	0.074	0.721	0.708	0.960	0.092	0.790
Use RG in winter	**0.021**	0.837	**0.000**	0.052	0.061	0.559	**0.000**	0.401	**0.001**	0.294
Use RG to meet neighbors/people	0.251	0.124	0.057	0.358	0.192	0.633	**0.026**	**0.013**	0.809	**0.033**
Use RG to get creative inspiration	**0.017**	**0.044**	0.143	0.305	0.199	0.211	0.658	0.135	0.227	**0.000**
It feels healthy to spend time in RG	0.273	0.978	0.619	0.265	0.107	0.533	0.579	0.651	0.275	0.296
Feel connected to RG	**0.038**	0.665	0.497	0.308	0.154	0.192	0.514	0.171	0.603	**0.021**
Allergies because of plants in RG	**0.011**	0.275	0.800	0.717	0.159	0.798	0.083	0.357	0.327	0.205
Feeling safe in RG	0.639	0.345	0.250	0.756	0.712	0.141	0.926	0.232	0.150	0.089
RG is a safe place for children	0.088	**0.000**	**0.043**	0.111	0.165	nd	**0.004**	0.372	0.936	**0.002**
RG is well kept, clean and orderly	0.493	0.347	0.174	0.055	**0.046**	0.120	0.813	0.902	**0.037**	**0.034**
Watch animals in RG	0.618	0.171	0.524	0.574	0.638	0.124	0.317	0.249	0.847	0.991
Enjoy the different plants in RG	0.057	0.212	0.458	0.704	0.283	0.519	0.106	0.400	0.423	0.390
Come to RG to get fresh air	0.149	0.503	0.458	0.878	0.974	1.000	0.210	0.201	0.308	0.315
Prefer the air in RG	**0.009**	0.188	0.710	**0.027**	**0.003**	0.651	0.058	0.747	**0.023**	0.056
Experience RG as a quiet place	0.577	0.495	0.753	0.594	0.132	0.607	0.925	0.162	**0.032**	**0.011**
Prefer the natural sounds in RG	**0.004**	0.146	0.152	0.335	0.767	0.653	0.642	0.624	0.157	0.291
Use RG to escape the heat in summer	0.167	0.954	0.813	0.536	0.180	0.838	0.841	0.704	0.860	0.280
Come to RG to enjoy the sunshine	**0.028**	0.881	0.617	0.586	**0.034**	0.158	0.776	0.970	**0.004**	0.468
Use RG for gardening activities	0.421	0.138	0.928	0.109	0.584	0.631	0.103	0.400	0.228	0.265

perceived the RG as less well kept than residents using bikes or public transportation (Table 3). The air in the RG was preferred to that indoors or on the streets by 80 % of resident. Residents living alone more often indicated that their RG is not well kept, clean and orderly.

RG were experienced as calm places within the city by 84 %, 91 % preferred the natural sounds of the RG compared to other city sounds, 78 % indicated liking watching animals in their RG, and 91 % stated enjoying the different plants, flowers and trees. Allergies due to plants or grasses in their RG were reported by 17 % of the respondents. In terms of safety, 8% did not feel safe in their RG, nearly one-third indicated just feeling safe in the daytime, and 17 % felt that their RG was unsafe for children.

Our data also demonstrate differences in the perception of RG between respondents of different ages. Residents below the age of 20 years felt less connected than older residents (Table 3). Older respondents were more often concerned about safety for children, but perceived the RG as better kept and orderly than younger respondents. In addition, older people more often indicated preferring the natural sounds and fresh air of RG to other urban environments. Residents using cars or bikes felt more connected to their RG than residents who mainly used public transportation. However, the latter more often stated that RG is a safe place for children. In contrast, women and dog owners were more concerned about children's safety in the RG than men or residents without dogs (Table 3). Compared to others, respondents with university education were less concerned about children's safety.

Respondents were classified as 'Active Users' if they mentioned high scores for park visits, having children, dogs and allotment gardens, and as 'Passive users' if they had low scores for these uses. Some uses mentioned less often by 'Passive Users' included meeting people, escaping heat, exercising, getting creative and gardening. Both groups appreciated many features of RG such as use to get fresh air, to walk and to sit. Interestingly, 'Passive Users' scored the perception of some RG features better than 'Active Users', including the percentage who perceived the RG as safe, quiet and healthy places, which was higher than in the 'Active User' group. Both groups gave high scores to features related to nature. A higher percentage of 'Active Users' perceived the RG as clean, orderly and well kept.

Respondents were classified as 'Order Lovers' if they mentioned maintenance and order problems in their RG. Only few features of RG were mentioned differently by these groups: compared to other residents, 'Order Lovers' indicated meeting neighbors more often, and walk and sit in the RG. 'Order Lovers' also indicated feeling less safe and connected to their RG, evaluated their RG less often as a quiet place within the city, and were more concerned about children's safety (Table 4).

3.5. *Differences regarding perception by residents across the neighborhoods*

Perceptions of respondents contrasted in the dense block edge developments of the Wilhelminian era (Table 2), while the RG of the Sprengelkiez/Wedding was highly appreciated by local residents, the RG of the Ideal Passage/Neukölln more negatively perceived compared to other neighborhoods (e.g. regarding safety for children, orderliness). At Ideal Passage/Neukölln, around 40 % percent of the residents expressed concerns about the state of the art of the RG, half of the residents did not feel connected to the RG, although local residents generally felt safe and enjoyed the different plants in the RG. In the

Table 4
Use and perception of Residential Greenery by different User groups. For grouping procedure see Material and Method section.

Number of respondents	156	46	112	47	111
Percentage of positive responses	Overall	Active Users	Passive Users	Order lover	Others
I use our RG…	%				
to get fresh air	94	93	95	94	95
to walk/sit	65	65	65	70	65
to enjoy sun	61	65	59	70	57
to escape heat	53	61	50	64	49
in winter	48	57	45	57	45
to meet people	44	65	37	64	36
to exercise	20	39	15	24	20
for gardening	12	20	9	15	11
to get creative	9	15	6	13	7
Perception	%				
I enjoy the different plants/trees in our RG	91	91	91	85	94
I prefer the natural sounds of our RG to city sounds	91	93	90	87	94
Our RG is a quiet place within the city	84	80	87	79	87
It feels healthy to spend time in our RG	79	74	81	79	79
I like to watch animals in our RG	78	76	79	91	72
I feel connected to our RG	71	70	71	62	75
I feel safe in our RG	61	58	64	50	67
Our RG is clean, orderly and well kept	57	61	56	30	68
Our RG is a safe place for children	47	45	57	34	53

extremely well kept RG of the third neighborhoods from the Wilhelminian era (General Barby Siedlung/ Reinickendorf), surprisingly, few residents indicated using the facilities actively apart from short-term visits to get fresh air. Some older people talked about the nice appearance of their RG. Some residents rent small allotment gardens inside the RG to plant vegetables. As it has no public access, all respondents felt safe being in their RG.

At Alte Jakobstr./Mitte, Marzahn, Haselhorst/Spandau, Sprengelkiez/Wedding and Gropiusstadt/Neukölln, more than 80 % participants felt very healthy being outside in their RG. Only at Ideal-Passage did about two-thirds not feel healthy, and less than half of the respondents not feel connected to their RG. Participants felt most connected to their nearby RG at Alte-Jakobstr./Mitte and Paul-Herz-Siedlung/ Charlottenburg, and also at General Barby Siedlung/Reineckendorf and Sprengelkiez/Wedding. At Haselhorst/Spandau, Ideal-Passage/ Neukölln and Sprengelkiez/Wedding, the participants felt mostly safe. The highest number of respondents who stated not feeling safe was at Paul-Herz-Siedlung/Charlottenburg (17 %) and Gropiusstadt/Neukölln (15 %). At Gropiusstadt/Neukölln, Marzahn and Alte Jakob Str./Mitte, about half of the respondents indicated not feeling safe at night. Residents at Alte Jakob Str./Mitte reported problems with trash, open bins and rats and conflicts with visitors to a nearby techno-club.

Haselhorst/Spandau, Alte Jakob Str./Mitte and Paul-Herz-Siedlung/ Charlottenburg had more respondents who did not think their RG is a safe space for children than the other areas.

Respondents in most neighborhoods gave very contradictory answers about order and cleanliness of the residential greenery, with proportions of positive and negative assessments nearly equal (Table 2). Respondents at Haselhorst/Spandau and Paul-Herz-Siedlung/ Charlottenburg most frequently disagreed that their RG is well kept, whereas respondents of Marzahn and General Barby Siedlung/Reinickendorf mostly agreed.

In all areas, most people indicated watching animals and listening to natural sounds in their RG, except at Ideal-Passage/Neukölln, where 36 % of all participants indicated that there were no natural sounds in their RG (Table 2). Between 30 and 40 % of the respondents at Ideal-Passage/ Neukölln and Haselhorst/Spandau indicated not experiencing their RG as a quiet place within the city. In contrast to all other study sites, at Ideal-Passage, half of all participants did not prefer the air in their RG compared to that indoors or on the streets. Most people stated enjoying the different plants, trees and flowers.

The biggest problem reported in Paul-Herz-Siedlung/ Charlottenburg was the maintenance of the greenery. They were especially concerned about the overpopulation of wild rabbits (*Oryctolagus cuniculus* L.) in the area. In Haselhorst (Spandau), many residents were unhappy with the current situation in the neighborhood, complaining about criminal activities like car races and drug trafficking, and about the buildings. At the same time residents indicated that they felt that the RG is not well kept (Table 2).

Respondents in Marzahn and Gropiusstadt were satisfied with the current state of their RG, though safety problems at nighttime were reported.

3.6. Residents' suggestions

The demands mentioned most often were the need for more bins for trash, better maintenance of residential greenery, provision of more seating facilities and plants (see Appendix C). Problems with dog excrement were also mentioned often, as was the need to enlarge the area of residential greenery, especially in the block-edge developments of the Wilhelminian era. Residents of the Sprengelkiez/Wedding suggested including more bee-friendly plants or facade- and roof greening, wealthier houses, next to a canal.

4. Discussion

To our knowledge, this is the first study of the green on one's door step around the modernist housing complexes that provide living space for the vast majority of residents in many European cities. Residential greenery has been the only accessible green space for many residents in Europe during the Corona crisis, with strong restrictions on movement. And even outside the time of the pandemic, near-home green is important for less-mobile people, after-work recreation and the healthy development of children. Our results provide a clear indication that public parks, whose importance of is not disputed, play a very small role in the everyday life for the respondents, and consequently that studies that focus on health effects of public parks are of only limited significance and neglect crucial stakeholders of urban green: the housing and real estate companies.

The state of residential greenery - often pejoratively referred to as 'distance green' between buildings - is much better than its reputation. Though it is mostly seen as a cost item for the real estate management, our study demonstrates that the RG of the modernist housing complexes in Berlin is largely appreciated by local residents (Table 2). Our interviewees represent a typical cross-section of the population in Berlin (AfS, 2019; Table 1). The slight differences between the general educational pattern in Berlin and among our respondents are due mainly to more detailed micro-census data that are not suitable for a short interview. In general, the residents feel closely attached to the green structures around their houses (Table 2).

4.1. Long rental period- high place attachment?

The rental period in the investigated areas is twice as long compared to the average of 9 years in German cities with more than 100 thousand inhabitants (Table 1; Lebuhn et al., 2017). This can be seen as a proxy for high residential satisfaction with the living environment including the RG, that influence the migration behavior. Several studies provided evidence, that the urban green determine a higher residential satisfaction (e.g. Krekel et al., 2015; Bonaiuto and Fornara, 2017). However,

other factors are also influencing place attachment and low mobility (Chen et al., 2019). In general, long rental periods in Germany are related to the tenancy law that enforces unlimited contracts so people can live permanently in an apartment, if they feel positive about it. People's mobility is regularly related to the educational and family formation phase (Lebuhn et al., 2017) and, in the later life phase, related to partnership disruptions, residential adaptation or health (Winke, 2017). Residential mobility can affect health, although there is conflicting evidence about how, why and when mobility matters (reviewed by Morris et al., 2018).

As a result of the rising population and the neoliberal housing policies of the 1990s and 2000s, which lead to a lack of new residential construction and growing real estate speculation, the Berlin housing market is under great strain (Möbert, 2019). Even though the rising rents for new rentals in the last decade tie tenants to existing rental agreements, our data indicates at least partially that residents are satisfied with their living environment including the RG and their suggestions refer to minor issues, such as demands for more trash bins or banks (Appendix C).

Residents' satisfaction with their urban environment may be associated with health status indicators such as lower levels of residents' mortality (e.g. Ribeiro et al., 2018). The interplay between social cohesion, disorder and the perception of lack of safety is decisive for health (Ruijsbroek et al., 2016).

4.2. Oasis of peace or active place to meet others?

Three quarters of our respondents perceived RG as calm and safe places to be outside and to come in contact with nature (Table 2,3). In addition, the RG was indicated as being used to meet other people by 44 %, twice as many as in the case of urban parks (Chiesura, 2004).

Surprisingly, though much effort has been dedicated to park maintenance in Berlin (SenUVK, 2018), 60 % of the residents interviewed in our study did not or rarely visited public parks (Table 1). To date, research has mainly highlighted the needs and activities of park visitors (e.g. Chiesura, 2004; Bertram and Rehdanz, 2015; Vierikko et al., 2020), but not of those neighbors who do not visit public parks. More attention is needed to identify obstacles and barriers to the use of public green by the majority of local residents even when large amounts of public resources are directed to these areas. Park visitors stated more often that their RG is well kept (Table 3). The baseline of judgement differs among respondents with different perspectives of their city (see also differences in regard with mode of transportation across the city, below). Respondents with more experiences of urban green perceived the RG more positively than others. However, our results underline the importance of the semi-public green spaces on one's door step for daily use and contact, which are crucial for a vital neighborhood, at least for those who want to stay socially connected with neighbors (Table 2). Rather than objective safety, perceived neighborhood safety and social environment have a larger impact on well-being and health (Polling et al., 2014; Ruijsbroek et al., 2016). Health-supportive physical environments foster the social capital of the places and reduce social inequalities (Mitchell and Popham, 2008).

In our study, passive uses such as getting fresh air, walking and sitting, and enjoying the sun dominated compared to more active use modes such as physical activities or gardening (Table 2). These motivations were also reported for urban parks (Chiesura, 2004), motivations can be manifold and can vary between cities (Vierikko et al., 2020). Residents who meet neighbors more often have dogs and an allotment garden than those who did not indicate meeting neighbors. There is a Berlin saying: 'If you want to get to know your neighbors, get a dog.' Children and dogs can be seen as 'contact assets', affecting residents' experience of being familiar within a neighborhood (e.g. Blokland and Nast, 2014). Compared to 'Passive Users', 'Active Users' perceived the RG as less safe and quiet, but more often as clean, orderly and well kept (Table 4). They mentioned unused potentials of the open spaces, demanded more opportunities to use it, and requested more benches, tables and places for gardening (Appendix C). These contrasting results underline that perception during active use or by 'Active Users' differs from the perception during passive use or by 'Passive Users'. Individual perceptions of people living in the same neighborhood determine the impact of well-being and need to be addressed by measures to foster physical activities. There is evidence that the access to smaller green spaces such as 'pocket parks' do not foster the level of physical activities such as recreational walking compared to local medium size parks (e.g. Giles-Corti et al., 2005; Christian et al., 2017). Fostering physical activities requires the creation of more walkable communities through provision of stimulating features such as walking and cycling routes, pleasant views, neighborhood esthetics, lights or bike rack (Schipperijn et al., 2013; Christian et al., 2017). Transport walking, to get to or from somewhere, and recreational walking, for health or fitness purposes, are linked to distinct behaviors and impacted by different neighborhood features (Giles-Corti et al., 2013). In general, more urban green was associated with more sports and cycling. Nature has the ability to encourage the use of outdoor spaces and promote the development of social ties among neighbors (Coley et al., 1997). In our study, only in Gropiusstadt/Neukölln, a higher proportion of respondents is doing exercises in their RG, i.e. many participants use their bicycles. Cycling friendly green corridors connect this neighborhood to nearby shopping facilities, schools and a nearby park and forest. motivation to be physically active and the welcoming qualities of RG can be enhanced by structural elements such as bike racks, barefoot paths or sport devices, although these may also contribute to noisier surroundings. Measured noise levels, presence of noisy neighbors, and building characteristics influence the self-reported perception of noise by residents (Koprowska et al., 2018). Generationally-adapted needs should to be considered (Hogan et al., 2016). In our study, residents expressed high motivation to engage in gardening in their neighborhoods. To overcome the gap between existing knowledge gained through research and practical interventions to foster health impacts on neighborhood level, there is an urgent need to directly involve local stakeholders (Frerichs et al., 2019).

4.3. Car drivers versus users of public transportation

Public transportation was the dominant transport mode of our respondents (Table 1). Overall, 40 % of Berliners use public transport on the way to work, 40 % use cars, and 15 % walk or ride a bicycle (AfS, 2019). Respondents in the inner-city neighborhoods used bicycles more often (Appendix B). Cycling predominates at distances less than five kilometers (AfS, 2019).

The interrelations between perception of the urban environment and transport mode have been little studied so far. In addition to the effect of number of park visits on the assessment of RG, our data show that perception of RG strongly depends on mode of transportation used by the residents. Travel mode choice is influenced by attitudes toward travel time, cost, comfort, convenience, safety and flexibility of public transportation and by environmental concerns (Gatersleben and Uzzel, 2007; Vredin Johansson et al., 2006). In our study, car drivers perceived the RG as better kept but not as calm, and felt more connected to their RG than residents who use public transportation. The latter perceive the city differently from car drivers and value RG as calm and safe places. Car users are typically more distant from their social environment and have less detailed information of that situation than cyclists and pedestrians (Gatersleben et al., 2013). Consequently, residents have different baselines for assessing RG depending on their perspective and experience of the urban environment. People who use public transportation may have a more holistic perspective of the city, other citizens and neighborhoods, due to, for instance, meeting people in the public and also due to exploring spaces between different destinations compared to car drivers, who travel in their privately-owned car space.

4.4. What you see depends on how you see

The residents benefit psychologically from the RG's attractive appearance (Chang et al., 2008). However, about design of urban green can be excellently argued (see 'Urban Devotees' versus 'Wilderness Enthusiasts' in Weber et al., 2014). Respondents who were dissatisfied with the RG often complained about garbage, noise, disorder and unkemptness. We grouped these people as 'Order Lovers', referring to both physical and social disorder such as nuisance from other neighbors or passersby. We identified 'Order Lovers' in all generations. They more often indicated using RG, especially to meet people, but less often indicated perceiving the RG as a quiet place, and feeling connected and safe in them, compared to the 'Others' (Table 4). Perceived safety and social cohesion in the neighborhood are associated with self-rated health, quality of life and overall well-being (Ruijsbroek et al., 2016). Residents who perceived their neighborhoods as unsafe often have a negative attitude toward physical activity, so enhancing social cohesion increases physical activities in a wide range of communities (Kosoko--Lasaki et al., 2019).

4.5. Neighborhood: small home or hell in the big city

Berlin is famous as the city of diverse neighborhoods, 'Kieze', fragmented urban spaces that can be understood as 'urban villages' with local social networks within the anonymous city (e.g. Vogelpohl, 2008). In them, people construct belonging through daily routines and everyday encounters such as shopping in the bakery or visiting the playground with children (e.g. Blokland & Nast 2014). To this, the RG add spots of color.

Though buildings structures belong to the same era, each of the neighborhoods in this study developed RG with individual characteristics, challenges and opportunities. Our study demonstrated that the residential greeneries are largely diverse. Even within the same building type, similarity is low. Although RG was determined by an architectural design and plant use created during the building of the houses, RG was often shaped by numerous actors, from the gardeners of the housing management to formative appropriation by resident. We found neither common design nor maintenance practices (Battisti et al., 2019). Moreover, requirements and suggestions of the residents are diverse and can result in conflicts about preferences, e.g. between 'Active' and 'Passive' users, between generations or residents with or without children (Table 4). This is a daily challenge to negotiated by residents and housing companies using multi-perspective and stakeholder approaches of co-creation. Co-design, co-creation and co-maintenance of residential greenery are promising processes for inclusive neighborhood-transitioning linked to experimentation, innovation and collaboration based on the local community of knowledge and practice. Neighbors and the housing companies are eager to participate in this open-ended process to create multifunctional residential greenery adaptative to existing and future challenges.

4.6. Attachment to place, not to people?

A third of our respondents lived alone (Table 1); less than in the whole city of Berlin, where every second inhabitant lives alone (AfS, 2019). Loneliness in urban societies is attributed to the erosion of the social tissue and the absence of spaces for co-existence, an issue that has received recently more attention in public health and urban planning (e.g. Ruijsbroek et al., 2016; Van den Berg et al., 2019). Loneliness, defined as a mismatch between perceived and desired level of social relation, makes people susceptible to illness and promotes overuse of medical services (Perlman and Peplau, 1981). In our study, the majority do not use RG to meet neighbors (Table 3). Singles more often indicated that their RG is not well kept, clean and orderly, so there may be a lack of neighborhood trust. Social isolation and place belonging are strong predictors of stress and negative health impacts (Roe et al., 2016; Ward Thomson et al., 2016). The high level of satisfaction with the RG, combined with low active and communicative use behaviors in the RG demonstrate the dominant role of attachment to place compared to social interactions in the neighborhood. However, as isolation and loneliness are not topics that are freely admitted to to oneself, and even less in an interview to an unknown person, they may have been underestimated in our study. If experiencing neighborhood belonging is determined by attachment to place (i.e. feel familiar within a neighborhood, the so-called 'comfort zone' or 'public familiarity'), but not to people (i.e. being connected with neighbors), urban planning interventions to encourage inclusive community development need to change (e.g. Blokland and Nast, 2014).

5. Conclusions

Our study provides insight for policy and planning on health relevant ecosystem services, on the use and perception of residential greenery, an important element of the urban green, that has been regularly overlooked in scientific studies and in policy and planning strategies that up to now focus mainly on public green and therefore on the action fields of public administration bodies. Through this research, we include the relevant stakeholders of semi-public green spaces, such as the different organizations of real estate management and housing sector, in the debate on policies to mainstream measures to foster health relevant ecosystem and environmental justice. This is necessary as the transformation of our cities into livable, healthy and ecologically just places must take place in public and private parts of the urban matrix, especially in areas of residential greenery that are often freely accessible.

Residential greenery (RG) is highly appreciated by the local residents and a key element of place attachment in the neighborhood. Passive uses dominate active uses. The potential of RG for health-supporting physical activities are underused and can be promoted through low cost interventions. Multifunctionality of residential greenery needs to address changing needs and diverse demands across cultures, generations and preferences. These have to be negotiated inclusively among all neighbors. The challenge is that more than the half of our respondents voluntarily or involuntarily do not use the RG to be socially connected. Improving use patterns among residents can encourage mingling between different groups and stimulate social cohesion. RG is currently mostly designed and maintained in top down processes by the real estate management. Neighbors observe, sometimes complain, but are also willing to participate actively in these processes (Appendix C). Co-creative appropriation of the green on one's door step, increasing environmental awareness and do-it-yourself movements only have winners: the housing associations save on maintenance costs and have satisfied tenants, who in turn identify with their surroundings and establish neighbor networks for the benefit of all. If people negotiate their green spaces to be more inclusive and healthier and thus move on from attachment to place towards social belonging amongst neighbors, the residential greenery can be the social tissue, especially in so-called 'disadvantaged' neighborhoods.

CRediT authorship contribution statement

Ina Säumel: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing - review & editing. **Jan Hogrefe:** Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing - original draft. **Luca Battisti:** Supervision, Methodology, Writing - review & editing. **Thomas Wachtel:** Methodology, Writing - review & editing. **Federica Larcher:** Writing - review & editing.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A

Questionnaire

1. To what extend do the following statements apply to you?

	Strongly disagree	Somewhat disagree	Pretty much true	Completely true
I come to our residential greenery in order to exercise	☐	☐	☐	☐
I walk and sit in our residential green (e.g. reading/watching)	☐	☐	☐	☐
During the winter I also use the residential greenery to be outside.	☐	☐	☐	☐
I use our residential greenery as spaces to meet people/neighbours	☐	☐	☐	☐
I come to our residential greenery to get creative inspiration (e.g. drawing/ writing/ music)	☐	☐	☐	☐
It feels healthy to be outside in our residential greenery	☐	☐	☐	☐
I feel connected to our residential greenery	☐	☐	☐	☐

2. Do you have allergies because of the plant and grasses in your residential greenery?
☐ yes☐ no☐ I don't know
3. Do you feel safe when you use your residential greenery? (also at night)
☐ yes☐ no☐ just in daytime
4. Is your residential green also a safe space for children?
☐ yes☐ no☐ I don't have children
5. Is your residential greenery well kept, clean and orderly?
☐ yes☐ no
6. Do you like to watch animals in your residential greenery?
☐ yes☐ no
7. Do you enjoy the different plants/trees/flowers in your residential greenery?
☐ yes☐ no
8. Do you go to your residential greenery to get fresh air?
☐ yes☐ no
Do you prefer the air in your residential greenery to that indoors or on the streets?
☐ yes☐ no
Do you experience your residential greenery as a quiet place within the city?
☐ yes☐ no
Do you prefer the "natural sounds" in your residential greenery to the city sounds?
☐ yes☐ no☐ there are no "natural sounds"
In Summer, do you come to your residential greenery to escape the heat?
☐ yes☐ no
Do you come to your residential greenery to enjoy the sunshine?
☐ yes☐ no
Do you use your residential greenery for gardening activities ?
☐ yes☐ no
Is there anything that bothers you or that you would like to change in your residential greenery?
Finally, we ask for some information about yourself.
These details remain anonymous and answering these questions is voluntary. For the quality of our study, we would be grateful if you provide as complete information as possible.

Your Gender: ☐ female ☐ male ☐ no information
Your Age: ☐ 10−20 ☐ 20−30 ☐ 30−60 ☐ >60
Highest education level: _____
How long have you lived in this area? _____ year(s)
How many people do you live with? ☐ 1 ☐ 2 ☐ more
Do you have dogs? ☐ yes ☐ no
Do you have an allotment garden? ☐ yes ☐ no
How many times a week do you use public parks? _____ time(s)
Which mode of transport do you use the most? _____
Thank you for your participation!
If you would like to be informed about the results of the study, please enter your email address below. E-Mail:
_____

Appendix B

Characteristics of respondents per study area (N=158)

Building type		Block-edge development 1870s–1920s		1920s–1940s	Row-building settlements 1920s–1970s			Large housing estates 1970s–1980s	
Suggestions	Overall	Sprengelkiez. Wedding	Ideal-Passage. Neukölln	General Barby Siedlung Reinickendorf	Paul-Herz-Siedlung. Charlottenburg	Haselhorst. Spandau	Alte-Jakobstr. Mitte	Marzahn	Gropiusstadt. Neukölln
Male/female ratio	1.3	0,5	1.0	2.0	2.6	1.1	3.0	0.7	1.3
Main Age Category	31–60a	31–60a	31–60a	31–60a	31–60a	31–60a	31–60a	31–60a	31–60a
Main Education level	2.8±1.1	4±0.6	3.8±0.4	3.8±0.4	2.5±1.2	2.0±0.7	2.7±1.1	2.3±1.1	2.9±1.1
Average residential time	18±16	13±10	6±8	20±15	21±20	18±16	23±16	15±15	24±17
Number of persons per household	1.9±0.8	1.7±0.9	1.8±1	1.7±0.5	2±0.8	1.6±0.6	2.2±0.7	2.3±0.8	2.0±0.7
Having children	0.7	0	0.1	0.2	0.3	0.2	0	0.2	0.2
Having dogs ratio	0.1	0.5	0.4	0.9	0.8	0.8	0.8	0.6	0.6
Having Allotment Garden ratio	0.1	0.1	0.1	0.2	0.2	0.2	0.0	0.2	0.2
Weekly Park visits	1.7±1.9	2.5±2.2	2.7±1.5	1.0±1.3	1.7±1.8	1.1±1.1	1.5±1.8	1.1±1.5	2.3±2.5
Public transport	0.5	0.4	0.6	0.4	0.5	0.6	0.7	0.5	0.6
Car	0.2	0.1	0.1	0.6	0.3	0.2	0.1	0.3	0.2
Cycling	0.2	0.5	0.4	0	0.2	0.1	0.3	0.2	0.2

Appendix C

Resident's main suggestions (summarized numbers of mostly indicated dissatisfactions for each area)

Building type		Block-edge development 1870s–1920s		1920s–1940s	Row-building settlements 1920s–1970s			Large housing estates 1970s–1980s	
Suggestions	Overall	Sprengelkiez. Wedding	Ideal-Passage. Neukölln	General Barby Siedlung Reinicken-dorf	Paul-Herz-Siedlung. Charlottenburg	Haselhorst. Spandau	Alte-Jakobstr. Mitte	Marzahn	Gropiusstadt. Neukölln
More trash bins	35	8	3	1	2	4	11	1	5
Enhance maintenance	13	1	2	1	1	3	3	2	–
More banks	11	2	1	–	–	2	1	4	1
More plants	8	2	1	–	3	1	–	1	–
Solutions to dog excrement	6	–	1	–	–	1	2	1	1
Enlarge size of RG	5	1	4	–	–	–	–	–	–
Reduce noise	3	–	–	2	–	–	–	–	1

Appendix D

Correlation between resident characteristics. use and perception of Residential Greenery by chi-squared test. df and p-values are given.

	Age			Gender			Education			Residential Time			Household		
	x^2	df	p	x^2	df	p	x^2	df	p	x^2	df	p	x^2	df	P
Use RG to exercise	10.363	9	0.322	1.838	3	0.607	13.706	12	0.320	6.231	9	0.717	11.394	6	0.077
Use RG to walk and sit/rest	7.557	9	0.579	1.009	3	0.799	24.988	12	0.015	9.953	9	0.354	11.507	6	0.074
Use RG in winter	19.537	9	0.021	0.854	3	0.837	51.842	12	0.000	16.802	9	0.052	12.066	6	0.061
Use RG to meet neighbors/people	11.380	9	0.251	5.767	3	0.124	20.599	12	0.057	9.906	9	0.358	8.679	6	0.192
Use RG to get creative inspiration	20.112	9	0.017	8.111	3	0.044	17.190	12	0.143	10.583	9	0.305	8.567	6	0.199
It feels healthy to spend time in RG	11.034	9	0.273	0.200	3	0.978	9.970	12	0.619	11.165	9	0.265	10.436	6	0.107
Feel connected to RG	17.758	9	0.038	1.576	3	0.665	11.376	12	0.497	10.541	9	0.308	9.358	6	0.154
Allergies because of plants in RG	16.667	6	0.011	2.579	2	0.275	4.597	8	0.800	3.702	6	0.717	6.593	4	0.159
Feeling safe in RG	4.281	6	0.639	2.128	2	0.345	10.214	8	0.250	3.411	6	0.756	2.130	4	0.712
RG is a safe place for children	10.999	6	0.088	22.614	2	0.000	15.975	8	0.043	10.350	6	0.111	6.498	4	0.165

(continued on next page)

(*continued*)

RG is well kept. clean and orderly	2.401	3	0.493	0.883	1	0.347	6.353	4	0.174	7.592	3	0.055	6.167	2	0.046
Watch animals in RG	1.786	3	0.618	1.873	1	0.171	3.205	4	0.524	1.992	3	0.574	0.900	2	0.638
Enjoy the different plants in RG	7.521	3	0.057	1.561	1	0.212	3.634	4	0.458	1.405	3	0.704	2.522	2	0.283
Come to RG to get fresh air	5.335	3	0.149	0.448	1	0.503	3.634	4	0.458	0.680	3	0.878	0.053	2	0.974
Prefer the air in RG	11.501	3	0.009	1.732	1	0.188	2.140	4	0.710	9.197	3	0.027	11.475	2	0.003
experience RG as a quiet place	1.977	3	0.577	0.467	1	0.495	1.908	4	0.753	1.896	3	0.594	4.045	2	0.132
Prefer the natural sounds in RG	18.868	6	0.004	3.842	2	0.146	11.985	8	0.152	6.849	6	0.335	1.828	4	0.767
Use RG to escape the heat in summer	5.068	3	0.167	0.003	11	0.954	1.577	4	0.813	2.282	3	0.536	3.430	2	0.180
Come to RG to enjoy the sunshine	9.067	3	0.028	0.022	1	0.881	2.653	4	0.617	1.937	3	0.586	6.751	2	0.034
Use RG for gardening activities	2.815	3	0.421	2.201	1	0.138	0.876	4	0.928	6.057	3	0.109	1.077	2	0.584

	Having children			Having Dog(s)			Having an Allotment Garden			Weekly Park Visits			Most used Method of Transportation		
	x^2	df	p	x^2	df	p	x^2	df	p	x^2	df	p	x^2	df	P
Use RG to exercise	3.584	3	0.325	0.673	3	0.880	1.327	3	0.723	9.931	9	0.356	6.536	6	0.366
Use RG to walk and sit/rest	1.402	3	0.721	1.1388	3	0.708	0.301	3	0.960	14.944	9	0.092	3.151	6	0.790
Use RG in winter	0.924	3	0.559	20.875	3	0.000	2.937	3	0.401	29.598	9	0.001	7.298	6	0.294
Use RG to meet neighbors/people	1.779	3	0.633	9.256	3	0.026	10.700	3	0.013	5.284	9	0.809	13.711	6	0.033
Use RG to get creative inspiration	4.904	3	0.211	1.604	3	0.658	5.567	3	0.135	11.757	9	0.227	32.435	6	0.000
It feels healthy to spend time in RG	2.076	3	0.533	1.967	3	0.579	1.635	3	0.651	11.007	9	0.275	7.280	6	0.296
Feel connected to RG	4.445	3	0.192	2.290	3	0.514	5.014	3	0.171	7.329	9	0.603	14.924	6	0.021
Allergies because of plants in RG	0.994	2	0.798	4.966	2	0.083	2.060	2	0.357	6.929	6	0.327	5.929	4	0.205
Feeling safe in RG	3.875	2	0.141	0.153	2	0.926	2.921	2	0.232	9.441	6	0.150	8.072	4	0.089
RG is a safe place for children	nd	nd	nd	10.947	2	0.004	1.980	2	0.372	1.820	6	0.936	16.633	4	0.002
RG is well kept. clean and orderly	2.53	1	0.120	0.056	1	0.813	0.015	1	0.902	8.455	3	0.037	6.790	2	0.034
Watch animals in RG	2.53	1	0.124	1.000	1	0.317	1.331	1	0.249	0.812	3	0.847	0.18	2	0.991
Enjoy the different plants in RG	0.660	1	0.519	2.612	1	0.106	0.707	1	0.400	2.801	3	0.423	1.885	2	0.390
Come to RG to get fresh air	1	1	0.0	1.568	1	0.210	1.639	1	0.201	3.597	3	0.308	2.311	2	0.315
Prefer the air in RG	0.300	1	0.651	3.603	1	0.058	0.104	1	0.747	9.491	3	0.023	5.748	2	0.056
Experience RG as a quiet place	0.412	1	0.607	0.009	1	0.925	1.960	1	0.162	8.803	3	0.032	8.947	2	0.011
Prefer the natural sounds in RG	0.253	2	0.653	0.887	2	0.642	0.943	2	0.624	9.310	6	0.157	4.963	4	0.291
Use RG to escape the heat in summer	0.05	1	0.838	0.040	1	0.841	0.145	1	0.704	0.756	3	0.860	2.546	2	0.280
Come to RG to enjoy the sunshine	2.357	1	0.158	0.081	1	0.776	0.001	1	0.970	13.148	3	0.004	1.518	2	0.468
Use RG for gardening activities	0.426	1	0.631	2.664	1	0.103	0.709	1	0.400	4.329	3	0.228	2.653	2	0.265

Appendix E. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ufug.2020.126949.

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