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# Urban residents' beliefs concerning green space benefits in four cities in France and Portugal

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ABSTRACT

Understanding how urban residents rate the benefits associated with urban green spaces is crucial in developing appropriate urban green infrastructure strategies. This study explores residents' beliefs concerning the benefits of urban green spaces and investigates whether similarities and differences can be highlighted in four different French and Portuguese urban areas (Paris, Angers, Lisbon and Porto) through a questionnaire survey ($n = 1000$) based on the best–worst scaling (BWS) method. The results demonstrated that urban green space benefits are not equally valued among cities, suggesting that there is simultaneously a consensus among the most and least valued benefits across cities, as well as local variations in city residents' beliefs about some other benefits of urban green spaces. For example, the importance of urban green spaces for personal health and well-being and to facilitate contact with nature were noted by residents of all four urban areas; consensus also exists on the little support given to two microclimatic functions of green spaces, namely, air temperature reduction and noise reduction. On the other hand, some green space benefits, such as the promotion of biodiversity or the contribution to the city image, are differentially valued among the four cities. Overall, the study stresses the importance of developing local assessments of the beliefs surrounding the benefits of urban green spaces. Recognizing these multiple beliefs and communicating clearly about the benefits offered by green spaces may help to mitigate future conflicts between residents and urban planners and managers, and thus contribute to optimizing green infrastructure planning benefits.



## Introduction

The concept of green infrastructure has emerged in the last few decades and has been gaining popularity in planning theory and policy. Various definitions and interpretations of green infrastructure are now in circulation, reflecting the ambiguity of a concept that is evolving between environmental theory and socio-economic policy (Wright, 2011). Despite the difficulty in achieving a single definition of green infrastructure, it is possible to identify its underlying principles, namely, the notions of connectivity and multifunctionality (Ahern, 2013; Madureira and Andresen, 2014; Newell et al., 2013; Roe and Mell, 2013; Wright, 2011).

The multifunctionality principle of green infrastructure has been considered one of the concept's key attractions (Ahern, 2013; Roe and Mell, 2013; Science for Environment Policy, 2012). In fact, by performing several functions and providing several benefits in the same spatial area, multifunctional green infrastructures can contribute to the achievement of a number of urban policy aims and fulfill the needs of a variety of stakeholder groups (Ahern, 2013; European Environment Agency, 2012).

This increasing interest in the multifunctionality principle of urban green infrastructures follows a growing realization of the multiple functions provided by urban green spaces. Green spaces are the key component of urban green infrastructures, and in fact, a broad swath of studies have been produced about green spaces' potential functions, benefits or values (James et al., 2009), all of which are designations that we consider as synonyms in this paper

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(Peckham et al., 2013). As part of the urban ecosystem, urban green spaces perform diversified functions and are appreciated for their environmental, amenity, psychological and health benefits. The environmental functions of urban green spaces include, for instance, support for urban biodiversity (Kattwinkel et al., 2011), carbon dioxide ($CO_2$) sequestration (Liu and Li, 2012), noise attenuation (Pathak et al., 2011), local climate stabilization via air filtration (Jim and Chen, 2008) and the reduction of urban air temperature (Gill et al., 2007; Schwarz et al., 2011), which is particularly important for mitigation strategies of urban heat island effects. Urban green spaces also offer potential social and cultural benefits. They are important in cities due to the opportunities they provide for people to come into contact with nature and with each other (James et al., 2009). Urban green spaces contribute to the improvement of health and well-being (Tzoulas et al., 2007) through atmospheric pollution reduction, the facilitation of physical exercise (Cohen et al., 2007) and the promotion of mental wellness (Tyrväinen et al., 2014). Moreover, they offer recreational benefits encompassing active and passive activities (Tzoulas and James, 2010) and act as meeting places for local residents, supporting neighborhood social interactions (Kamierczak, 2013). Furthermore, urban green spaces provide esthetic contributions to cities' images by expressing values, beliefs and cultural trends in urban societies (James et al., 2009).

Despite the general agreement on the importance of all these benefits and the increasing popularity of the principle of multifunctional green infrastructures, some concerns and criticisms have been expressed in recent years about the applicability of multifunctionality. One of these criticisms focuses on the general belief that multifunctionality is straightforwardly achieved by green infrastructure promotion, without the need to make choices among functions, as if green infrastructure has the intrinsic ability to 'provide it all' (Science for Environment Policy, 2012) or 'have it all' (Horwood, 2011). Even with the increasing awareness that some functions may come into conflict with one another and may not be simultaneously fulfilled (Horwood, 2011; Madureira and Andresen, 2014; Roe and Mell, 2013), green infrastructure policies typically remain attached to a general listing of green space functions and benefits, without making any inventory of differing levels of priorities (Horwood, 2011).

These criticisms have thus been accompanied by demands for approaches that consider the principle of multifunctionality as a stage to be accomplished through a decision-making process in which we necessarily make choices among functions (Madureira and Andresen, 2014). Thus, an evidentiary basis should be defined to inform the necessary people about the relevance and prioritization of green infrastructure functions and to support the decision making process. This evidentiary basis certainly depends on the assessment of the multiple green infrastructure functions in a correct, understandable and easily repeatable way (Vandermeulen et al., 2011). Moreover, it also depends on the assessment of people's opinions about green infrastructure values. In fact, the failure to address people's beliefs about green infrastructure values may generate conflicts between residents, planners, and managers (Eriksson et al., 2012).

Because urban green spaces, as core components of green infrastructures, may hold different values for people depending on their different social, cultural, environmental and economic contexts, it is furthermore important to assess people's beliefs about the functions of urban green spaces. Previous studies conducted in different cities show that urban residents evaluate the benefits associated with urban green spaces. While using different methodologies, this set of studies provides information on how the values associated with green spaces are evaluated in worldwide urban contexts. For example, studies conducted in cities in the United States (Lohr et al., 2004) and New Zealand (Vesely, 2007), Bari (Sanesi and Chiarello, 2006), Helsinki (Tyrväinen et al., 2007) Hong Kong (Lo and Jim, 2012) and Guangzhou (Jim and Shan, 2013) used questionnaire surveys to assess the benefits related to urban green spaces, while others focused specifically on urban forests (Eriksson et al., 2012; Peckham et al., 2013). These studies, however, have mainly been developed using a single city as case study or focusing on a particular national context. A comparative review of these studies' results reveals some inconsistencies between the rated benefits, suggesting the need for further research into values associated with urban green spaces.

**Table 1**
Resident population in the four urban agglomerations (Source: Insee, 2011; INE, 2011).

| Urban Area, Country | | Population |
|---|---|---|
| Paris | France | 12,223,100 |
| Lisbon | Portugal | 2042,477 |
| Porto | Portugal | 1287,282 |
| Angers | France | 397,435 |

The present research explores urban residents' beliefs about the benefits of green spaces and investigates whether similarities and differences can be highlighted in four different urban areas. We therefore tested two complementary hypotheses: (1) green space benefits are equally rated among the four urban areas; (2) green space benefits ratings differ according to national context or the dimension of the urban area. We used the best–worst scaling (BWS) method to compare the samples from four urban areas with different dimensions and from two different national contexts (Table 1): Paris and Angers from France and Lisbon and Porto from Portugal.

## Methods

### *Questionnaire design*

For the purposes of this study, a three-part questionnaire was developed. The questionnaire was prefaced by an explanation of the purpose of the study and a statement about the meaning of urban green spaces: "urban green spaces are public or private vegetated areas located within built-up areas, including natural and planted trees, grass, shrubs and flowers." The term "urban green spaces" was used to avoid any confusion about the interpretation "green infrastructure". The first part of the survey included questions about socio-demographics (age, gender, income, education, parenthood, and place of residence). The second part included questions about the global perception of the city's green spaces, namely, overall satisfaction with the city's green spaces, overall satisfaction with green spaces close to the respondent's residence, the walking time to reach the nearest public park from the respondent's home and work, and the frequency of visiting public parks. The third and main part of the survey measured the importance the respondents attributed to green space benefits. The BWS method, described below, was used for this purpose. Ten green space benefits referenced broadly in the literature were selected, reflecting a balanced distribution among social benefits (contact with nature, opportunities for outdoor sport and recreation, enhance health and well-being, enhance neighbor–social interaction, city image enhancement) and environmental benefits (diminution of urban air pollution, diminution of urban air temperature, carbon dioxide sequestration, biodiversity promotion, noise reduction).

### *Best–worst scaling methodology*

The BWS method has become a popular method in studying how important a particular issue is to an individual or group of individuals relative to other issues under consideration (Burke et al., 2013). BWS was introduced by Finn and Louviere (1992), who used

**Table 2**
Socioeconomic characteristics of respondents.

| Variables | | Sample (%) | | | |
|---|---|---|---|---|---|
| | | Paris | Angers | Lisboa | Porto |
| Age | 15–24 | 16 (6.4%) | 33 (13.2%) | 5 (2%) | 31 (12.4%) |
| | 25–34 | 72 (28.8%) | 74 (29.6%) | 51 (20.4%) | 47 (18.8%) |
| | 35–44 | 57 (22.8%) | 64 (25.6%) | 105 (42%) | 58 (23.2%) |
| | 45–54 | 50 (20%) | 42 (16.8%) | 44 (17.6%) | 57 (22.8%) |
| | 55–64 | 41 (16.4%) | 29 (11.6%) | 28 (11.2%) | 36 (14.4%) |
| | ≥65 | 14 (5.6%) | 8 (3.2%) | 17 (6.8%) | 21 (8.4%) |
| Gender | Male | 119 (47.6%) | 114 (45.6%) | 107 (42.8%) | 102 (40.8%) |
| | Female | 131 (52.4%) | 136 (54.4%) | 143 (57.2%) | 148 (59.2%) |
| Monthly income (euros) | <1.000 | 24 (9.6%) | 41 (16.4%) | 71 (28.4%) | 100 (40%) |
| | 1.000–1.500 | 26 (10.4%) | 33 (13.2%) | 66 (26.4%) | 66 (26.4%) |
| | 1.500–2.000 | 53 (21.2%) | 58 (23.2%) | 58 (23.2%) | 52 (20.8%) |
| | 2.000–2.500 | 44 (17.6%) | 55 (22%) | 27 (10.8%) | 19 (7.6%) |
| | 2.500–3.000 | 45 (18%) | 27 (10.8%) | 15 (6%) | 5 (2%) |
| | ≥3.000 | 58 (23.2%) | 32 (12.8%) | 9 (3.6%) | 6 (2.4%) |
| | No answer | 0 (0%) | 4 (1.6%) | 4 (1.6%) | 2 (.8%) |
| Education level | Basic education | 3 (1.2%) | 2 (.8%) | 2 (.8%) | 1 (.4%) |
| | Incomplete secondary education | 8 (3.2%) | 14 (5.6%) | 6 (2.4%) | 13 (5.2%) |
| | Complete secondary education | 16 (6.4%) | 23 (9.2%) | 21 (8.4%) | 27 (10.8%) |
| | Technological courses | 6 (2.4%) | 7 (2.8%) | 10 (4%) | 10 (4%) |
| | University and higher | 217 (86.8%) | 204 (81.6%) | 211 (84.4%) | 199 (79.6%) |
| Occupation | Entrepreneur | 4 (1.6%) | 3 (1.2%) | 10 (4%) | 13 (5.2%) |
| | Self-employed | 30 (12%) | 19(7.6%) | 26 (10.4%) | 25 (10%) |
| | Employed | 155 (62%) | 158 (63.2%) | 164 (65.6%) | 120 (48%) |
| | Other active occupation status | 15 (6%) | 13 (5.2%) | 12 (4.8%) | 8 (3.2%) |
| | Unemployed | 2 (.8%) | 4 (1.6%) | 8 (3.2%) | 17 (6.8%) |
| | Finding a first job | 2 (.8%) | 3 (1.2%) | 2 (.8%) | 6 (2.4%) |
| | Student | 22 (8.8%) | 34 (13.6%) | 7 (2.8%) | 27 (10.8%) |
| | Homemaker | 1 (.4%) | 0 (0%) | 1 (.4%) | 1 (.4%) |
| | Retired | 18 (7.2%) | 15 (6%) | 19 (7.6%) | 32 (12.8%) |
| | Other no active status | 1 (.4%) | 1 (.4%) | 1 (.4%) | 1 (.4%) |
| Children | Yes | 41 (16.4%) | 62 (24.8%) | 68 (27.2%) | 46 (18.4%) |
| | No | 209 (83.6%) | 188 (75.2%) | 182 (72.8%) | 204 (81.6%) |
| Total | | 250 (100%) | 250 (100%) | 250 (100%) | 250 (100%) |

it to measure public concern about food safety, and it has since been used in various contexts, including social sciences, consumer behavior and health care (Burke et al., 2013; Cohen, 2009; Dekhili et al., 2011; Flynn et al., 2010; Jones et al., 2013; Marti, 2012).

It has gained in popularity based on the idea that this approach has greater discriminatory power than other scale measures (Sirieix et al., 2011) and allows for better comparisons among countries and segments (Cohen and Neira, 2004). Rather than asking respondents to rate items one at a time, respondents are shown a predefined number of candidate items and are asked to choose the two items within each set that they consider the 'best' and 'worst' (Finn and Louviere, 1992). Two main groups of advantages have been identified in adopting a BWS methodology: first, it involves a fairly simple task for respondents and it is less cognitively demanding to select extremes on a scale rather than ranking all items simultaneously (Burke et al., 2013; Erdem et al., 2012; Jones et al., 2013); second, it provides rich information to the researcher by allowing sufficient information to calculate even individual-level scales and by providing precise and comparable scales (Burke et al., 2013; Jones et al., 2013; Louviere and Islam, 2008; Marti, 2012)

In this study, the ten attributes were combined into ten choice sets of four items each and respondents were asked to select the best and worst attribute in each set, i.e., the most and least important urban green space benefits. Four or five items per set are regarded as optimal for respondent evaluation, as more than this may lead to respondent fatigue (Sawtooth Software Inc., 2013). The question sets were balanced in factor frequency, positional frequency and orthogonality and therefore satisfy optimal design characteristics (Sawtooth Software Inc., 2013). This means that each attribute appears the same number of times across all choice sets and that each pair of attributes appears only once within each set. Multiple versions of the survey were generated to increase variation in the position and combination of attributes across respondents, reducing any potential context bias (Sawtooth Software Inc., 2013).

*Survey administration*

Both French and Portuguese language versions of the survey were prepared as described above. The surveys were piloted with a subset of French and Portuguese-speaking volunteers. Their suggestions allowed us to revise the instructions and to identify confusions in wording, translation, and the time needed to complete the survey. Four independent online surveys, one for each city in the study, were constructed. A snowball sampling strategy was adopted. The surveys links were first distributed through mail. Our invitation to participate in the survey also asked recipients to share it through mail or social media to family members, friends or colleagues aged 15 years or older and living in the entitled city. Data were collected between July and November 2013. Four subuniverses were therefore considered, contemplating the resident population aged 15 years and over in the four urban agglomerations under study: Paris (9779,020 inhabitants), Angers (319,230 inhabitants), Lisbon (2383,995 inhabitants) and Porto (1095,599 inhabitants). Conducting online surveys has several advantages, such as their comparative low cost and quick completion times, but also may compromise the representativeness of the resultant sample (Nielsen, 2011). Given the disadvantages associated with non-probabilistic online surveys in relation to sample representativeness, emphasis was placed on keeping a balanced distribution

by applying a weighting factor to adjust the sample to age and gender population characteristics. The weighting factors are shown in Section 3.1.

*Data analysis*

The data analysis was organized in two main sections. The first focused on global perceptions of the city's green spaces, where categorical variables were expressed as frequencies and percentages. The second section focused on the preferred benefits of urban green spaces. We began by computing best–worst raw scores for each respondent (individual B–W) for each green space attribute. The raw scores were then rescaled or transformed into relative scores (0–100), so that the scale presents ratio-scaled probability properties with the sum of all items being 100. This assumes that an item is chosen a particular percentage of times when presented with other items (Sawtooth Software Inc., 2013). Additionally, differences in attributes rating between the different urban areas were also explored by calculating confidence limits for the rescaled scores means and comparing the confidence intervals. Confidence limits (95%) for rescaled scores were calculated using a Bootstrap approach, a method of sampling from a data set to make statistical inference (Efron and Tibshirani, 1986).

## Results

*Response rate and respondent characteristics*

A total of 1000 respondents took part in this study, 250 for each city. The response rates cannot be established precisely as a consequence of the methods employed for the distribution of the survey. Only respondents who completed all the survey sections in full were included in this study, corresponding to an overall completion rate of 66%. The profile of the respondents in each city in the study is denoted by six socioeconomic variables (Table 2). For age, considerable differences can be found among the 4 samples. In both Paris and Angers, the 25–34 age group (28.8% and 29.6%) outnumbers other groups, followed by the 35–44 and 45–54 age groups. The more senior >65 group only accounts for 5.6% and 3.2% for Paris and Angers, respectively. In both Lisbon and Porto, the 35–44 (42.0% and 23.2%) age group was most represented, followed by the 25–34 (20.4%) and 45–54 (17.6%) age groups in Lisbon, and by the 45–54 (22.8%) and 25–34 (18.8%) age groups in Porto. The least represented groups were the 15–24 age group in Lisbon (2.0%) and the >65 in Porto (8.4%). In terms of gender, females slightly exceed males in the four samples. As expected, there are substantial differences in income among the four samples. The Paris and Angers samples show a more balanced distribution across income levels, although Paris has a prevalence of higher income groups and Angers has a prevalence of middle-income groups. For both Lisbon and Porto, the lower income groups were the most represented and the higher income groups only accounted residually. In terms of education, the great majority of respondents hold a university or higher degree, and therefore higher educational levels are overrepresented in comparison to census data. Specifically, more than three quarters of respondents reported having a university degree or higher (Paris 87%, Angers 82%, Lisbon 85% and Porto 80%), whereas the census data show a much smaller proportion of population with a university degree (Paris 37%, Angers 28%, Lisbon 27% and Porto 22%). This bias may be due to diverse reasons, such as the online administration of the survey, the survey's non-inclusion of people under 15 years or a greater interest in the subject by more educated people. This limitation is somewhat mitigated by the balanced distribution among the 4 cities, which enables comparisons. Finally, there is a clear primacy of respondents without children in the four samples.

Emphasis was placed on adjusting the sample to age and gender population characteristics. Table 3 shows the weighting factors applied by age groups and gender. All the subsequent results reflect the applied weighting factors.

*Global perception about urban green spaces*

With the aim of creating an overview of the global perceptions of respondents about cities' green spaces, three main groups of questions were included in the survey, focusing on satisfaction with green spaces, the perception of public green spaces' proximity and the frequency of visiting urban parks (Fig. 1).

Satisfaction with green spaces was assessed by two questions about global satisfaction with city green spaces, the first one focused on overall city green spaces, and the second one focused on green spaces close to the respondent's residence. For both cases, respondents selected answers from a five-point scale from 'very satisfied' to 'very dissatisfied.' Three main results may be drawn from these two questions. First, respondents are generally satisfied or very satisfied with both overall city green spaces (62%) and green spaces close to their residences (57%). Second, the results achieved by these two questions are very similar, the only evident difference being a slightly worse evaluation of the green spaces close to respondents' residences. Third, the results show some differences between cities. Respondents from Angers are the most satisfied with both overall city green spaces (83%) and green spaces close to their residences (74%). Respondents from Paris are also globally satisfied, even more moderately, with its city green spaces (61%) and with green spaces close to their residence (59%). Lisbon and Porto show very similar results. About half of respondents from both cities are satisfied or very satisfied with overall city green spaces and with green spaces close to their residences.

The assessment of perception about the proximity of public parks was made by inquiring about the existence of a public park a 5 min walk from the respondent's residence and work place. The results from both questions are quite similar between the four cities. In fact, the great majority of respondents declare that they have access to a public park at 5 minutes' walk from their residences (range by city, 71–86%) and from their work places (range by city, 61–82%).

Finally, the results of the frequency of reported visits to public parks show some differences between cities. Respondents from Paris frequent public parks most often, with 67% of respondents reporting going to a public park at least once a week. The majority of respondents from Angers (54%) and Lisbon (50%) also report visiting urban parks at least once a week. Respondents from Porto show the lowest frequency of park visitation, with only 37% of them report going to a park at least once a week.

*Rated benefits of urban green spaces*

The best–worst scores relating to the ten green space benefits evaluated by respondents from Paris, Angers, Lisbon and Porto are listed in Table 4. For convenience, the scores have been sorted and rescaled and are graphically displayed in Fig. 2. The rescaled scores can be interpreted in the following manner: for Paris, the attribute "diminution of urban air pollution" (10.9) was chosen as the most important, on average and when compared with the other attributes, 11% of the time and is about twice as important as the attribute "diminution of urban air temperature" (5.3).

Taking into account the overall scores for all four cities, social and cultural benefits (60%) are globally more valued than environmental benefits (40%). "Enhance health and well-being" (17.1) and

**Table 3**
Weighting factor applied to gender and main age groups giving the characteristics of respondents in comparison with an ideal distribution according to census data.

| Age | | Paris | | Angers | | Lisbon | | Porto | |
|---|---|---|---|---|---|---|---|---|---|
| | | Gender | | Gender | | Gender | | Gender | |
| | | M | F | M | F | M | F | M | F |
| 15–34 | Census | 43 (17%) | 45 (18%) | 42 (17%) | 44 (18%) | 36 (14%) | 38 (15%) | 36 (14%) | 37 (15%) |
| | Survey | 43 (17%) | 45 (18%) | 43 (17%) | 64 (26%) | 26 (10%) | 30 (12%) | 17 (7%) | 61 (24%) |
| | Weighting factor | 1 | 1 | .97674 | .6875 | 1.38462 | 1.26667 | 2.11765 | .60656 |
| 35–54 | Census | 43 (17%) | 45 (18%) | 40 (16%) | 41 (16%) | 41 (16%) | 44 (18%) | 43 (17%) | 47 (19%) |
| | Survey | 43 (17%) | 64 (26%) | 50 (20%) | 56 (22%) | 56 (22%) | 93 (37%) | 53 (21%) | 62 (25%) |
| | Weighting factor | 1 | .70313 | .8 | .73214 | .73214 | .47312 | .81132 | .75806 |
| ≥55 | Census | 33 (13%) | 41 (16%) | 37 (15%) | 46 (18%) | 40 (16%) | 51 (20%) | 38 (15%) | 49 (20%) |
| | Survey | 33 (13%) | 22 (9%) | 21 (8%) | 16 (6%) | 25 (10%) | 20 (8%) | 32 (13%) | 25 (10%) |
| | Weighting factor | 1 | 1.86364 | 1.7619 | 2.875 | 1.6 | 2.55 | 1.1875 | 1.96 |
| Total | Census | 119 (48%) | 131 (52%) | 119 (48%) | 131 (52%) | 117 (47%) | 133 (53%) | 117 (47%) | 133 (53%) |
| | Survey | 119 (48%) | 131 (52%) | 114 (46%) | 136 (54%) | 107 (43%) | 143 (57%) | 102 (41%) | 148 (59%) |

"contact with nature" (14.7) are rated as the most important green space benefits. "Diminution of urban air pollution" (12.9), "opportunities for outdoor sport and recreation" (11.4) and "biodiversity promotion" (11.3) are also rated as important green space benefits. On the other hand, "city image enhancement" (9.0), "carbon dioxide sequestration" (8.7) and "enhance neighbor social interaction" (7.8) are seen as less important. Finally, "diminution of urban air temperature" (4.0) and "noise reduction" (3.1) benefits are ranked near the bottom.

When analyzing best–worst scores by city, results show some similarities and some key differences between cities. For all respondents in the four cities, there is consensus that "enhance health and well-being" and "contact with nature" are important green space benefits. Moreover, there is also a consensus in the slight support given to "diminution of urban air temperature" and "noise reduction" and in the moderate support given to "opportunities for outdoor sport and recreation."

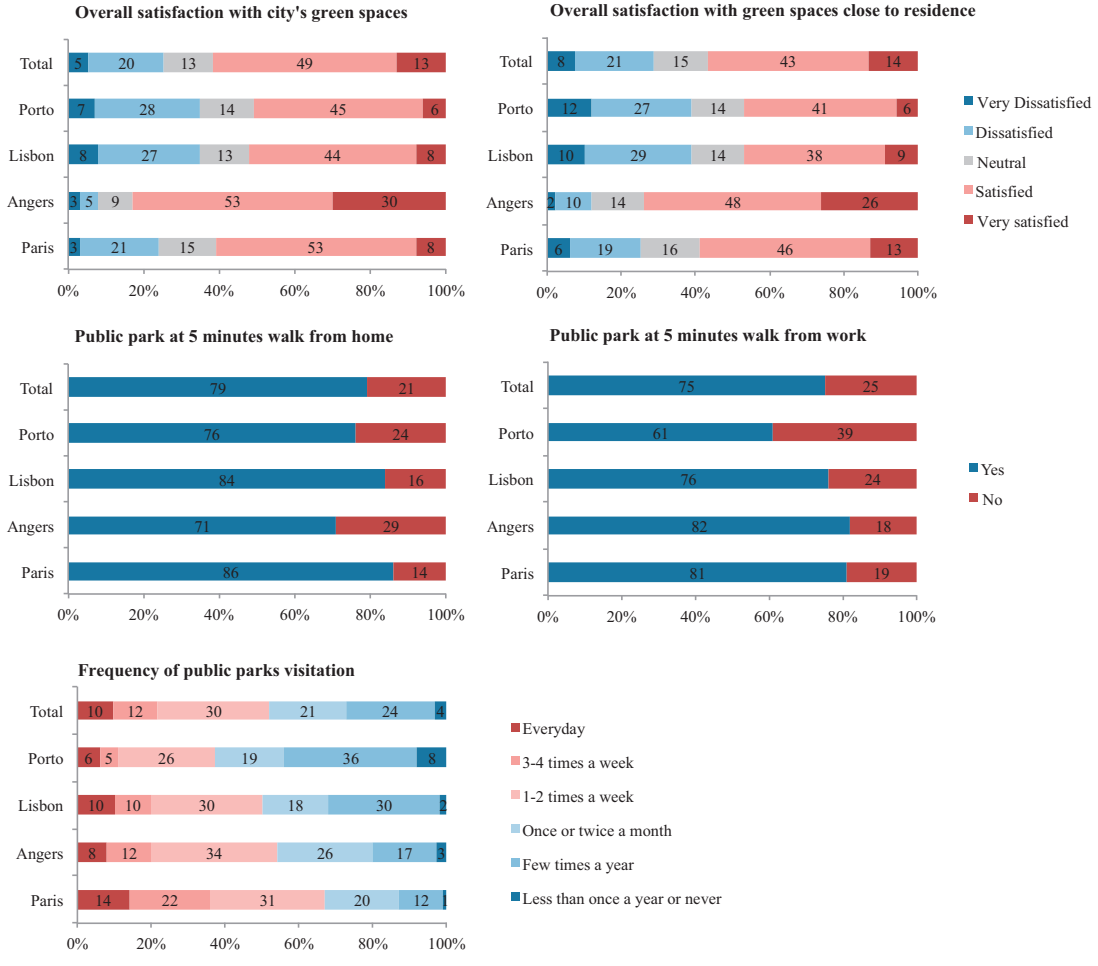


**Fig. 1.** Global perception concerning cities' green spaces.

**Table 4**
Raw Scores (RS) and Rescaled scores (RsS) relating to the ten urban green spaces benefits.

| Attribute | Paris | | Angers | | Lisbon | | Porto | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | RS | RsS | RS | RsS | RS | RsS | RS | RsS | RS | RsS |
| Diminution of urban air pollution | .38 | 10.9 | .2 | 10.1 | 1.7 | 15.2 | 1.7 | 15.1 | 4.0 | 12.9 |
| Diminution of urban air temperature | −1.33 | 5.3 | −2.5 | 2.7 | −1.9 | 3.8 | −2.1 | 4.1 | −7.9 | 4.0 |
| Carbon dioxide sequestration | −.97 | 6.4 | −.9 | 6.9 | .8 | 11.5 | .5 | 10.2 | −.6 | 8.7 |
| Biodiversity promotion | 1.31 | 13.9 | 1.0 | 13.0 | .0 | 9.2 | .0 | 8.9 | 2.4 | 11.3 |
| Noise reduction | −1.99 | 4.2 | −2.3 | 2.8 | −2.5 | 2.6 | −2.6 | 2.9 | −9.5 | 3.1 |
| *Environmental* | *−2.6* | *40.7* | *−4.5* | *35.6* | *−1.9* | *42.4* | *−2.6* | *41.2* | *−11.6* | *40.0* |
| City image enhancement | −.17 | 9.6 | 1.3 | 14.1 | −1.5 | 6.3 | −1.6 | 6.1 | −1.9 | 9.0 |
| Contact with nature | 1.78 | 15.6 | 1.7 | 15.6 | 1.4 | 14.3 | 1.2 | 13.4 | 6.1 | 14.7 |
| Opportunities for outdoor sport and recreation | −.23 | 9.8 | .7 | 12.0 | .7 | 12.1 | .7 | 11.5 | 1.9 | 11.4 |
| Enhance health and well-being | 1.15 | 13.7 | 1.7 | 15.4 | 2.6 | 18.9 | 3.3 | 20.6 | 8.7 | 17.1 |
| Enhance neighbor–social interaction | .07 | 10.6 | −.9 | 7.4 | −1.3 | 6.0 | −1.1 | 7.2 | −3.2 | 7.8 |
| *Social/cultural* | *2.6* | *59.3* | *4.5* | *64.4* | *1.9* | *57.6* | *2.6* | *58.8* | *11.6* | *60.0* |
| Total | .0 | 100.0 | .0 | 100.0 | .0 | 100.0 | .0 | 100.0 | .0 | 100.0 |

All the other benefits generate more important variation between cities. Two environmental benefits, namely the "diminution of urban air pollution" and "carbon dioxide sequestration," are more valued by respondents from the two Portuguese cities. "Diminution of air pollution" is considered the second most important benefit in Lisbon (15.2) and Porto (15.2), being only moderately rated in Paris (10.9) and Angers (10.1). "Biodiversity promotion" is a benefit more valued by respondents of the two French cities, and especially in Paris (13.9), where it is considered the second most important attribute of green spaces. In spite of "city image enhancement" being a generally underrated benefit, it is highly valued by respondents from Angers (14.1). The same goes for "enhance neighbor social interaction," which is seen as moderately more important by respondents from Paris (10.6). In summation, we might highlight the great similarities in the results for the two Portuguese cities. Paris and Angers, the most and the least populated cities, have more moderate similarities.

The denoted similarities and differences in the rated benefits of urban green spaces between the four urban areas are supported by the examination of the 95% confidence intervals of the mean scores across samples (Table 5). Significant differences between the mean scores of the green spaces benefits (non-overlapping confidence intervals) are mainly found when comparing results of urban areas belonging to different countries. Results from Paris and Angers also show significant differences between the mean scores for some of the green spaces benefits. In contrast, when comparing results of Porto and Lisbon, all the ten 95% confidence intervals are overlapping, suggesting similarities between the samples.

## Discussion and conclusion

This study outlined a hierarchical view of the benefits associated with urban green spaces in four different urban areas. Beyond the detailed results for each of the urban areas, one global result must be underlined: there is a clear distinction between one group of green space benefits that are valued in a similar way among the four urban areas, and another group of attributes that are unequally valued. Findings concerning consensus and mismatches in beliefs about urban green space benefits, as well as possible insights into urban policies, deserve a broader discussion.

### *Consensus in beliefs about urban green spaces benefits*

One of the most interesting results of this study is that there are some green space benefits that are similarly valued among different cities. "Enhance health and well-being" and "contact with nature" emerge consensually as highly valued attributes, confirming the valorization of functions that are directly related to individual and family interests (Jim and Shan, 2013). The high priority given to these functions partially matches the studies conducted in Helsinki (Tyrväinen et al., 2007), in Hong Kong (Lo and Jim, 2012) and Guangzhou (Jim and Shan, 2013), in which contribution to health and well-being emerge as key attributes and contact with nature is found to be moderately important. In general, and following a qualitative study conducted in two Canadian cities (Peckham et al., 2013), respondents expressed a preference for the psychological and moral benefits provided by nearby access to nature, which affects urban citizens' physical and mental well-being.

The moderate emphasis given to recreational benefits echoes the results obtained in Hong Kong (Lo and Jim, 2012) and Bari (Sanesi and Chiarello, 2006). They differ from Tyrväinen and colleagues' work (2007), in which recreational opportunities were the most important benefit to Helsinki respondents.

A great consensus exists also on the little support given to two microclimatic functions of green spaces, namely, "diminution of urban air temperature" and "noise reduction." If the low recognition

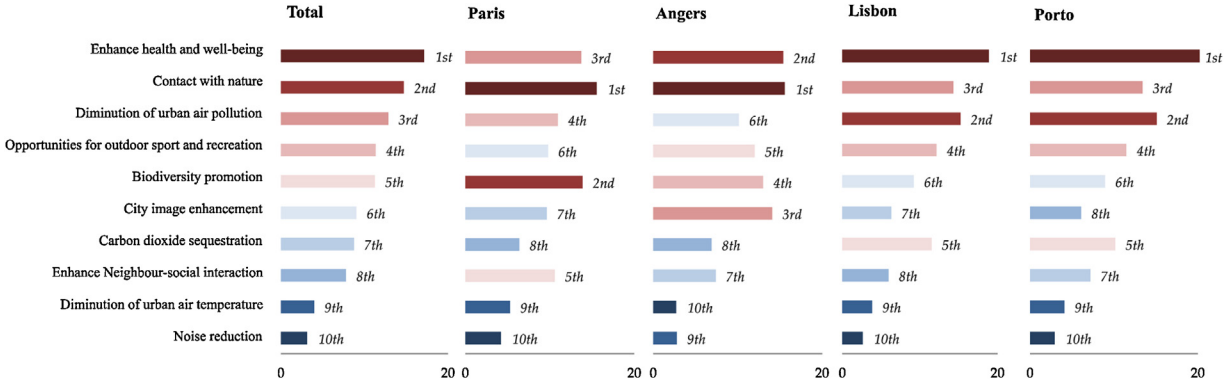


**Fig. 2.** Rescaled Scores. Scores are ordered according to global results. A color ramp was applied to support visualization.

**Table 5**
95% confidence intervals for the mean of the rescaled scores among the four urban areas. The table is arranged to facilitate a comparison of confidence intervals between the four urban areas. The gray shade indicates non-overlapping confidence intervals, and so significant differences between the mean scores among urban areas.

| | Diminution of urban air pollution | Diminution of urban air temperature | Carbon dioxide sequestration | Biodiversity promotion | Noise reduction | City image enhancement | Contact with nature | Opportunities for outdoor sport and recreation | Enhance health and well-being | Enhance neighbor–social interaction |
|---|---|---|---|---|---|---|---|---|---|---|
| Paris | .039–.048 | .018–.025 | .022–.030 | .050–.061 | .014–.020 | .034–.043 | .057–.067 | .034–.044 | .050–.060 | .037–.048 |
| Angers | .035–.046 | .008–.014 | .023–.033 | .046–.059 | .009–.014 | .049.–064 | .056–.069 | .043–.053 | .055–.068 | .025–.035 |
| Paris | .039–.048 | .018–.025 | .022–.030 | .050–.061 | .014–.020 | .034–.043 | .057–.067 | .034–.044 | .050–.060 | .037–.048 |
| Lisbon | .054–.068 | .012.–019 | .040–.053 | .031–.042 | .008–.013 | .020–.031 | .051–.063 | .043–.054 | .069–.083 | .020–.028 |
| Paris | .039–.048 | .018–.025 | .022–.030 | .050–.061 | .014–.020 | .034–.043 | .057–.067 | .034–.044 | .050–.060 | .037–.048 |
| Porto | .055–.066 | .013–.020 | .036–.045 | .031–.041 | .008–.015 | .019–.029 | .048–.060 | .041–.051 | .076–.088 | .024–.035 |
| Angers | .035–.046 | .008–.014 | .023–.033 | .046–.059 | .009–.014 | .049.–064 | .056–.069 | .043–.053 | .055–.068 | .025–.035 |
| Lisbon | .054–.068 | .012.–019 | .040–.053 | .031–.042 | .008–.013 | .020–.031 | .051–.063 | .043–.054 | .069–.083 | .020–.028 |
| Angers | .035–.046 | .008–.014 | .023–.033 | .046–.059 | .009–.014 | .049.–064 | .056–.069 | .043–.053 | .055–.068 | .025–.035 |
| Porto | .055–.066 | .013–.020 | .036–.045 | .031–.041 | .008–.015 | .019–.029 | .048–.060 | .041–.051 | .076–.088 | .024–.035 |
| Lisbon | .054–.068 | .012.–019 | .040–.053 | .031–.042 | .008–.013 | .020–.031 | .051–.063 | .043–.054 | .069–.083 | .020–.028 |
| Porto | .055–.066 | .013–.020 | .036–.045 | .031–.041 | .008–.015 | .019–.029 | .048–.060 | .041–.051 | .076–.088 | .024–.035 |

of noise abatement seems to be an usual result (Lo and Jim, 2012; Lohr et al., 2004; Tyrväinen et al., 2007), the little support given to air temperature reduction contrasts with results from similar studies, where it is evaluated as very important (Lo and Jim, 2012; Lohr et al., 2004; Sanesi and Chiarello, 2006) or moderately important (Tyrväinen et al., 2007; Vesely, 2007). Thus, the widespread concern about the urban heat island effect and global warming, as noted by these studies, was not confirmed by the present study.

In summary, in spite of the remarkable agreement found in our study concerning the evaluation of some benefits of urban green spaces, the comparison of these results with our literature review reveals some discrepancies that suggest a careful interpretation of the achieved results.

### *Mismatches in beliefs about urban green spaces benefits*

In the present research we hypothesized that the evaluation of green space benefits could not be generically widespread and that specific contexts, namely city size and national contexts, could influence the way respondents rated the various green spaces benefits. The results do not permit us to establish these types of causal associations, however. In fact, the results from the two Portuguese cities show great similarities both in global perceptions about city green spaces and in the rated benefits of urban green spaces, which may suggest that national context is important factor in explaining the perceptions of green space benefits. For instance, respondents from Lisbon and Porto share a moderate evaluation of cities' urban green spaces and a comparatively lower frequency of visiting urban parks. The two Portuguese cities also share a very similar rating of green space benefits, and in some cases in clear divergence with the French cities. For example, respondents from Lisbon and Porto agree in their highly evaluation of the "diminution of urban air pollution" as a green space benefit, matching the results obtained for Hong Kong (Lo and Jim, 2012) and Calgary and Halifax in Canada (Peckham et al., 2013), and contrasting with the moderate support given to this benefit in Paris and Angers but also in cities in Finland (Tyrväinen et al., 2007), North America (Lohr et al., 2004) or New Zealand (Vesely, 2007).

However, despite these interesting matching results, we must also underscore the more moderate similarities found between Paris and Angers. Belonging to the same national context, but highly differentiated in their dimensions, Paris and Angers share a comparatively greater satisfaction with city green spaces. However, despite some assemblages, context-specific local factors seem to emerge. For instance, the "biodiversity promotion" benefit is comparatively highly evaluated in the two French cities, but specially supported by Parisian respondents.

A high support for this intangible environmental function was also reported in the studies conducted in New Zealand (Vesely, 2007) and Canadian (Peckham et al., 2013) but contrast with the moderate valuation reported for Hong Kong (Lo and Jim, 2012) and North-American cities (Lohr et al., 2004). Another example of what could be a local context-specific tendency is shown in Angers through the high recognition of the contribution of urban green spaces to "city image enhancement."

There are several possible explanations for the observed variation of urban green space benefits among the four cities in this study. The great similarities found between the two Portuguese cities and the moderate resemblances established between the two French cities suggest that some differences may be the result of cultural differences between the communities. On the other hand, the influence of the city size remains unclear from the results of this study. Even another possibility is that local planning institutions, by its communication or participatory processes, could be influencing residents' perceptions about the benefits of urban green spaces. Overall, whether these differences stem from city size, cultural factors or institutional policies and whether they operate at the urban, regional or national level, they cannot be determined from the data used in this study. A clarification of the basis for people's beliefs about urban green spaces should therefore be developed in future studies.

### *Policy implications*

The general agreement about the multiple benefits potentially offered by urban green spaces has encouraged a wide acceptance of multifunctionality as a key principle of urban green infrastructure approaches. Simultaneously, there is a growing awareness that planning for multifunctional green infrastructures requires a decision making process that defines the priorities for green space functions to enhance them.

The main challenge to urban planning and decision-making is therefore to accommodate a diversity of desirable social, environmental, and economic green spaces values. Local technical knowledge and expertise is essential to inform decision-making processes. Moreover, residents' values related to urban green spaces are as important as technical issues and can inform urban planning and decision making (Faehnle et al., 2011).

Therefore, when considering green infrastructure values it is vital to highlight people's opinions regarding green space benefits. By examining relevant urban green space beliefs among four different cities by placing those beliefs on a "best–worst scale", the present study extends the understanding of urban residents' beliefs regarding green space benefits. The results confirm that

urban green space benefits are not equally understood or appreciated among cities, suggesting simultaneously a consensus among the most and least valued benefits and the existence of local variations in beliefs about other urban green space benefits. Moreover, the results offer two main insights for practitioners and researchers interested in urban green spaces and urban green infrastructure issues.

First, local assessments of residents' beliefs about urban green space benefits should be encouraged. Because beliefs about other urban green spaces benefits differ among cities, there is a need to avoid generic assumptions concerning people's beliefs about green space benefits and to encourage local assessments. For instance, according to our findings, a green infrastructure policy focused on the enhancement of urban biodiversity, perhaps including more naturalized green spaces, is expected to be more easily accepted by residents of Paris than of Lisbon. Moreover, just as urban green space benefits change over time, so too do urban cultures, leisure time activities and environmental knowledge (Tyrväinen et al., 2007), and information about people's beliefs should therefore be updated regularly.

Second, planners and researchers need to communicate effectively about the multiple benefits offered by urban green infrastructures. Urban green space benefits are not equally understood or appreciated among cities. Using the example provided above, a green infrastructure policy for Lisbon focused on the enhancement of urban biodiversity, although technically well supported, would hardly be valued by city residents. Therefore, if community support for green infrastructure was the goal, a dilemma could be generated: from one side, the scientific and technical expertise that lends credibility to the decision, and from the other side, the public values and beliefs that legitimate the decisions (Janse and Konijnendijk, 2007). The use of communication tools, such as information, consultation, and public participation, would be therefore crucial to reduce or avoid conflicts between residents, planners, and managers (Eriksson et al., 2012; Konijnendijk, 2000).

A number of limitations in the present study should be noted. First, the present samples were attained through convenience sampling techniques and there are not representative samples of the populations being studied. For age and gender the samples bias were minimized by a weighting adjustment. However, the huge overrepresentation of highly educated respondents remains a limitation of this study. In fact, overrepresentation of educated people has been reported in similar web survey based studies (Couper et al., 2007; Fan and Yan, 2010). Although this limitation is somewhat mitigated in this study by the balanced distribution of highly educated respondents among the four urban areas, replication is necessary in more representative samples to establish generalizability. Second, the selection of our ten urban green spaces benefits could be extended, or possibly some different benefits could be used. The study could be further expanded by adopting qualitative methods such as focus groups or interviews to gain more in-depth insight into urban residents' beliefs concerning green spaces benefits. Third, results from this study suggest simultaneously a consensus about some green space benefits and the existence of local variations in beliefs about other urban green space benefits. Despite the insights into possible factors that could explain this observed variation, additional studies should be conducted in other cities and countries in order to provide evidence of the people's beliefs surrounding the benefits of urban green spaces.

This study is a first step toward a better understanding of how urban residents rate the benefits associated with urban green spaces. From a theoretical and policy perspective, this subject is of great importance and more research is needed. Paraphrasing Tyrväinen (2001), the amount and quality of urban green spaces in cities is ultimately a political question and a matter of whose interests are to prevail in decision-making. The recognition of urban residents' beliefs about urban green spaces and, on other hand, the development of communication tools that favors mediation between urban residents beliefs and planners or managers expertise, would certainly optimize green infrastructure planning processes and results.

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