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Insights and Beliefs about Green Spaces: An International Comparative Study

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Insights and Beliefs about Green Spaces: An International Comparative Study

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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.

Keywords: Benefits, Best-Worst scaling**,** Insights, Urban green spaces

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Introduction

Nowadays a huge quantity of scientific literature applying to the Best Worst Scaling (BWS) has emerged in numerous fields of knowledge. Nevertheless, Landscape, Urban and Planning Sciences are not included in these recent methodology advances.

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), 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 a 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. In a way to contribute for a better understanding, we apply the BWS to increase the knowledge about the way users value Green Park attributes.

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 the 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: Paris and Angers from France and Lisbon and Porto from Portugal.

The BWS Method

Several techniques based on rankings can be used to measure the importance of numerous product attributes. Monadic models allow ordering attributes from the most preferred/important to the least preferred/important by using scale scores (*i*.e. Likert) or rankings from the most to least preferred/important. In the paired comparisons technique, first developed by Louis Thurstone (Thurstone, 1927), the attributes/values are shown in pairs and the respondents choose the one they find most important in each pair. It is also possible to assign a specific score (typically ranging from 0 to100) to different attributes depending on preference or importance. Methods based on ordered attributes admit that the respondents are able to communicate their true affinity with the use of a numerical scale of hierarchy (from the first to the last). However, this makes it difficult for trials with more than six or seven attributes. With more than six or seven attributes, the method of paired comparisons no longer allows the respondents to evaluate all pairs and requires the design of an experimental plan ensuring that each attribute appears about the same number of times. This method can be extended to comparisons between three or more attributes (Round robin). The BW scaling method assumes that each respondent rate in each choice set presents all possible pairs of attributes contained therein and selects the pair that reflects the maximum difference (Max-Diff) of preference or importance. As such it may therefore be considered as an extension of the Thurstone method of paired comparison.

First developed by Finn and Louviere (1992), the BW scaling method distributes all the different attributes to be judged by choice sets within the questionnaire. In all created sets, each attribute must appears the same number of times with the other attributes as well as the same number of times in first place, second place, etc. Each respondent must analyse a minimum number of attributes equal to 1.5 times the number of attributes considered. The minimum number of sets considered is given by $3K/k$, where K is the total number of attributes and k is the number of attributes to consider in each set. Briefly, in terms of importance, we prioritize the k attributes in C different choice sets and two questions are made in each set: *Which is the most important* and *which is the less important*. In each set there are $k(k-1)/2$ pairs of attributes to be analyzed for the definition of the **most** important attribute and $k(k-1)/2$ pairs of attributes to be analyzed for the definition of the **least** important attribute. Therefore, the respondent will choose among $k(k-1)$ pairs of attributes in each set presented. The choice variable for each respondent is a discrete variable, and each choice must be coded twice: once for the *most* important attribute $(+1)$ and a second time for the *least* important attribute(-1). Based on the respondents' answers, this method provides an ordinal *ranking* of attributes for each *most* and *least*, on an interval scale basis.

Level of Preference/Importance

The level of preference/importance of an attribute (maximum difference scaling or BW score) is given by the difference between the number of times a particular attribute is mentioned as the most preferred/important and the number of times it is mentioned as the least preferred/important. Thus, such a level of preference/importance is dependent on the number of respondents and the frequency with which each attribute appears in the choice sets. If each attribute appears the same number of times in all the sets considered (balanced design) and the number of respondents per set is the same, the level of preference/importance can be used to prioritize the attributes by preference/importance. Consequently, and considering the same data, it has an accuracy of 95% of a multinomial logit – MNL (Auger et al., 2004). Indeed, Finn and Louviere (1992) found that the BW scaling task results they obtained by using the simpler most-minus-least difference scores were essentially the same as those obtained from the logit analysis. If not well balanced, the level of importance should no longer be used to rank the attributes by preference/importance. The attribute preference level value can be converted into a standard score, which allows comparisons between groups of respondents with different compositions. The standard score of each attribute can be expressed as:

$$\text{Standard score} = \frac{N_{most} - N_{least}}{f \times n} \qquad (1)$$

where N_{most} it is the number of times the attribute is mentioned as the most important, N_{least} the number of times the attribute is noted as the less important, f is the frequency with which the attribute appears in the experimental design and n the number of respondents (questionnaires). As $n \times f$ is the number of times the attribute is shown in different sets, the above formula can be presented as:

$$\text{Standard score} = \frac{N_{most} - N_{least}}{number\ of\ times\ displayed} \qquad (2)$$

Finally, with the standard scores, the attributes in order of preference/importance can be ranked in total and in each group (regions, ages, gender, income, involvement, etc.). This in turn makes important comparisons possible.

Raw Score and Rescaled Score

A series of steps are needed in order to compute the attribute scores. First, each respondent is assigned a coefficient obtained from the logit rule named *raw score*. This score is often used to perform various multivariate analyses - where it is used as *utility*, cluster analysis, multinomial logit, ordinal regression, latent class analysis (LCA), etc. Like the *item scores* of a MNL, MaxDiff *raw scores* are interval scale and they reflect more relative preferences than absolute ones, thus they are difficult to interpret. In order to make it easier to view and interpret, these parameters are centered on zero. Thus, a *zero line* makes an absolute differentiation between the preferred/important items (*raw scores* greater than zero) and the not preferred/important items (*raw scores* smaller than zero). To make data easier to interpret, *raw scores* can be converted into probabilities for the initial data (*counts*). However, these probabilities should be regarded with some caution when comparisons are made between groups with significant differences in scale. As such, these new values are renamed as *raw scores* and their sum is equal to 100. The conversion of the *raw weights* or *raw scores* to a ratio scale with a probability ranging from 0 to 100 is achieved via the transformation of each *raw score* using to equation 3:

$$P_i = 100[e^u / (1 + e^u)] \qquad (3)$$

where P_i is the probability of choosing the item i and u is the *raw score* for item i. For example, when $P_i = 15$ this means that item i, when compared to the other items, is chosen (or not rejected) on average 15% of the time. This rescaled score also allows for a more comprehensive reading such as: the attribute X ($rescaled\ score\ =\ 14$) is twice as important (strong) as the attribute

$Y\ (rescaled\ score\ =\ 7)$. The transformation of each *raw weight* may also be achieved by the following expression:

$$e^{u_i}/(e^{u_i} + a - 1) \qquad (4)$$

where u_i is the weight (*logit raw weight*) centered to tem i, e^{u_i} is the equivalent to consider the u_i antilog and a is the number of items shown in each choice set followed by another transformation to sum 100.

Questionnaire Design

For the purposes of this study, a 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”. This questionnaire measures the importance of 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, enhanced health and well-being, enhance neighbour-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).

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 the 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 sub-universes were therefore considered, contemplating the resident population aged 15 years and over in the four urban agglomerations under study: Paris (9,779,020 inhabitants), Angers (319,230 inhabitants), Lisbon (2,383,995 inhabitants) and Porto (1,095,599 inhabitants). Conducting online surveys has several advantages, such as their comparative low cost and quick completion times, but also it 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.

Results

Data Analysis

The data analysis was performed 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 for 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 the confidence limits for the rescaled score 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).

Rated Benefits of Urban Green Spaces

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 best–worst scores relating to the ten green space benefits evaluated by the respondents from Paris, Angers, Lisbon and Porto are listed in Table 1. For better convenience, the scores have been sorted and rescaled and are graphically displayed in Figure 1. 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).

Figure 1. *Rescaled Scores. Scores are Ordered According to Global Results. A Colour Ramp was Applied to Support Visualization*

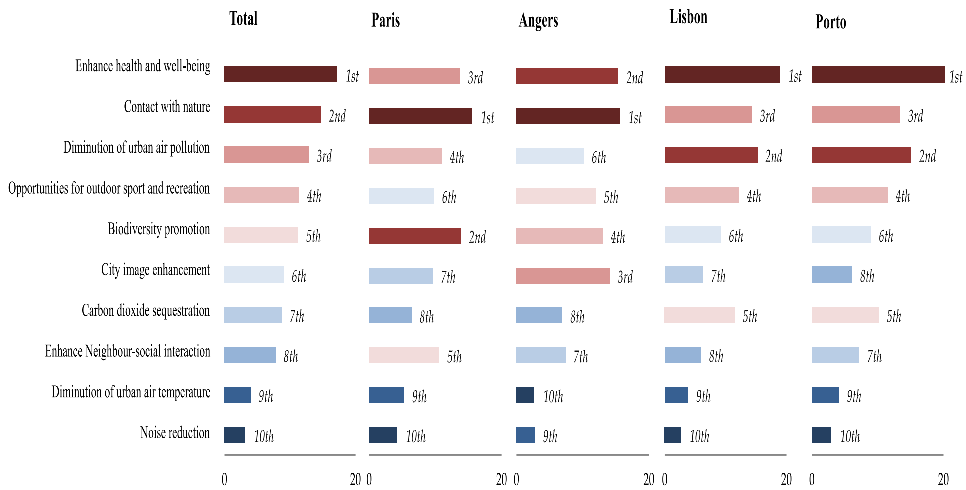

Table 1. *Raw Scores (RS) and Rescaled Scores (RsS) Relating to the Ten Urban Green Spaces Benefits*

	Paris		Angers		Lisbon		Porto		Total	
Attribute	RS	RsS	RS	RsS	RS	RsS	RS	RsS	RS	RsS
Diminution of urban air pollution	0.38	10.9	0.2	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	-0.97	6.4	-0.9	6.9	0.8	11.5	0.5	10.2	-0.6	8.7
Biodiversity promotion	1.31	13.9	1.0	13.0	0.0	9.2	0.0	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	-0.17	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	-0.23	9.8	0.7	12.0	0.7	12.1	0.7	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	0.07	10.6	-0.9	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	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0

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 “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 neighbour 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 analysing 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 the “diminution of urban air temperature” and “noise reduction” and in the moderate support given to “opportunities for outdoor sport and recreation.”

All the other benefits generate more important variations 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 neighbour social interaction," which is seen as moderately more important by the 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.

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 Conclusions

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 valorisation 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), the 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 of noise abatement seems to be a 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 the 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 an important factor in explaining the perceptions of green space benefits. For instance, respondents from Lisbon and Porto share a moderate evaluation of the 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, the respondents from Lisbon and Porto agree in their high 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 them 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 Canada (Peckham et al., 2013) but in 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 the 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.

We can conclude that BWS seems to be a suitable method to be applied in Landscape, Urban and Planning Sciences. First, this methodology allowed an appropriated cross-country comparison. Second, green park users enrolled in the survey, allowing a high level of participation. Third, BWS is a powerful and inexpensive tool that policy makers can use to undertake strategic planning options.

A number of limitations in the present study should be noted. First, the selection of our ten urban green space 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 a more in-depth insight into the urban residents' beliefs concerning green space benefits. Second, 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 towards 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 Tyrvainen (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 the other hand, the development of the communication tools that favour mediation between urban residents beliefs and planners or managers expertise, would certainly optimize green infrastructure planning processes and results.

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