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Dog Walkers' Views of Urban Biodiversity across Five European Cities

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Abstract: Contact with nature makes people feel better, live healthier and act more environmentally-friendly. We hypothesized that dog walking, an omnipresent people–nature interaction in cities, translates to a more positive view of urban nature and, subsequently, to more support for conservation initiatives. Insights into such positive side-effects of dog walking are relevant for dog-related urban policies that often focus on negative impacts of dogs (e.g., health risks, disturbance of wildlife). Based on a field survey in five European cities ($N = 3717$), we analyzed if people who walked dogs regularly valued four urban ecosystem types (park meadows, wastelands, streetscapes, forests), and the plant species diversity within, differently from other people. Opposite to our hypothesis, participants from both groups valued urban ecosystems and their biodiversity very similarly across the cities. Thus, our study does not confirm that regular dog walkers value natural elements more than other people. It thus remains an important challenge for urban planners to balance services and disservices of dog walking in urban greenspaces.

Keywords: biodiversity valuation; cultural ecosystem services; greenspace management; nature interaction; nature-related outdoor activity; pet ownership; urban biodiversity perception

1. Introduction

Experiencing nature in outdoor surroundings is an exception, rather than a norm, in today's society [1] because experiences such as climbing trees, going fishing or watching birds have severely declined in the last decade [2]. The loss of nature experiences contradicts basic human needs, as experiencing nature is fundamental to human wellbeing; being outside in green areas improves physical and mental health of people [3,4]. At the same time, interaction with natural elements in cities has been shown to lead to a positive attitude towards nature, e.g., through gardening activities [5], urban foraging [6] or frequent visits to parks [7]. As a positive feedback to urban conservation approaches, a higher valuation of non-human life forms can translate to an improved environmental stewardship (e.g., [8,9]).

One phenomenon that encourages many urban dwellers to go outside is walking a dog (e.g., [10]). Dog ownership is a global phenomenon with, for example, 36–39% of households owning dogs in the United States of America and the United Kingdom [11,12]. A range of urban greenspaces attract dog walkers. For example, in six European cities, dog walkers are between 8% to 22% of park users [13,14]. While dog walking has the potential to increase urban nature experiences—with positive feedbacks to human health and environmental stewardship—it is unknown whether people who regularly walk a dog value urban nature differently from people that do not. This question is relevant for dog-related

urban environmental policies [15,16] since these should consider the full range of dog-mediated effects on people and the environment.

Indeed, dogs in urban environments are associated with manifold positive and negative impacts. These can be conceptualized as cultural ecosystem services, ecosystem disservices and environmental impacts as indicated in Figure 1. As an important cultural ecosystem service, dog walking supports human health and wellbeing [17]. Dog ownership often—but not necessarily [18,19]—increases physical outdoor activity [20,21], even in unfavorable weather [22]. Moreover, daily interaction with dogs may lead to positive mental reactions and social interactions such as meeting other dog walkers and providing a conversation point [23]. However, dogs can also compromise human health—and that of animals—by bites, and the transmission of diseases or pathogenic infections [24–26]. Accordingly, people perceive animal waste as a health risk to themselves (e.g., while collecting edible plants in urban settings [27]). In some urban regions, feral dog populations have established from companion dogs and now induce negative associations bound to urban disorder [28]. Dog-mediated environmental impacts include negative influences on wildlife [26,29,30] and changes in the soil and water settings through eutrophication from dog feces [31,32].
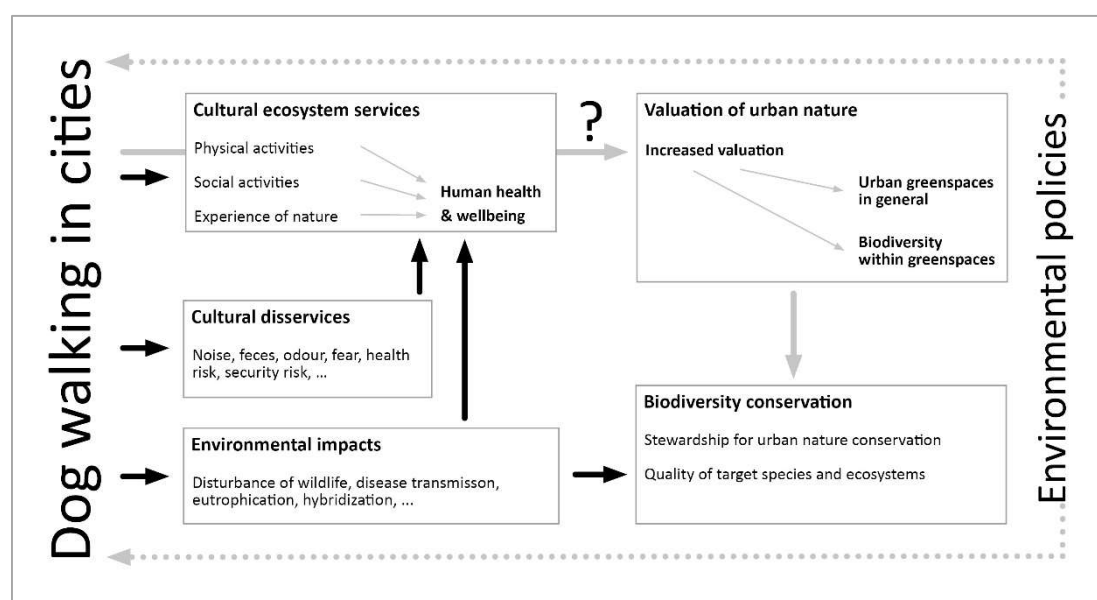
Figure 1. Possible relationships between dog walking in cities, people and the environment. Dog walking can support manifold cultural ecosystem services but also induces disservices and negative environmental impacts. Environmental policies that regulate dog walking in cities should be informed by the total range of dog-mediated effects on people and the environment (symbolized by the dotted arrows), including possible positive side effects on biodiversity conservation. Black arrows indicate evidenced relationships. Grey arrows indicate the hypothesized relationship between dog walking and valuation of urban nature, which could translate to an increased stewardship for nature conservation in cities and considers that dog walkers may represent valuable allies for the conservation of urban nature.

Beyond this background, dogs remain a controversial topic in urban society, and in city's environmental policies [15,16]. To enhance opportunities and minimize risks for both people and the environment, dog-related policies must consider tradeoffs between negative and positive effects related to dog ownership and dog walking in urban areas (Figure 1).

We here address the intersection between dog walking and the valuation of urban nature, which is important for two reasons. First, dog walking could compensate for the loss of nature contact experienced by urban residents [1,2]. Second, interaction with green spaces in cities could increase dog walkers' appreciation of urban nature, which might translate to an increased commitment to nature

conservation as indicated in Figure 1 [33]. Up to now, there are some hints to changes in people's values and attitudes towards nature elements when they own or walk a dog, as opposed to people who do not. For example, the attitude towards other animals may be influenced by owning a companion dog [34], including being less afraid of wildlife, such as snakes [35]. We therefore hypothesize that people who regularly walk dogs and inevitably come into contact with different urban open spaces will assess urban nature more positively than people who do not walk dogs.

In this study, we therefore address whether contact of regular dog walkers with different forms of urban green spaces is associated with a more positive view of urban nature, compared to other people. While answering this main question, we have considered three different contexts. Since the assessment of how people value urban nature or urban green may depend on the specific type of ecosystem addressed (e.g., forest vs. wasteland; [36–38]), we, first, included four types of ecosystems in our study, which are frequently used for dog walking (park meadows, wastelands, streetscapes, forests). Second, we conducted a Europe-wide study involving five cities from five European countries (Bari, Italy; Berlin, Germany; Edinburgh, UK; Ljubljana, Slovenia; Malmö, Sweden), because the assessment of urban green spaces can vary depending on the geographical context [38–40]. Many studies on the assessment or perception of urban nature are based on green space types or urban green as such and do not address the species level [41]. The latter, however, is most relevant for biodiversity conservation. We therefore, third, considered different levels of biodiversity for each of the ecosystem types addressed, i.e., low, medium and high plant species richness.

Specifically, we aimed to answer the following research questions: Do people who walk a dog regularly value urban nature differently compared to those who do not, and does this valuation vary by

(a)   the ecosystem context, that is, regarding four different urban greenspace types (park meadows, wastelands, streetscapes, forests);

(b)   the geographical context, that is, regarding five cities (Bari, Berlin, Edinburgh, Ljubljana, Malmö) in five European countries; and

(c)   the biodiversity context, that is, regarding three levels of plant species richness (low, medium, high) within each of the four ecosystem types?

2. Materials and Methods

2.1. Field Survey

Our study was conducted within the framework of the Green Surge project [42], and employed an extensive field survey in five different European cities. The questionnaire study was conducted at the intersection of the social and ecological sciences, to evaluate how people value and use urban nature in different ecosystem types and the biodiversity within. The analyses at hand specifically uses the data we gathered on the valuation of urban ecosystems and their biodiversity with regard to people that walk dogs on a regular basis or not. Thus, in the following, the respective part of the questionnaire and the evolving database is explained. For more information on the field survey itself, and information that is more specific on the data assessed on how people use urban greenspaces, see [14,38].

To assess the valuation of several ecosystem types and the biodiversity levels within, we used standardized questionnaires with embedded photographic stimuli material that displayed four ecosystem types (park meadows, wastelands, streetscapes, forests; see Figure 2). These types represent a range of urban environments, which are usually used for dog walking. For each ecosystem type, the stimuli material showed three biodiversity levels (low, medium, high). The information on the biodiversity levels were based on actual plant species richness that was assessed via vegetation mapping. In association with vegetation mapping, photographs were taken on the site, that is, we know exactly which and how many plant species are presented in the raw photographic material. From this material, we selected photographs that represented the lowest, medium and highest species richness for each ecosystem type and city. For the park meadow, for example, species numbers ranged from

10 species (low biodiversity level) to 17 (medium biodiversity level) to 26 (high biodiversity level; means for five European cities; for more information, see Table S1 in [38]).
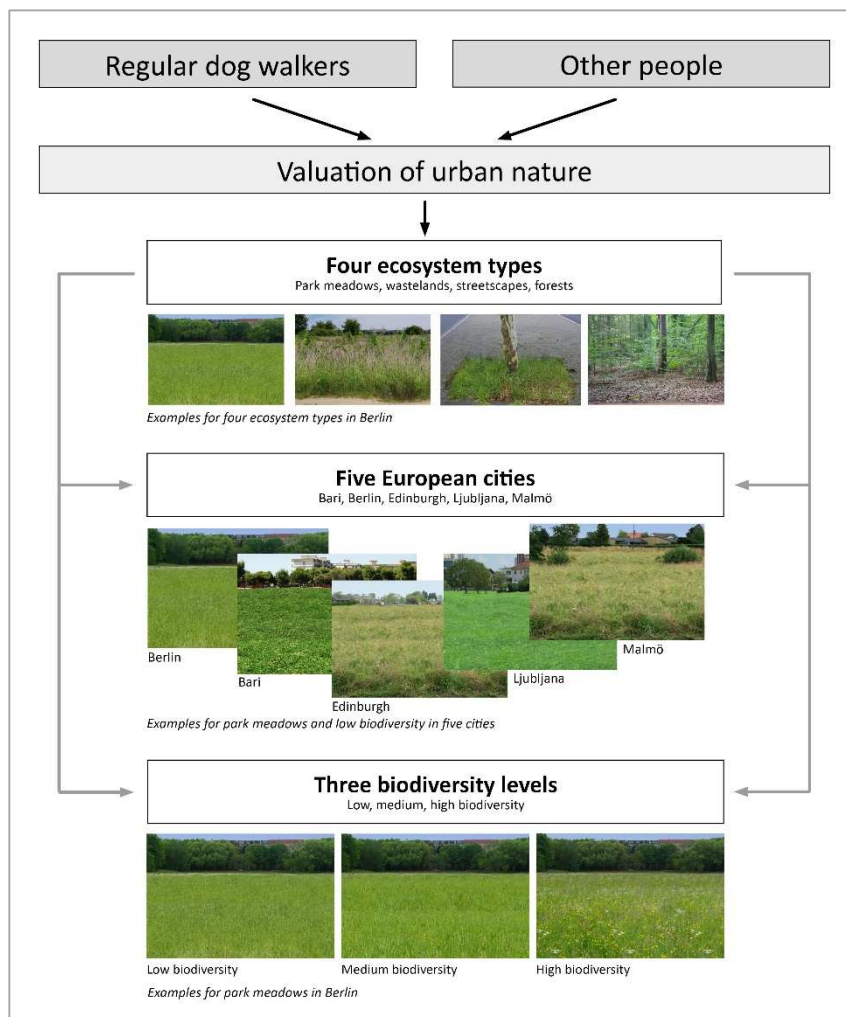
Figure 2. Study design for testing for effects of regular dog walking on the valuation of urban nature, differentiated for the context of urban ecosystem types, biodiversity levels and European cities. The pictures show examples of the stimuli used in the field survey. In all, these collages included four ecosystem types each depicting three levels of biodiversity, and for all five study cities. Additionally, we displayed for the streetscape scene a fourth collage without any vegetation, as this is a common setting for streetscapes globally.

Vegetation mappings and photographing were conducted in all ecosystem types, in all of the five European cities, and for all biodiversity levels. The photographic material was then used for composing collages, which were comparable not only in terms of their vegetation composition, but also in regard to the vegetation's framing, such as a neutral blue sky and the urban context. For each of the five cities we used four series of stimuli, that is, one picture series for each ecosystem type displaying the different biodiversity levels.

In the first section of the questionnaire, each respondent was asked to rate the photographic stimuli material that displayed the three biodiversity levels of park meadow and either the three biodiversity levels of wasteland, streetscape or forest, respectively. For the streetscape scene, we also presented a fourth scene without any vegetation, as eradicating spontaneous vegetation along streets is a common management approach in urban areas worldwide. Hereby, the items evaluated respondents' preferences for each of the three alternative scenes of park meadows by asking "How do you like

each of these three variations of a meadow in a park?" using seven-point Likert scale (1, [like] not at all–7, [like] completely). The same items were then used to assess respondents' valuations for each of the pictures of the second ecosystem type in question (wasteland, streetscape or forest, respectively). In the second section of the questionnaire, we assessed each respondent's background including whether respondents regularly walk a dog (see relevant interview questions and resulting response and explanatory variables in Table 1).

The survey method, as well as the underlying concept of including series of stimuli material, was tested in-depth one year prior to the main study with qualitative (*N* = 9) and quantitative (*N* = 979) pretests in German. The final version of the questionnaire was translated into 10 local languages that were relevant to reach a multitude of residents in the focal cities. The translation process followed standardized methods (cf [43]) including a backward translation procedure [44]. The final version of the questionnaire was transferred into a questionnaire version for (a) face-to-face interviews and (b) an online version.

Table 1. Overview on the questions and related response and explanatory variables used in the field survey.

Variables	Question	Coding/Scale	Remarks
Biodiversity valuation (dependent)	*How do you like each of these three variations of* [insert ecosystem type]*?*	Valuation on a 7-point Likert scale regarding the general valuation of three biodiversity levels; handled as quasi-metric variable	Assessed in the first, nature-related part of the questionnaire that employed stimuli material depicting three levels of plant species richness in four ecosystem types in five cities; in-depth analyses of this data with regard to differences in biodiversity valuation in a companion study [44].
Dog walking (explanatory)	*Do you regularly walk a dog?*	1 = no; 2 = yes as answer options were translated to *regular dog walkers* (respondent walks a dog regularly), *other people* (respondent does not walk a dog regularly), *N/A*	
Ecosystem type	*Park meadow, wasteland, streetscape, forest*		Ecosystem type attributed to questions on dependence of the stimuli material chosen. All respondents answered the questions that related to park meadows and to one of the three remaining ecosystem types, respectively.
City	*Bari, Berlin, Edinburgh, Ljubljana, Malmö*		Filled in by field survey staff

On this basis, data was collected from the period May to August 2015, following standard protocols and by trained staff (see [38]). We approached potential interviewees in a range of public and semi-private settings such as open spaces, administrative offices, parks, and at official cultural events, in order to include a wide variety of people that translated to different sociocultural backgrounds. In parallel, we used multiple social media and private networks to collect answers of people via the online version of the questionnaire. We constantly reviewed the variation in the sociocultural backgrounds of our respondents and adjusted our recruitments to include underrepresented groups while we proceeded with the study.

2.2. Database

In all, more than 4000 people were interviewed, leading to a database used for this study with 3717 entries, excluding some few underage persons or those that did not answer the relevant questions for this analysis. For the answering of our research questions on potential differences between people who regularly walk dogs or do not, we differentiated our respondents into two groups with (i) people that walk a dog regularly, henceforth "regular dog walkers" and (ii) those that do not, henceforth

"other people" (explanatory variable), and compared how these two groups valued urban nature (Figure 2). The underlying item refers to the question in the second section of the questionnaire, that read "Do you regularly walk a dog?" with answer options "yes" and "no" (see Table 1).

We asked for regular dog walking because we hypothesized that changes in the view of urban nature would result in an exposure to or interaction with urban greenspaces on a regular basis. We thus contrasted regular dog walkers with people that do not walk dogs at all or perform this activity only occasionally. As a limitation of our study, we did not define in the survey what regular dog walking means, which may leave space to ambiguity. However, we expected a clear differentiation between self-estimated regular dog walkers and other people since we anticipated that people who assigned themselves to the category of regular dog walkers perform this activity on a daily basis with the same dog, or at least multiple time per week (e.g., shared dog walking in a family). In contrast, the other group includes people that never or only occasionally walk a dog, e.g., when visiting dog owners or accompanying a dog-owning person at a single walk. We did not ask whether people had a dog, because dog ownership is not necessarily related to regular dog walking [18,19].

We compared how regular dog walkers and other people valued (a) the four ecosystem types and (b) the three biodiversity levels within each of these ecosystem types, and (c) these ecosystem types across five European cities (Figure 2). Our response variables were (a) the mean valuation of three levels of biodiversity in park meadows, wastelands, streetscapes and forest, respectively (i.e., the ecosystem context), (b) the valuation of each level of biodiversity in the very same ecosystem types (i.e., the biodiversity context), and (c) the mean valuation of each ecosystem type differentiated for each European city (i.e., the geographic context). The values were obtained from the Likert-scale items that reached from low valuation to high valuation of the photographic stimuli material (see above). For statistical analyses, Likert-scale answers were regarded as quasi-metric variables.

2.3. Statistical Analyses

In a first step, we used Kruskal–Wallis tests (function *kruskal.test*) to detect significant differences between regular dog walkers and other people, with regard to their mean valuation of biodiversity in park meadows, wastelands, streetscapes and forests (i.e., the ecosystem context).

In a second step, we determined with linear models (function *lm;* see, e.g., [45]) whether there are significant differences between regular dog walkers and other people with regard to their mean valuation of biodiversity in park meadows, wastelands, streetscapes and forests, and with regard to the geographical context of each respondent, referring to the five European cities Bari, Berlin, Edinburgh, Ljubljana, and Malmö. This step resulted in 4 × 5 models (i.e., the geographic context).

In a third step, we used linear models (function *lm*) to detect significant differences between regular dog walkers and other people with regard to their valuation of three biodiversity levels (low, medium, high biodiversity; plus a "no vegetation" valuation scene in streetscapes only) in park meadows, wastelands, streetscapes and forests (i.e., 4 models total; the biodiversity context). All statistical analyses were carried out using R (version 3.4.3) in the RSTUDIO environment (version 1.1.383).

3. Results

In all, 569 respondents indicated to be regular dog walkers, that is, 15% of the sample. Contrary to what we originally assumed, the results do not consistently support the idea that regular dog walkers value urban greenspaces and their biodiversity differently compared to other people. However, there were some differences in the three contexts we examined.

3.1. Ecosystem Context

In the ecosystem context, our field survey demonstrates that regular dog walkers valued wild vegetation in wastelands less than other people, but there was no difference between both groups for the valuation of park meadows, the wild vegetation in streetscapes and urban forests (Table 2).

Table 2. Details of Kruskal–Wallis tests that assessed differences in the mean valuation of greenspace settings between regular dog walkers and other people, with regard to the four urban ecosystem types in all European cities (*N* = 3716).

	All Cities			
Ecosystem Type	**n**	**Chi^2**	**df**	**p**
Park meadows	3708	2.212	1	0.137
Wastelands	1226	5.109	1	**0.024**
Streetscapes	1237	1.071	1	0.301
Forests	1240	1.400	1	0.237

3.2. Geographical Context

For the geographical context, our results reveal that throughout the European cities in our field survey and across four ecosystem types, respondents from both groups valued urban biodiversity similarly (Table 3). We determined only three differences in the valuation of regular dog walkers and other people: In Bari, there were differences in the valuation of wastelands, as there were in Berlin for park meadows, with regular dog walkers indicating a lower valuation of the respective greenspace scenes than other people. In Ljubljana, the latter group valued the wild vegetation in tree pits higher than regular dog walkers. In Edinburgh and Malmö, there were no significant differences between the valuations of any ecosystem type in the two groups of respondents.

Table 3. Details of linear models that assessed differences in the mean valuation of greenspace settings between regular dog walkers and other people, and with regard to the four urban greenspace types and the five European cities (Bari, Berlin, Edinburgh, Ljubljana, Malmö). n, number of respondents in subset; p, *p* value.

	Bari			**Berlin**			**Edinburgh**			**Ljubljana**			**Malmö**		
Ecosystem Type	**n**	**F Value**	**p**	**n**	**F Value**	**p**	**n**	**F Value**	**p**	**n**	**F Value**	**p**	**n**	**F Value**	**p**
Park meadows	861	0.086	0.770	1284	5.058	**0.024**	454	1.73	0.189	549	3.503	0.061	482	1.713	0.191
Wastelands	293	8.194	**0.005**	437	0.001	0.972	149	0.186	0.667	169	0.25	0.618	155	0.047	0.828
Streetscapes	289	0.001	0.970	414	1.156	0.283	150	1.13	0.289	191	5.809	**0.017**	162	1.219	0.271
Forests	279	0.204	0.652	430	0.018	0.894	154	0.171	0.680	190	0.885	0.348	163	0.0	0.991

3.3. Biodiversity Context

Taking a closer look at the different biodiversity levels that respondents were asked to rate, we found differences between regular dog walkers and other people only in one out of four models (Table 4). Here, regular dog walkers valued the high biodiversity level of wastelands lower than other people. All other biodiversity levels in the four ecosystem types were valued similarly by both groups of respondents.

Table 4. Details of the linear models performed for each urban ecosystem type to assess differences between regular dog walkers and other people, with regard to the three biodiversity levels within each urban ecosystem type across all European cities. In bold are significant *p* values that directly relate to our hypothesis, that is, whether there are differences between regular dog walkers or other people.

Ecosystem Type	**Coefficients**	**Estimate**	**Standard Error**	*p*
Park meadows	*Intercept*	4.404	0.029	<0.001
	Dog walking (yes)	−0.081	0.045	0.07
	Biodiversity level (Medium)	−0.001	0.040	0.98
	Biodiversity level (High)	0.734	0.040	<0.001

Table 4. *Cont.*

Ecosystem Type	Coefficients	Estimate	Standard Error	*p*
Wastelands	*Intercept*	4.051	0.053	<0.001
	Dog walking (yes)	−0.289	0.084	**<0.001**
	Biodiversity level (Medium)	0.012	0.073	0.87
	Biodiversity level (High)	0.419	0.073	<0.001
Streetscapes	*Intercept*	3.969	0.050	<0.001
	Dog walking (yes)	−0.101	0.068	0.13
	Biodiversity level (Medium)	−0.105	0.070	0.13
	Biodiversity level (High)	0.062	0.070	0.38
	Biodiversity level (No vegetation)	−2.154	0.070	<0.001
Forests	*Intercept*	4.885	0.047	<0.001
	Dog walking (yes)	−0.098	0.071	0.17
	Biodiversity level (Medium)	0.581	0.065	<0.001
	Biodiversity level (High)	0.068	0.065	0.29

4. Discussion

Interactions with nature elements in cities such as gardening, collecting herbs or visiting parks engender positive attitudes towards nature (e.g., [5–7]) and likely influence people's environmental behavior (e.g., [8]). Some studies previously stated that dog ownership—a regular interaction of many residents with urban nature in cities around the globe—positively influences people's attitudes towards other animals [34,35]. Taking this as a starting point, our study tested whether regular dog walkers reveal a more positive valuation of urban nature than other people.

The core finding of our cross-national study was that there was no support for the central hypothesis. That is, whether regular dog walker or not, people value green open space no matter what level of species richness. Where differences were identified (ca. 18% of comparisons) the differences between dog walkers and others were not consistent among urban ecosystem types, biodiversity levels, or European cities (Tables 2–4).

We believe that a largely missing effect of regular dog walking on people's view on urban nature is generalizable: This is, because our study (i) involved a large number of 3717 participants with diverse sociocultural backgrounds, including 15% of respondents that regularly walked dogs, compared to an average of 23% dog-owning households that existed 2017 in the European countries we sampled [46]; our study (ii) included several types of urban ecosystems suitable for dog walking, ranging from near-natural forests to highly managed streetscapes; and (iii) stretched over a large geographical scale in Europe, including urban residents from the Mediterranean and other parts of Europe that have been shown to differ in their view on nature (e.g., [46]). The lack of geographic differentiation is surprising because studies at the local scale (e.g., a park, a city) suggest that dog walking relates to the cultural background of people—for example, as traditions in the practice of dog walking are missing in some countries and cultures [47].

One explanation for the missing link might be that regular dog walkers are often focused on their animals, including dog-induced interactions with other animals or people. For example, it is widely known that people also visit parks with their dogs to meet other dog walkers, and dogs are a point of social contact that may act as catalyst [23]. Correspondingly, regular dog walkers might perceive the ecosystems visited during dog walking from a more social or cultural perspective and less from a nature-related perspective. This would indicate that for dog walkers, the focus is on the dog or the community of dog walkers in a park, and not—per se—on the natural surrounding they experience meanwhile. In parallel, regular dog walkers may walk their dogs for exercise in a convenient place basically; whereas those without a dog may also walk for the sake of exercise, being in nature, etc. The limited difference between dog walkers and others may be that nature is not always the driving force for people (dog walkers or others) to get out and walk.

5. Conclusions

From our study, we may conclude that dog walkers are not more environmentally aware than the rest of the population. While dog walking is omnipresent in cities worldwide, our study does not support the idea that this human–nature interaction translates to an increased valuation of urban nature. Dog walkers thus do not necessarily represent valuable allies for the conservation of urban nature. As dog walking can be associated with a range of cultural ecosystem services, but can also challenge human health and the environment (Figure 1), policies need to balance these two sides of the coin. As a practical implication from this study, urban policies should continue to develop concepts that minimize environmental impacts of dogs in urban greenspaces while taking into account the manifold cultural benefits that have been proven for dog walkers internationally.

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