

Sustainable Blue-Green Infrastructure: A social practice approach to understanding community preferences and stewardship

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ABSTRACT

Blue-Green Infrastructure (BGI) is an approach to urban flood resilience, recognised globally and in international literature, that capitalises on the benefits of working with urban green-spaces and naturalised water-flows. Literature reveals BGI's sustainable functioning and benefits-provision depend on the behaviour of those who use it, therefore local stewardship is often proposed to support maintenance. However, there is a gap in understanding the requirements and behaviours of users, as well as their potential for developing stewardship behaviours, that is not addressed through traditional analysis approaches based around demographics. Therefore, this research used correlation analysis of survey data from two locations in the UK to explore the potential contribution of Social Practice Theory (SPT) to improve such understanding. Results show statistically significant correlation (better than 1%) between performance of practices associated with urban BGI and attitudes towards BGI stewardship, whereas demographic variables showed little correlation. Reflection on the practices demonstrates that this connection is traceable through the meanings people attach to their practices, the benefits of BGI spaces as material to those practices and their competencies in relation to existing and proposed stewardship practices. Practices, it is proposed, have embedded behaviours and attitudes that transcend locational and demographic factors. These findings imply in a wider context that, for any proposed or existing BGI, understanding associated practices would improve targeting of stewardship-engagement towards users with compatible meanings and competencies. Furthermore, sustainable design of BGI would benefit from consultation with all identified user-groups in order to understand existing and potential practices.

1. Introduction

Blue-Green Infrastructure (BGI) is regarded as a more nature-friendly means of managing urban flood-risk (particularly pluvial). The phrase 'blue-green' or 'green/blue' infrastructure emerged around the turn of the last decade (Gledhill & James, 2008; Selman, 2008) from a growing awareness of the need for a more integrated systems-approach to the management of Green and Blue Infrastructure. Ghofrani, Sposito, and Faggian (2017, 15) describe BGI as 'an interconnected network of natural and designed landscape components, including water bodies and green and open spaces'; a short list of examples could include green roofs, retention and detention ponds, re-naturalised and de-culverted rivers, swales and 'bioswales', or rain gardens (Abbott et al., 2013). BGI has been argued to offer multiple further benefits, such as improvements in air and water quality, aesthetics, biodiversity and amenity (Hoyer, Dickhaut, Kronwitter, & Weber, 2011; Lawson et al., 2014). As a result, it is increasingly seen internationally as an effective way of managing flood risk and simultaneously improving the public realm (Alves, Gómez, Vojinovic, Sánchez, & Weesakul, 2018; Hoyer et al., 2011; Jiang, Zevenbergen, & Ma, 2018; Shandas, Nelson, Arendes, & Cíbor, 2010; Wong & Eadie, 2000).

Debates around the longer-term sustainability of BGI centre principally around the uncertainty of maintenance costs needed to ensure

projected benefits are delivered over installations' lifetimes (Stevens & Ogunyoye, 2012). A further complication is that the performance, and appreciation, of BGI can be positively or negatively affected by the behaviours and attitudes of facilities-users. Local stewardship has been proposed as a means of supporting longer-term BGI maintenance (Everett, Lamond, Morzillo, Master, & Chan, 2018). Stewardship in this context could include refraining from negative behaviour such as littering, and taking part in positive behaviours such as monitoring, or clearing and maintenance. As Langemeyer, Camps-Calvet, Calvet-Mir, Barthel, and Gómez-Baggethun (2018) and others have argued, stewardship of urban ecosystem services is a huge challenge – and the more BGI areas proliferate, the truer this will be. Further, Benedict and McMahon (2006) note that it is only with large- and wide-scale BGI implementation that multiple potential benefits will be realised. Recognising the tight financial constraints municipal and other bodies operate under, and the challenges and uncertainties around adoption and maintenance recognised as stymying wider BGI rollout (O'Donnell, Lamond, & Thorne, 2017; Thorne, Lawson, Ozawa, Hamlin, & Smith, 2018), the more that lay stewardship can be encouraged, the greater the potential for its wider implementation.

Contrasting findings have been reported from social surveys investigating attitudes towards BGI, in terms of perceived efficacy in flood risk management (FRM). Werritty (2006) and Johnson and Priest

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(2008) observed a preference for hard-engineered approaches, while at around the same time Kenyon (2007) observed a preference for BGI solutions. More recently, Bastien, Arthur, and McLoughlin (2012) and Wright, Arthur, Bowles, Bastien, and Unwin (2011) found a preference for using BGI. ‘Amenity’ is a frequently referenced BGI benefit (Alves et al., 2018; Ashley et al., 2013; Bastien et al., 2012; Jarvie, Arthur, & Beevers, 2017; Ossa-Moreno, Smith, & Mijic, 2017). Apostolaki and Jefferies (2005), for example, found their survey respondents most preferred ‘greener’ approaches to FRM such as ponds, as these enhanced ‘amenity’ and ‘recreation’ opportunities; Baptiste, Foley, and Smardon (2015) in Syracuse, New York similarly found that aesthetics and improvements to personal and community space were a significant factor influencing acceptance. Jarvie et al. (2017) found that a series of natural and constructed BGI ponds were valued for biodiversity and walking opportunities in Edinburgh, whilst Jose, Wade, and Jefferies (2015) surveys in Dundee found that aesthetics, well-being, educational and recreational values, as well as biodiversity, were all popular.

Behaviour around BGI may be affected by awareness of purpose and function, and perceptions of risk, amongst other things (Everett, Lamond, Morzillo, Chan, & Master, 2015), but also by where and how facilities are positioned within the public realm. While some of these studies have postulated connections between attitudes and behaviours, such work has thus far been framed only around demographics, and has produced no clear conclusions. This research therefore seeks to improve understanding of attitudes to and behaviour around BGI, and the link between attitudes, behaviour and stewardship, through the first use of Social Practice Theory (SPT) (Chapin et al., 2009; Langemeyer et al., 2018; Schatzki, 1996) in the field of BGI. Section 2 next sets out the case for using SPT to frame our analysis of community engagement potentialities.

2. Social practice and community engagement around BGI

As noted above, BGI cannot be simply an undertaking of governments, national, regional or local; to be sustainable, it will require the involvement of local publics in new stewardship practices. Engagement will be needed to achieve changes in behaviour and this is often approached through communication of potential benefits, to encourage communities to appreciate and value the BGI. Proponents of BGI often focus on amenity (Charlesworth & Warwick, 2011), as arguably the most immediately tangible benefit and therefore of most concern from social and sustainability perspectives.

The amenity concept is, however, rarely unpacked and can leave planners and designers without identifiable targets. This is unfortunate, because amenity may arguably be ‘harder to get right than more physical SuDS [Sustainable Drainage System] functions’ (Singleton, 2012, 1), being dependent on local cultures and contexts. Engagement with local communities is therefore recommended to understand preferences, but there is little understanding of who constitutes the relevant communities and how best to engage them.

As MacQueen, McLellan-Lemal, Metzger, and Kegeles (2001) stress, identifying *relevant communities* is not straightforward. Meikle and Jones (2013) propose a broad typology of five ‘community’ forms:

- Interest (people sharing similar interests or passions)
- Action (those trying to enact change)
- Place (those associating due to geographical features or boundaries)
- Practice (people who undertake similar activities or share a profession), and
- Circumstance (those brought together by external events or situations).

All of these will be relevant in thinking about how ‘communities’ (and individuals within them) are involved with BGI. This research is particularly concerned with commonalities of interest and practice within place-based populations; it does therefore not consider

communities of action and circumstance.

2.1. Social Practice Theory

Social Practice Theory (SPT) is here proposed as a framework for understanding relevant communities and their needs, motivations and capacities for contributing to the design and management of BGI. SPT considers the things people do, to reflect upon *why* and *how* they do them – and the tools, technologies and infrastructure that could enable or frustrate, encourage or discourage this and other forms of ‘doing’.

SPT derives from a family of theories influenced by Michel Foucault, Anthony Giddens, Pierre Bourdieu and others (Reckwitz, 2002); it seeks to overcome the agency/structure, individualism/holism divide mentioned above by considering the *series* (or complex) of practices of *groups* of individuals. A ‘social practice’ is defined by Reckwitz (2002, 249) as:

«... a routinised type of behaviour which consists of several elements, interconnected to one another... A practice – a way of cooking, of consuming, of working, of investigating, of taking care of oneself or of others, etc. – forms so to speak a ‘block’ whose existence necessarily depends on the existence and specific inter-connectedness of these elements, and which cannot be reduced to any one of these single elements.»

A practice consists of certain bodily *and* mental activities. If somebody ‘carries’ (and ‘carries out’) a practice, they must assume the bodily and mental patterns that constitute it. These mental patterns are not the ‘possession’ of an individual ‘deep inside’, but part of the practice.

Individual autonomy and the importance of social, cultural and economic forces are not denied; rather, it is argued that somewhere in-between and across these there lie more messy and complex spaces of practices – the social. Practices are ‘norms’ or ‘shared behavioural routines’, common sets of acts performed by groups of people (Spaargaren, 2011, 815). These social practices then become the point of interest for social analysis, rather than *individual* agency or *social* structures.

2.2. The evolution of practices

Elizabeth Shove’s *social practice framework* model (Shove, Pantzar, & Watson, 2012) argues that three elements frame the re/production of practices: Materials, Meanings and Competencies. Materials relates to the physical artefacts needed to undertake a practice, Competencies to the skills and knowledge required to perform it and Meanings to associated social norms, understandings and conventions. Practices develop iteratively through thousands of repetitions, in response to changes in materials, meanings and competencies, through innovations in behaviour and the gradual adoption (or not) of developments by others, until new dominant forms may eventually emerge. Actors will either hold to older variants, perform currently dominant ones or look to re-model conventions. Social, political and technological developments, cultural and historical influences, can all contribute to the formation and reshaping of practices (Shove & Southerton, 2000).

SPT is increasingly being used as a lens to explore behaviour change within the environmental social sciences, with respect to the greening of consumption and resource-use (Glover, 2013; Shove, 2005, 2010; Spaargaren & Mol, 2008; Spurling, McMeekin, Shove, Southerton, & Welch, 2013). However, there are as yet no studies using SPT to look at practices around BGI or the community engagement that should surround its development and post-installation.

2.3. Stewardship as a social practice

In the context of urban and *peri*-urban BGI, particularly where it is retrofit into or around existing developments, a wide range of practices may already exist. Encouraging more sustainable behaviours around

new BGI could require efforts at cultivating or encouraging new practices and/or reshaping, influencing or discouraging existing ones, such as littering. Agencies will need to understand the complex of existing practices (and how they balance and interact) to reflect upon how they can seek to strengthen old, and facilitate or enable new, positive practices.

The term Blue-Green *Infrastructure* implies a municipal quality, and so a municipal responsibility; meaning that, for some, lay stewardship should not be required (Rosol, 2011). However, those whose practices bring them into regular contact with BGI could potentially observe and report issues, and correct minor matters, far more regularly than a municipal body.

With regard to Shove *et al.*'s model cited above (2012), Materials would be BGI devices, their components (including flora) and any tools required for performance (gloves, trowels, guidebooks, etc.); Competencies, understanding the appropriate 'look' for devices, flora that should be present or not, and skills to engage appropriately, and Meanings, people's understanding and appreciation of BGI's direct immediate and multiple potential benefits, and conceptualisations of community volunteering and responsible environmental behaviour. This would imply connection with a complex of practices loosely labelled "civic participation" or "ecology" (Krasny *et al.*, 2015), people engaging because of the significance they attach to activities.

Stewardship around BGI could include not littering and vandalising, monitoring for performance, and involvement with lay clearing and maintenance (gathering litter, clearing ponds or river blockages, removing invasive species and weeds, and so forth). Community volunteers would require competencies in the specifics of stewardship and materials to do the job. Competencies and materials might overlap with other practices such as "gardening" and "home pond maintenance", such that some existing communities of practice feel more pre-skilled and suitably-equipped to offer help. However, the specifics of BGI devices may still necessitate some explanation and upskilling.

The city of Portland, Oregon for example has a volunteer Green Streets Stewards (GSS) initiative to assist with maintenance of 'bios-wales' (highly-engineered rain-gardens using native plants to extract and retain pollutants), installed as part of a citywide Green Streets programme (2010). The programme is intended to take water off the streets, reduce stormwater flooding of nearby houses, and clean the water before it returns to the Willamette and Columbia Rivers running through the centre and along the northern edge of the city, respectively. Reasons (meanings) for engaging with this scheme were expressed by a local resident (Everett, Lamond, Morzillo, Master, & Chan, 2018), when asked whether they would get involved, as being something of a localised social practice of community-care: 'Yeah sure, we could do that ... people like to do that kind of stuff around here'.

2.4. Purpose of the research

This research sought to explore how prevalent positive attitudes to BGI stewardship may be, and characteristics that could increase willingness to carry out stewardship practices. This has not generally been explored; the paper proposes SPT as an approach for investigating and seeking to connect attitudes, preferences and practices that will help or hinder BGI's functionality and sustainability. The hypothesis is that a range of practices will be undertaken in BGI areas, and these will connect with requirements, attitudes and meanings attached to the BGI. Furthermore, the paper hypothesises, they may also connect with willingness to carry out stewardship practices (more so than other characteristics more commonly studied). Support for these hypotheses through quantitative empirical analysis will lend weight to the need to examine practices in more detail.

The research also sought to trace meanings, materials and competencies that may link to these patterns of connections. In the discussion section, with reference to supporting literature, the elements of practices are discussed in relation to the empirical findings, to validate and

generalise the applicability of observed relationships. The research ultimately proposes that this evidence leads to the conclusion that understanding local *communities of practice* will help in improving BGI designs to better fit with them, and that longer-term engagement will deepen understanding, and so improve efforts to encourage stewardship behaviours through the formation, reproduction and transformation of practices.

3. Methods

Research employing SPT has historically been principally qualitative, considering respondents' understandings of activities' meanings, and historical, reviewing the documented emergence and establishment of practices. However, a number of more quantitatively-oriented researchers are emerging who demonstrate the potential value in analysing numerical social surveys with a practice-lens (Browne, Pullinger, Medd, & Anderson, 2014; Hansen, 2015). These authors propose that engaging in common practices may result in measurable shared attitudes and behaviours. The survey approach is used in this research to add empirical weight to the assertion that 'carrying' practices will influence and be influenced by aspects of individual attitudes.

For the purposes of this research, a postal survey was developed and mailed out to two different UK sites. Two sites were used to allow for inclusion of a wider range of demographic and social contexts:

- 1750 houses within 750 m of Study Site 1 (England, new development, Fig. 1), SuDS ponds installed in a development cell around the time of construction, three miles from the centre of a major conurbation;
- 2467 houses within 500 m of Study Site 2 (Northern Ireland, retrofit, Fig. 2), a retrofitted renaturalised river with improved aesthetics and amenity provision, running through a park in the centre of a major conurbation.

The sites were selected purposively as examples of BGI in multi-purpose green-spaces within urban developments. The two sites were selected within cities embracing BGI as part of an integrated strategy to help manage flood risk; both have experienced severe incidences of flooding within the last decade. The English site is part retrofit, sited between existing and new developments, whereas the Northern Irish site is retrofit within an established park. In England, the properties are subject to a maintenance charge for the BGI whereas in Northern Ireland, maintenance is the responsibility of the local authority.

A covering letter, information sheet and pre-paid return envelope were included with the survey, and recipients informed that returns would be entered into a draw for ten £25 Amazon vouchers as an incentive. A reminder postcard was issued two weeks later (with thanks and apologies to those who had already returned). Survey-responses were recorded by number and distance from the BGI to ensure data confidentiality and anonymity. Addresses were stored temporarily in a separate spreadsheet solely to record winners' details.

Aside from demographic information (demographic variables), survey questions were principally five-point Likert-score based (Strongly Like/Agree – Strongly Dislike/Disagree), for ease of completion and to produce statistically useful data, with a select number of open-text response boxes to elicit more information where useful (Brannen, 2005).

The surveys asked for opinions about BGI services seen as being provided in the existing literature (Hoyer *et al.*, 2011; Lawson *et al.*, 2014) (attitudes variables); how often respondents visited; awareness and understanding of flood risk and belief that the BGI might help, and thoughts about stewardship (stewardship variables) – whether they littered, whether they cleared litter, and whether they would be willing to carry out more demanding stewardship practices if asked. The surveys also enquired as to activities carried out (practice variables); a list was developed from observations at the English site. These were



Fig. 1. Case study site 1, England: A SuDS retention pond close to a new housing development, planted with reeds to aid with the uptake and filtration of stormwater, foster biodiversity and provide amenity opportunities. (Credit: Jessica Lamond, 2017).

specified *a priori* as selection tick-boxes: Social activities (e.g. barbecues), Playing games, Exercise, Recreation, Relaxing and Dog-walking. A free-text “Other, please specify” box provided the opportunity to identify other practices.

Survey results were analysed using SPSS v.25 to determine correlation (spearman’s rank/rho) between stewardship and demographic variables. Correlation analysis was also performed between stewardship variables and visit frequency. In recognition that the pre-specified practices are not mutually exclusive, as well as the fact that some individuals perform multiple practices, and to avoid the large number of potential combinations of practices it was necessary to categorise

respondents’ practices in some way. A cluster analysis (Browne et al., 2014) was employed on the practice variables to categorise visitor-types. Analysis of Variance (ANOVA) (Strangor, 2004) was then performed between stewardship variables and practice category to determine if there were statistically significant differences in average willingness to engage in stewardship behaviour related to visitor-type. Finally, patterns between attitudes to BGI benefits and visitor-type were explored.



Fig. 2. Case study site 2, Northern Ireland: A renaturalised river flowing smoothly after heavy rain; the work is also designed to reconnect communities and restore the river as a community asset, as well as encouraging biodiversity. (Credit: Albert Bridge, 2015).

Table 1
Demographic characteristics of respondents in two BGI study sites.

	England	Northern Ireland
Response rate	17%	13%
Median Age	45–54	45–54
Median Income	£45,000 +	£15,000–£30,000
Median Educational Level	Degree or above	Vocational Qualification
Median family size	2 adults 1 child	2 adults 1 child
Median length of residence	5 years	10 years or longer
% homeowners	92%	88%
% disabled	3%	6%
% non-white	8%	2%
Like BGI	92%	94%
Don't Litter	94%	99%
Clear litter	31%	33%
Would help clear BGI	30%	30%
Would help maintain BGI	22%	22%

4. Results

Responses received were: England, 299 (17.1%) and Northern Ireland, 329 (13.3%). There would appear to be no widely-recognised level for an 'accepted' return-rate on unsolicited surveys, smaller response rates having been found by some more representative than larger ones (Holbrook et al., 2007; Visser, Krosnick, Marquette, & Curtin, 1996), so given the spread of non/visitors and non/activity-undertakers, these responses present workable samples.

4.1. Demographics and willingness to volunteer

Key demographic features and attitudes are summarised in Table 1 below.

These statistics reflect the character of the areas and are not claimed to be representative of the communities surrounding the BGI. Importantly, there is some variability in the demographics of the households surveyed. The English site includes a highly-priced new housing development on one side of the BGI and an older development on the other; this results in some relatively low lengths of residency and high incomes. In contrast, the Northern Irish site has longer-term residents with a lower average income. Between the two sites, there are some similarities; age of respondent, high ethnic homogeneity and high home ownership.

A further similarity is shown in the stewardship variables. Despite the general positivity toward BGI, willingness to volunteer was low at both sites. Whilst the great majority (England 84%, Northern Ireland 89%) understood that BGI maintenance was important in reducing flood risk, only 22% at either site would volunteer to help maintain. A slightly higher percentage (30%) would help clear and similar numbers said they already did so (not necessarily the same respondents). However, while the proportions willing to volunteer were relatively low, they still represented sizeable minorities, boding well for community engagement potential were a scheme instigated.

In Northern Ireland, the only demographic characteristic correlated to behavioural variables was respondents' age, with older residents more likely to express willingness to volunteer and also refraining from littering. In England, the only demographic characteristic correlated to willingness to volunteer was length of residence. Demographics are therefore seen as poor predictors of willingness to carry out stewardship among these respondents.

4.2. Awareness of and visiting the BGI

Awareness and visiting were strong at both sites, although somewhat stronger in Northern Ireland (see Tables 2 and 4). The areas were strongly liked, and most respondents valued being near water, as well as the aesthetics and wildlife. A smaller number in each case, although

Table 2
Proportion of respondents liking aspects of BGI in two study sites.

	England (%)	Northern Ireland (%)
Knew about BGI before receiving the survey	83	94
Like the area	90	94
Like being near water	78	72
Like aesthetics	82	91
Like the wildlife	90	90
Like the new wildlife brought by BGI	82	81
Park good for recreation	76	95
Like park as a social space	77	91

Table 3
Proportion of residents disliking aspects of BGI in two study sites.

	England (%)	Northern Ireland (%)
don't LIKE Litter	17	42
don't LIKE Untidiness	10	11
don't LIKE Animal waste	12	50
don't LIKE Insects	22	17
don't LIKE Increased traffic	6	11

Table 4
Reported frequency of visits to BGI and park areas in two study sites.

	Count		Cumulative Percent	
	England	Northern Ireland	England	Northern Ireland
Never	40	17	13.6	5.2
Less than once a month	58	42	33.2	17.9
Monthly	34	25	44.7	25.5
Weekly	56	87	63.7	52.0
More than once a week	54	87	82.0	78.4
Daily	53	71	100.0	100.0
Total	295	329		

still a strong majority, enjoyed the new wildlife brought by the BGI. Three quarters thought that the park provided a good space for social interaction and recreation in England, whereas over nine-tenths did in Northern Ireland. Dissatisfactions such as untidiness and increased traffic were relatively low at both sites, although around a fifth did not like the insects, and litter and animal waste were significantly greater concerns in Northern Ireland (see Table 3).

People visited both sites on a regular basis (Table 4); however, on average, the frequency of visits in Northern Ireland was higher and the number of non-visiting respondents smaller. Frequency of visits correlated with 'liking', but even amongst non-visitors the majority liked having BGI in their area, rated services highly and some even indicated they would be willing to help with stewardship. However, frequency of visits was not monotonically related to willingness, nor was the relationship between frequency and willingness the same between sites.

This perhaps suggests that not all visits are equal in the sense of increasing engagement, sense of ownership and so willingness to volunteer. It would therefore be useful to break down the reasons for visiting and associated practices, meanings and competencies.

4.3. Social practices in the parks

The survey results can usefully be examined using an SPT lens to explore the range, diversity and relative popularity of activities. Apart from the pre-specified practices, respondents mentioned commuting (school and work, a high proportion of responses) and wildlife activities (pond-dipping). Some respondents did not identify practices, and non-

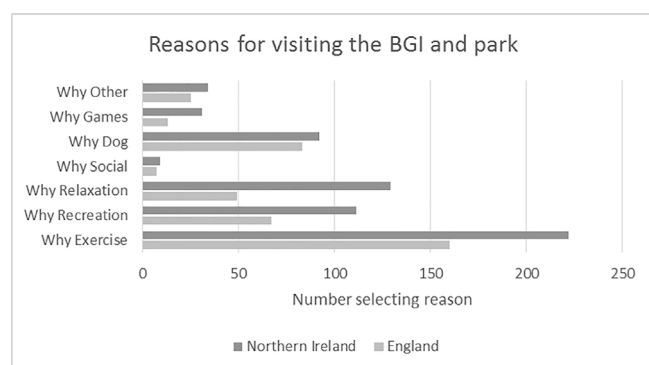


Fig. 3. Respondents' reasons for visiting BGI area (number selecting reason).

visitors clearly did not perform any practices.

The breakdown of responses amongst our pre-specified activities is shown in Fig. 3. The aggregated total of 'reasons for visiting' is greater than the number of respondents, as people could select multiple reasons. Dog-walking and exercising were a common combination, as were recreation and games. Exercise was the most common reason given for both sites. Dog-walking was second most popular in England and fourth in Northern Ireland. There were higher numbers of respondents in Northern Ireland visiting for all reasons, but particularly exercising, recreation and relaxation. This may reflect the character of the area, with more facilities provided.

As a result of the cluster analysis in England, responses were loosely grouped into four categories – non-visitors, pure exercisers, exercise and leisure, and dog-walkers. In Northern Ireland, the categorisation was subtler, splitting exercisers into active game-seekers, relaxation exercisers and pure exercisers. Balancing the need for consistency across sites, the categorisation developed into six main types (Table 5): *Pure exercisers* (who selected only this option); *dog-walkers* (those who selected this were classified as such, regardless of other activities); *active recreational exercisers* (including games or recreation with exercising), and *relaxation and social exercisers*. Cluster 5 covers those who selected neither exercise nor dog-walking, and cluster 6 non-visitors and those who gave no reason. The common characteristics of people clustered by practices were then explored.

One of the main distinguishing features between these groups was the frequency with which practices were performed, ranging from never (non-visitors) through to daily (dog-walkers). Dog-walkers were much more likely to visit daily (over 80% for both sites) and 'more than once a week' visitors included people playing games and those engaging in social activities; all other groups visited on average once a week, with the least frequent being recreational. Pure exerciser habits varied the most, with some visiting daily but a larger subset visiting less than once a month.

The categorisation was clearly associated with existing litter practices and expressed willingness to undertake stewardship (Table 6). ANOVA shows that not dropping litter and average willingness to perform active stewardship within practice categories showed statistically significant differences. However, the practice of currently clearing litter did not. The detailed patterns of responses are shown in Fig. 4.

Table 5
Categorisation of practices performed in the BGI and surrounding area.

SPT Category	England	Northern Ireland
1. Pure Exercisers	22.7%	19.1%
2. Dog-walkers (regardless of other activities)	28.1%	28.0%
3. Active recreational exercisers	13.0%	20.4%
4. Relaxation and social exercisers	5.4%	12.8%
5. Other reasons	16.4%	15.2%
6. Non-visitors or no reason given	14.4%	4.6%

Table 6
Summary of ANOVA significance testing, stewardship variables vs. practice category.

Impact of practice group on clearing	England		Northern Ireland	
	F-Statistic	Significance	F-Statistic	Significance
*sig at 5% **sig at 1%				
I don't litter	5.8	0.000**	2.4	0.038*
I clear litter	1.8	0.104	0.5	0.746
I would volunteer to clear	3.9	0.002**	4.4	0.001**
I would volunteer to maintain	3.7	0.003**	4.8	0.000**

Littering was denied by most people, however the least likely to litter were active recreational and relaxation visitors. Just under one-third of people said they already cleared litter and these were more likely to be dog-walkers and active recreational exercisers in Northern Ireland, and active recreational and relaxation visitors in England.

Active recreational exercisers were the most willing to volunteer for stewardship and pure exercisers the least; dog-walkers and relaxation visitors fell somewhere in between, and non-visitors were understandably least willing. Broadly speaking, those with multiple visiting reasons, for example 'exercise + recreation', were more likely to be already collecting litter and slightly more likely to express stewardship willingness (see Fig. 4).

Wildlife attitudes varied. Dog-walkers and active recreational visitors were more likely to strongly identify with benefit statements about animals and wildlife than other groups, whereas when negatives associated with insects and animal waste were mentioned, dog-walkers were least likely to associate with these negative statements in Northern Ireland but the active recreation group least likely in England. Most people were very concerned about the areas' aesthetics, even non-visitors. However, active recreational and relaxation users seemed marginally more concerned, with pure exercisers and others marginally less so.

Access was unsurprisingly rated as being more difficult by those who did not visit, and these were also among the groups where more people stated they would like to visit more often. In England 50%, and in Northern Ireland 65%, of respondents wanted to visit more frequently. Dog-walkers were the least likely to want to visit more (already visiting much more frequently, in any case) and those seeking relaxation the most, around 70% for both sites.

Most people agreed the BGI areas were a social space, even those that did not visit. Dog-walkers were most likely to see strengthened social relations, with almost half in England and over 60% in Northern Ireland agreeing they had met new people, compared with less than 10% of pure exercisers in England and 40% in Northern Ireland.

5. Discussion

This study proposed using Social Practice Theory (SPT) as a lens to improve understanding of people's modes of involvement with Blue-Green Infrastructure (BGI), rather than simply looking at demographics, and connecting this back to expressed willingness to perform stewardship.

5.1. Insights from using an SPT lens

Through a critical examination of the literature, it was found that SPT would be useful in addressing gaps in understanding around appreciation of BGI's multiple benefits, the amenity and recreation dimensions of which are as-yet poorly understood in literature and practice (Apostolaki & Jefferies, 2005; Wallingford, 2003). Improved understanding of these benefits would be facilitated through considering users' social practices, because meanings and materials will be inextricably linked to the concept of such spaces as providers of

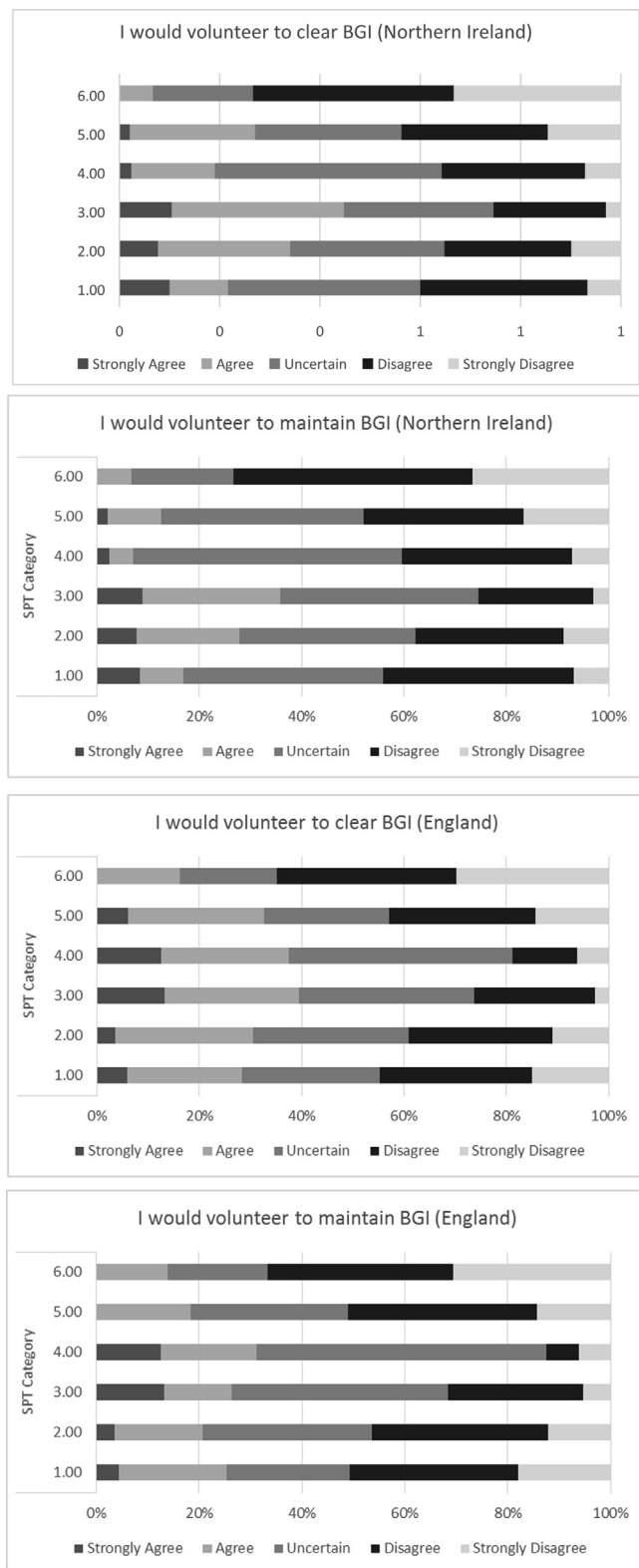


Fig. 4. Stated willingness to volunteer to clear and to maintain, BGI percentage of agreement by practice category.

amenity and recreation.

Empirical analysis of survey data from residences proximate to the two BGI sites saw that demographics shed little light on respondents' stewardship willingness and that visit-frequency, although related, showed a non-monotonic relationship with willingness. This resonates with Baptiste et al. (2015) finding that demographics had no

relationship with levels of green stormwater infrastructure acceptance. However, by grouping respondents through practices, some subtle but statistically significant patterns emerged whereby carriers of certain practices were more likely to express willingness than others.

A rational interpretation of these empirical observations (willingness vs. practice) is that concern for, and therefore engagement with, a space's amenity is less related to visit frequency than to the practices performed during visits (and therefore the elements associated with them). Material requirements of the space are different depending on the practice performed, Competencies employed in undertaking practices vary in their connectivity to the space and the Meanings associated translate into differing conceptualisations of amenity and aesthetic value. Although the quantitative survey employed does not allow in-depth analysis of each element, the following section draws on some existing knowledge of practices to validate this interpretation.

5.2. Unpacking BGI practices

In broad terms, of those less inclined to volunteer, dog-walkers and pure exercisers (walking, running, cycling, etc.) may have a more functional view of the space, where the material requirements are simply space and paths to exercise self and pets. Competencies would be those required for walking (and running), as mentioned by Harries and Rettie (2016); bodily mobilisation skills and the ability to navigate between locations. Dog-walkers also need skills of judgement and control in exercising pets within acceptable timescales and resource investment, while obeying park norms and conventions on lead management, waste disposal and dog-to-dog behaviour. Pure exercisers' competencies relate to the exercise they perform, such as monitoring cardio-vascular performance, balancing and manoeuvring a bicycle, ensuring hydration, etc. (see for example Spotswood, Chatterton, Tapp, & Williams, 2015), as well as material equipment requirements.

For those in the "other" category using the space to transit, walking is a dispersed practice embedded within other sets of integrative practices (a means to an end, walking to school or work), whereas dog-walking and walking for exercise position walking as an end-goal (Harries & Rettie, 2016). Where walking is not the goal, they argue, it carries less meaning and is not the focus of attention; it becomes a competency, a means to another desired end, and involvement with the space in which it is performed also reduces.

The increased social engagement of dog-walkers may indicate that they attribute meaning to human/animal interactions more than human/nature interactions and use these to establish and explore changes in practice norms. This accords with findings on dog-walking that show highly social motivations (Cutt, Billie Giles-Corti, Wood, & Burke, 2008). Conversely, relaxation exercisers and game-seekers are more concerned with the material requirements of adequate areas for their practice (aesthetic and amenity value), making sure not to leave litter.

5.3. Practices and preferences, materials and meanings

Literature sheds some light on how practices may translate into preferences and how to cluster and unpick practices. Dog-walking and outdoor exercise associate with meanings of health, keeping individuals and/or pets healthy (Christian et al., 2013). Spaces will require health-related aspects such as good air quality and unrestricted (uncluttered) space for exercise, dog-walkers also appreciating water-sources for drinking, and trees and bushes (Cutt et al., 2008).

Walking, or cycling, to a place of work, school or social activity may imply different meanings; duty and routine (work) or pleasure (social), material requirements being possibly clear, shorter navigation routes and less interrupting traffic, with health and aesthetic considerations less important. This group may be less positive toward the provision of water features that could lengthen their route.

Relaxation, recreation and social activities will have meanings

associated with mental rather than physical amenity; aesthetics, peace and quiet and the presence of flora and fauna are likely to be more important. The practices of relaxation and social gathering imply more static activities; talking, perhaps sitting around and the provision of sheltered and attractive areas. For some, this may be best served by spaces away from routes used for transit, dog-walkers and joggers.

Most involved of all with the physical space might be those pursuing wildlife activities or playing games. Young families engaging in pond-dipping (mentioned by some in the “other” category), and natural history enthusiasts, in particular, may ascribe great meaning to the presence of wildlife and be highly-concerned with water quality, flora diversity and general cleanliness. Families and groups already physically interacting with BGI also may be motivated by the “performativity” aspects of family nature activities (Humberstone & Stan, 2012), valuing the social practice of shared nature activities in and of themselves. Logically, they would be presumed to be more motivated to help with stewardship practices helping to foster wildlife, such as pond-clearing, litter-picking and planting/plant clearance.

5.4. SPT, community engagement and design

With the retrofit of BGI into existing urban green spaces, this analysis demonstrates that SPT could be used to understand the potential or actual effects on social practices (disruption or enhancement) from changes introduced into spaces. In future cases of retrofit, populations could be surveyed once desired hydrological and ecological outcomes were identified, prior to any design work; identifying existing practices, provisionally developing ideas around different groups’ potential for stewardship activities and then orienting engagement towards these groups to improve buy-in, sense of ‘ownership’ and stewardship potential. With new developments, SPT could be used to hypothesise likely practices from work with existent communities and careful use of wider studies. Practitioners could then include provisions likely to encourage more ‘ownership’, helpful practices and sense of amenity (paths, seating, flora and viewing areas, for example). In both cases, they could employ a social practice approach to help with identifying and seeking to accommodate ‘the often non-compatible needs of the users’ (Riechers, Barkmann, & Tschardtke, 2018, 166); providing alternative-use spaces for practices that might not fit with others (active ball-sports and quiet rest areas – or mountain bikers and runners, Santos, Mendes, & Vasco, 2016), or discouraging less socially-acceptable practices (drinking, drug-use and rough sleeping).

During the operational phase, SPT has been argued to be useful in identifying and characterizing diverse agentive communities, allowing insight into the meanings they assign BGI spaces. SPT may also help us understand which groups have the competencies, and even materials, to facilitate the development and adoption of stewardship practices. This could enable more meaningful, timely and cost-effective engagement; it is typically problematic to engage with an amorphous ‘community of place’ defined solely by locality, and there may be more self-recognised and agentive communities (of interest, action, practice and circumstance) ready to be engaged (Meikle & Jones, 2013).

Articulated clearly and with a solid evidence-based grounding, findings from this and further research could hopefully encourage practitioners to adopt an SPT approach. They might survey local populations and users, evaluate proposals’ strengths and weaknesses around observed practices (or lack thereof), and then cross-compare with experiences from similar developments. It could also allow practitioners to prioritise scheme consultees, ensuring representation from a range of actual or potential users.

Practitioners’ confidence could be strengthened by empirical evidence that SPT offers new insight into user-groups’ attitudes and behaviours. The paper therefore makes a significant contribution in demonstrating that categorizing BGI users by practices can provide greater insight into meanings and behaviours than simple demographics.

The findings furthermore suggest that increasing BGI’s social and activity offers (following careful consultation and analysis of existing practice) could improve sustainability, given individuals using spaces for recreation are more willing to undertake stewardship. Creative thinking about practices could encourage local non-visitors into these spaces to take part in recreational activities and felt benefits then be enhanced through greater exposure.

5.5. Study limitations

Whilst the study focused on just two UK sites, the employment of SPT as an analytical lens around BGI is generalisable as a global analytical approach – although the types of practices linked to meanings and materials, as well as their detailed performance, would be location and BGI-installation specific. A number of studies have, for example, looked in detail at the practice of dog-walking in relation to perceptions of other types of public realm across France (Tissot, 2011), Australia (Cutt et al., 2008) and Canada (McCormack, Graham, Christian, Toohey, & Rock, 2016). SPT could therefore be used internationally to understand more about local communities’ preferences, behaviour and capacities or dis/inclinations to adopt BGI stewardship roles. Further research could usefully explore the types of practices associated with stewardship of other types of BGI, for example rain gardens, green roofs, swales, etc.

The study did not allow for detailed exploration of correlations between observed practices and competencies or materials. In-depth study of existing practices, and mapping onto proposed new or modified ones, would improve understanding of how positive behaviours can be encouraged. In particular, it would be important to understand more about proposed new practices (such as stewardship), to consider how they might evolve from existing clusters. It is likely that a two-stage approach would be needed to gain a fuller picture; a survey or observational phase coupled with an in-depth practice analysis.

The study also neglected to look at ‘agents for change’ as a type of community, partly because this is not a practice tied to visiting the spaces. The social practices of community action, lobbying, volunteering etc. are very relevant to our understanding of BGI sustainability and warrant further investigation. Other unobserved practices may also be relevant.

6. Conclusion

This research finds that a social practice approach to improving BGI sustainability could be useful, because community attitudes and actions will be inextricably linked to the amenity and recreation functions provided.

Survey data analysis demonstrates that there is a degree of correlation between individuals’ practices in BGI spaces, their preferences and assigned meanings for the space and their actual and potential behaviour.

While the surveyed communities valued BGI regardless of their use and frequency of visit, expressed willingness to engage positively with stewardship practices increased if their use included leisure, recreation or play rather than purely exercise or transit.

The study therefore provides unique empirical evidence that inclusion of features specifically targeted at leisure, recreation or play in multi-purpose BGI spaces could improve sustainability through improved involvement and willingness to contribute to practices such as lay clearing and maintenance.

Further detailed deconstruction of typical practices around BGI will be required to provide practitioners with a deeper understanding of the intersection between existing and new practices. There is also a need to examine social practices such as community action that will intersect with those performed within BGI spaces.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.landurbplan.2019.103639>.

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