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Research Paper

All about the 'wow factor'? The relationships between aesthetics, restorative effect and perceived biodiversity in designed urban planting

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HIGHLIGHTS

- Strongest correlation between perceived attractiveness and perceived insect benefit.
- Positive correlation between perceived attractiveness and restorative effect.
- Planting with flower cover 27% or above perceived as most attractive.
- Subtle green planting afforded greatest restorative effect.
- Planting with moderate or most natural structure most restorative.

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ABSTRACT

Urban populations experience the multiple health and well-being benefits of nature predominantly via urban green infrastructure. If this is to be designed and managed optimally for both nature and people, there is an urgent need for greater understanding of the complex relationships between human aesthetic experience, well-being and actual or perceived biodiversity. This integrative study assessed human aesthetic reaction, restorative effect and perceived biodiversity in relation to fine-grained categories of woodland, shrub and herbaceous planting. We surveyed 1411 members of the public who walked through planting of varying structure, species character and percentage flower cover whilst completing a site-based questionnaire. Semi-structured, in-depth interviews were then carried out with 34 questionnaire participants. Correlations between perceived attractiveness and perceived biodiversity were identified for three out of four biodiversity indicators. There was a correlation between perceived attractiveness and restorative effect yet this was not strong. Colourful planting with flower cover above a critical threshold (27%) was associated with the highest level of aesthetic preference. Subtle green 'background' planting afforded a restorative effect. These results are discussed with reference to the Circumplex Model of Affect. Our findings indicate that people appreciate colourful flowering public planting for the 'wow factor', but that green planting outside the narrow flowering season of most species is greatly valued. Planting moderately or most natural in structure was perceived as significantly more restorative than that least natural in structure suggesting that people in the UK may be increasingly accepting of a messier 'ecological aesthetic' in urban planting.

1. Introduction

During the last decade much evidence has accrued to support the proposition that exposure to natural environments and their associated wildlife has multiple benefits for human health and well-being (for reviews see Clark et al., 2014; Jorgensen and Gobster, 2010; Velarde, Fry, and Tveit, 2007), yet the world's increasingly urban population is becoming less likely to have direct contact with nature (Soga and Gaston, 2016). The need for urban green spaces to foster physical and psychological well-being has therefore becoming a key focus of urban policy (for example, GCV, Green Network Partnership, 2016; GLA, 2015). Running in parallel with this is a desire to halt the loss of biodiversity and ecosystem services, as for example in the EU Biodiversity strategy 2020. In the UK a recent change in national policy (Health and Social Care Act,

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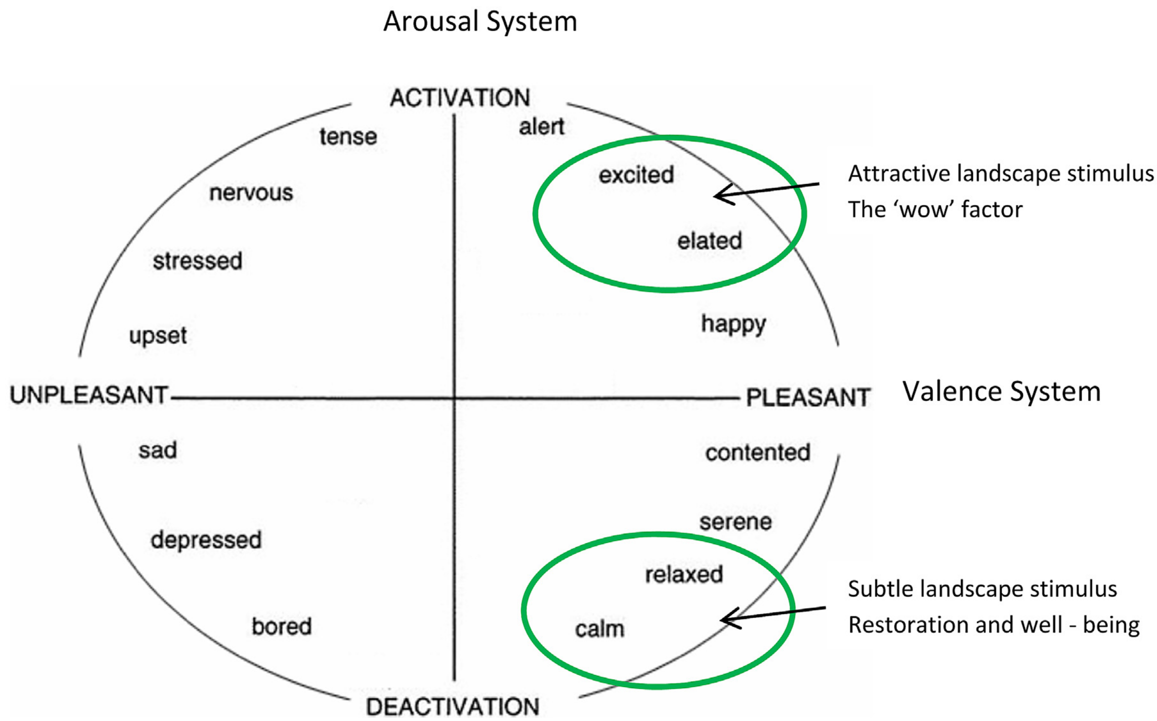

Fig. 1. Graphical representation of circumplex model of effect from Posner et al. (2005) adapted to show impact of contrasting landscape stimuli.

2012) and the adoption of the National Planning Policy Framework, provide the opportunity for planners and landscape architects to work more closely with public health agencies to create public green infrastructure which is popular with local people, beneficial in terms of health and well-being, and ecologically biodiverse.

Much contemporary well-being research incorporates measures based on Attention Restoration Theory (ART), (Kaplan and Kaplan, 1989). This proposes that if an individual is engaged in a task which requires directed attention for a prolonged period of time, they will become mentally fatigued (Staats, Jahncke, Herzog, and Hartig, 2016; Stevens, 2014). Recovery (restorative effect) is most likely within settings in which it is possible to escape the routine environment by 'being away' (Kaplan, 2001); finding a 'whole other world', which provides opportunities for effortless attention or 'fascination'; and 'compatibility' with an individual's purpose or intent (Kaplan, 1995). Natural settings have these characteristics (Herzog, Maguire, and Nebel, 2003). An alternative approach focuses specifically on the human aesthetic response to contrasting built and vegetated urban landscapes (Ulrich, 1986) and the 'affective (emotional) response' of the observer.

For landscape architecture and planning a major shortcoming of attention restoration research (Hartig and Staats, 2006; Hartig, Mang, and Evans, 1991; Herzog, Black, Fountaine, and Knotts, 1997; Herzog et al., 2003; Staats et al., 2016; Stevens, 2014) and earlier studies of human aesthetic response (Berlyne, 1971; Ulrich, 1986, 1983) has been the treatment of natural spaces as homogenous (Clark et al., 2014; Van den Berg, Jorgensen, and Wilson, 2014; Velarde et al., 2007). Stevens, (2014) compared the perceived restorativeness of natural and urban environments by showing research participants images from either 'nature' or 'cities' categories. Staats et al. (2016) compared the general preference and likelihood of achieving psychological restoration in a park, café, shopping mall or walking along a busy street, with the 'park' treated as one homogenous area of green space. Growing awareness of the need for a much more nuanced understanding of how the form, composition and character of plantings of trees, shrubs and herbaceous plants are perceived and preferred has generated three parallel strands of literature addressing firstly, the relationship between varying biodiversity levels and human aesthetic preference, secondly the relationship between biodiversity and restorative effect or well-being and thirdly the relationship between varying aesthetics of green space and restorative effect or well-being.

The relationship between human aesthetic response and biodiversity is complex. Jorgensen, Hitchmough, & Dunnett (2007) concluded that residents of Warrington, UK had both positive and negative feelings towards the 'trees and greenery' that formed the biodiverse 'ecological style' of woodland surrounding their homes. Planting was perceived as attractive, although many residents had concerns about threats to personal safety related to lack of sight lines in dense planting. A study by Qiu, Lindberg, & Nielson (2013) revealed a negative relationship between people's preferences and biodiversity within four contrasting habitat zones of a Swedish park. Participants directed negative comments towards the 'wild-looking' woodlands with the highest biodiversity value, and positive ones towards the ornamental park habitat with the lowest biodiversity value, perhaps because urban residents are most familiar with a cultural context of the 'deep pervasive cultural norm' of 'care' (Nassauer, 2011). More ecologically diverse plantings may be perceived as messy and disordered because they do not contain the 'cues to care', i.e., subconscious indicators of human intervention in the landscape such as clipped edges and close mown lawns. A recent study (Palliwoda, Kowarik, and von der Lippe, 2017) focusing on human-biodiversity interactions at the individual species-level in two parks in Berlin revealed that 12% of total observed activities involved interactions with plants based around 'biodiversity experience' as well as 'consumption' and 'decoration'. Gobster, Nassauer, Daniel, & Fry (2007) focus specifically on the relationship between aesthetics and ecology, concluding that future landscape design should be able to create landscapes that are both ecologically biodiverse and aesthetically pleasing.

Table 1
The planting typology: The criteria (planting structure and species character) used to define the nine types of woodland, shrub and herbaceous vegetation used in the study.

Species Character similarity to natural vegetation ↓ / Structural similarity to natural vegetation →	least natural	moderately natural	most natural
least natural	**Structure**: Simple, largely single layer. Isolated trees or shrubs, discrete 'blocks' of shrubs/herbaceous plants. Strong cues to being designed **Character:** Mostly non – native species of different appearance to those found in relevant reference ecosystem	**Structure**: Intermediate **Character:** Mostly non – native species of different appearance to those found in relevant reference ecosystem	**Structure**: Complex, two or three layers. Trees, shrubs, and herbaceous species randomly mixed together. Cues to being designed absent. **Character:** Mostly non – native species of different appearance to those found in relevant reference ecosystem
moderately natural	**Structure**: Simple, largely single layer. Isolated trees or shrubs, discrete 'blocks' of shrubs/herbaceous plants. Strong cues to being designed **Character**: Intermediate	**Structure**: Intermediate **Character**: Intermediate	**Structure**: Complex, two or three layers. Trees, shrubs, and herbaceous species randomly mixed together. Cues to being designed absent. **Character:** Intermediate
most natural	**Structure**: Simple, largely single layer. Isolated trees or shrubs, discrete 'blocks' of shrubs/herbaceous plants. Strong cues to being designed **Character**: Native species with appearance same as/similar to relevant reference ecosystem	**Structure**: Intermediate **Character:** Native species with appearance same as/similar to relevant reference ecosystem	**Structure**: Complex, two or three layers. Trees, shrubs, and herbaceous species randomly mixed together. Cues to being designed absent. **Character**: Native species with appearance same as/similar to relevant reference ecosystem

Over the last 10 years urban ecologists have sought to evidence and correlate the health and well-being benefits of exposure to green space with actual and perceived levels of biodiversity within green space. Two studies carried out in Sheffield, UK, used plant, butterfly and bird species richness as biodiversity indicators. The first (Fuller, Irvine, Devine-Wright, Warren, and Gaston, 2007) identified a positive relationship between self-reported well-being and actual biodiversity levels, whereas the second (Dallimer et al., 2012) found no such relationship, yet identified a positive relationship between well-being and perceived biodiversity. A recent study (Carrus et al., 2015) conducted in four medium-to-large size Italian cities revealed the positive role of biodiversity upon perceived restorative properties and self-reported benefits for urban and peri-urban green spaces.

Most studies have identified a positive association between aesthetic or visual preference and restorative effect (Herzog et al., 2003; Laumann, Garling, and Stormak, 2001; Nordh, Hartig, Hagerhall, and Fry, 2009; Pals, Steg, Siero, and van der Zee, 2009; Pazhouhanfar and Kamal, 2014; Purcell, Peron, and Berto, 2001; Tenngart Ivarsson and Hagerhall, 2008; Van den Berg, Koole, and Van der Wulp, 2003), although the strength of that association has varied. Purcell et al. (2001), observed a particularly high correlation (0.81) between visual preference and the Perceived Restorative Scale. A later study of Norwegian urban 'pocket parks' (Nordh et al., 2009) concluded that restorative effect was positively related to the percentage of grass-covered surface and the amount of visible trees and bushes. Pazhouhanfar & Kamal (2014) found a positive relationship between three out of four predictors of visual landscape preference (Complexity, Coherence, Mystery) and Perceived Restorative Potential (PRP), but no relationship between the fourth predictor, Legibility, and PRP. In contrast, research focusing on the impact on psychological well-being of walking in 'wild' and 'tended' urban forests (Martens, Gutscher, and Bauer, 2011) revealed a more positive well-being affect from walking in the latter, yet no relationship between perceived attractiveness and well-being. Van den Berg et al. (2014) differentiated between four setting types; urban street, parkland, tended woodland and wild woods. Their findings revealed no significant relationship between restorative potential and setting types, although there was a relationship between restorativeness and perceived 'naturalness'.

We identified a need to move from these parallel strands of thought to a more integrative approach. If public green infrastructure is to be designed and managed optimally, the complex relationships between human aesthetic experience, restorative effect and well-being, and perceived and actual biodiversity in relation to varying 'natural' environments need to be better understood. A useful concept to approach this by is the Circumplex Model of Affect (Russell, 1980). Originally used in psychology, and more recently applied to neuroscience (Posner, Russell, and Peterson, 2005) the Circumplex Model (Fig. 1) can be used to understand human emotional (affective) reactions. It proposes that all human reactions or affective states arise from two overlapping systems; one related to valence, a pleasure-displeasure continuum, and the second related to a degree of arousal or alertness, i.e., 'activation' to 'deactivation' (Russell, 1980). Each emotion is then understood as a linear combination of valence and alertness. The emotions 'excited', 'elated', 'relaxed' and 'calm' are all associated with a positive valence, yet all involve a different degree of 'arousal'. The model has been applied recently in the investigation of children's experiences with nature in a botanical garden (Linzmayer, Halpenny, and Walker, 2014). Our study builds on this with a large sample of 1411 questionnaire participants, and a wider range of landscape stimuli. We apply the Circumplex Model of Affect (Russell, 1980) to interpret varying human reactions to planted environments. We focus

Fig. 2. Images of actual case study sites representing the planting types defined by structure & species character used in woodland questionnaire surveys.

Table 2
On-site questionnaire: Individual attitudinal statements and questions used to address participants' perceptions of the (a) aesthetic qualities, (b) restorative effects (c) biodiversity value of the planting.

Research theme	Questionnaire Measures (Individual attitudinal statements & questions)
Aesthetic qualities	The planting along this walk is interesting
	The planting on this walk is attractive
	The planting on this walk looks natural
	The planting on this walk looks cared for
	The planting on this walk looks designed
	The planting on this walk looks tidy
	The planting on this walk looks familiar to me
	The planting on this walk is colourful
	The combination of colours is attractive in this planting How structurally complex would you describe this planting?
Restorative effects	I feel comfortable on this walk
	This walk allows me to escape more mundane routines and work
	I feel relaxed on this walk
	This walk reveals a special unique place
Perceived biodiversity value	How many different plant species do you think there are here?
	How many native UK plant species do you think are in this planting?
	The planting along this walk appears good for butterflies, bees and other insects
	How many species of native UK insects (flies, butterflies, bees) do you think this planting will support?

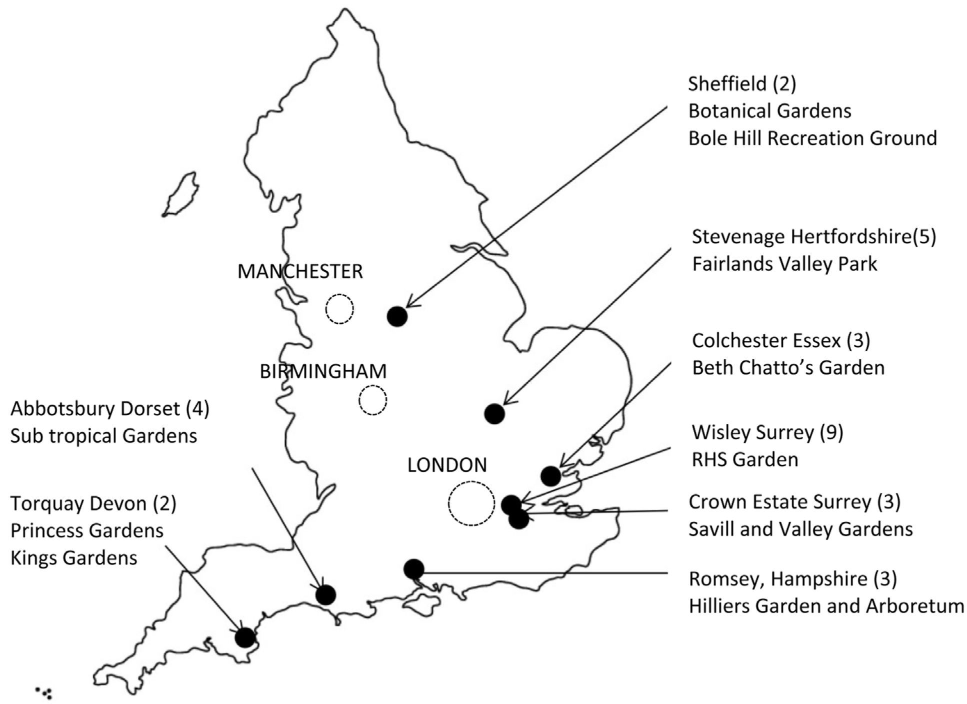

Fig. 3. Geographical distribution of case study sites (n = 31) throughout England.

(a) (b)

Fig. 4. On-site walks were marked along existing paths: RHS Wisley, Surrey (a) and Sheffield Botanical Garden (b).

on public perception of the: aesthetic qualities, restorative effect and perceived biodiversity of the planting. We investigate whether varying emotions are triggered by walking through planting of a particular structure and species character and with varying percentage flower cover. Previous studies have indicated that flowers induce powerful positive emotions (Haviland-Jones, Hale, Wilson, and McGuire, 2005). We propose that planting perceived as highly attractive may result in 'excitement' and 'elation'. These emotions are the product of a high degree of 'arousal'. In contrast, the emotions 'calm' and 'relaxed' are relatively much closer to 'deactivation'. These calm, relaxed affective responses may be generated by less dramatic planting, resulting in a restorative effect. Interpreting human affective response to varying landscape stimuli via this framework might also elucidate the complex and conflicting evidence, for example (Martens et al., 2011; Purcell et al., 2001) concerning the relationship between aesthetic preference, restorative effect and well-being. The research questions we addressed were as follows: (a) How does perceived attractiveness relate to perceived biodiversity? (b) How does restorative effect relate to perceived biodiversity? (c) How does perceived attractiveness relate to restorative effect?

2. Methods

2.1. The planting typology and case study sites

A typology of 9 planting types was first developed across each of three vegetation communities: woodland, shrub and herbaceous. Individual planting types were defined by gradients in planting structure and species character for each community (Table 1). Structure refers to the manner in which plants are layered through the third dimension. Species character is derived from the appearance of the species present on a gradient from native to non-native. These variables were selected because they define the relative 'naturalness' of the planting, and are qualities which are readily manipulated in urban areas by landscape architects. In the UK 'natural' vegetation is exemplified by multi-layered broad-leaved deciduous woodland, shrubby woodland edge and herbaceous communities of tall grasses and forbs, all composed of native species. We identified three levels of structure and species character for each community in relation to these reference ecosystems: 'most natural', 'moderately natural' and 'least natural'. These structure/species character levels interacted to generate the nine types

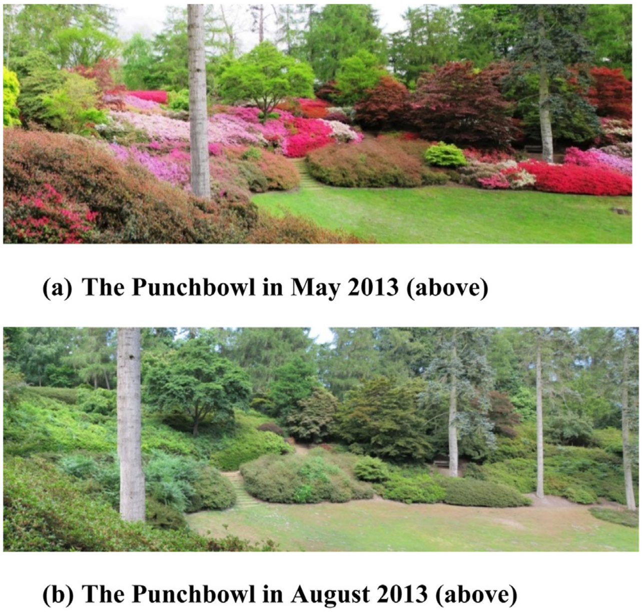

Fig. 5. Planting at 'The Punchbowl' (Valley Gardens), Crown Estate. Vibrant planting with a flower cover above 27% (a) was considered the most attractive and associated with the 'wow factor', whereas subtle greens (b) were associated with a greater restorative effect.

for each vegetation community (Table 1). For example, in the case of woodland, a multi-layered system represents the 'most natural' structure, and in contrast, a single layer of arboretum-style trees represents a highly designed 'least natural' structure. Broadleaved deciduous trees represent the 'most natural' species character, whereas broadleaved evergreen species such as *Eucalyptus* and *Cordyline australis* are 'least natural' in species character (Fig. 2). Specific case study sites were then identified to represent the combined structure and character levels (types) of relative 'naturalness' for each vegetation community: woodland, shrub and herbaceous (Figs. 2 and 3).

The additional planting variable 'percentage flower cover' was calculated using panoramic photographs of the planting taken by the researcher during the on-site walks/questionnaires. The percentage vegetated surface covered by flower was recorded.

2.2. On-site questionnaires

Participants (useable sample size n = 1411) walked through and observed contrasting areas of planting that corresponded with our combined structure/character planting types within each of the three vegetation communities. Surveys were conducted during different seasons, at 31 different sites within 8 locations in England. The geographical-climatic spread of sites (Fig. 3) facilitated the capture of the appropriate structure/character combinations. Dorset (Abbotsbury) and Torquay (Devon) provided examples of near Mediterranean plantings. Many locations, for example RHS Wisley in Surrey and Fairlands Valley Park in Stevenage, provided a number of case study sites. Each respondent took part in one walk only and completed a questionnaire as they walked, commenting on the planting at a human experiential scale.

2.2.1. Questionnaire design and procedure

The questionnaire was designed to capture respondents' perceptions of the aesthetic qualities, restorative effect and perceived biodiversity value of the planting (Table 2). A section focusing on the respondents' demographic characteristics was also included. At the end of the questionnaire respondents were invited to leave their email address or telephone number with a view to taking part in a follow-up interview.

After ethical clearance, the questionnaire was piloted in April and May 2012 in woodland areas at RHS Wisley, Surrey and at Fairlands Valley Park Stevenage. Short (approximately 30 m) walks (after Martens et al., 2011) were established and marked along paths through sections of planting which best represented a particular planting type at the case study site (Fig. 4). All site-users walking through or adjacent to the marked section of planting were approached as potential participants. Participants had the opportunity to walk independently and to engage fully with the planting. All walks were carried out in relatively comparable weather: dry days with low wind speeds. The limitations of this method are that specific light or weather conditions, or the exact configuration of plants cannot be controlled as in photographs, (Purcell and Lamb, 1998; Purcell et al., 2001), digitally manipulated photographs (Jorgensen, Hitchmough, and Calvert, 2002; Todorova, Asakawa, and Aikoh, 2004), or videos (Van den Berg et al., 2014), yet we concluded that for the purposes of this study the three-dimensional multi-experiential benefits of the immersive approach outweighed these disadvantages. All (n = 1411) surveys were completed during spring, summer and autumn 2012 and 2013. This comprised 595 questionnaires at 13 different woodland sites, 348 at 8 different shrub sites and 486 at 10 different herbaceous sites.

2.2.2. Questionnaire data analysis

All questionnaire data were analysed using SPSS version 20. Principal Components Analysis (PCA) with a varimax rotation was applied to the data for all vegetation communities to identify questionnaire items that varied in a consistent pattern and loaded onto single components, each measuring specific dimension of participants' perceptions (Table 3). Meaningful components were extracted via parallel analysis (Watkins, 2005).

ANOVA techniques were then used to explore these components' relationships with each planting variable ('structure', 'character', % flower cover, 'vegetation community') and respondents' demographic characteristics. One-way ANOVA (Table 6) was first conducted with the emergent perceptional principal components as dependent, and planting and demographic variables as independent, to identify all significant planting and demographic variables. Multi-factor ANOVA (Table 7) was then conducted with the emergent perceptional principal components as dependent and all planting and demographic variables identified as significant in the first analysis (one-way ANOVA) as independent. This established the independent effect of the strongest explanatory planting variables, adjusting for demographic variables. Subsequent adjustment for planting variables identified the independent effect of the strongest explanatory demographic variables. When these final models were obtained, post hoc multiple comparisons were carried out using the Sidak correction to distinguish significant differences between groups or categories (Tables 8 and 9).

Pearson correlations were then carried out to identify associations between perceived attractiveness and perceived biodiversity, restorative effect and perceived biodiversity and perceived attractiveness and restorative effect (Table 10). In order to focus specifically on perceived attractiveness, the measure used in this analysis was the individual variable relating to the attitudinal statement, 'the planting on this walk is attractive' in the questionnaire. The measure of restorative effect was the component, 'restorative effect' emerging from the PCA. Perceived biodiversity was measured by four individual variables relating to items in the questionnaire (Table 2).

Table 3
Sorted pattern matrix for the three key dimensions of participants' perceptions (n = 1411) emerging from principal components analysis with a varimax rotation. Item loading values >0.5 are shown.

	Components				
Questionnaire item (Individual attitudinal statements & questions)	Aesthetic effect (Colour, attractiveness, interest & invertebrate benefit)	Restorative effect	Neatness	Perceived native plant & invertebrate biodiversity	Unfamiliarity & complexity
The planting on this walk is colourful	**0.85**				
The combination of colours is attractive in this planting	**0.85**				
The planting along this walk is attractive	**0.72**				
The planting along this walk is interesting	**0.72**				
The planting along this walk appears good for butterflies, bees and other insects	**0.59**				
I feel relaxed on this walk		**0.84**			
I feel comfortable along this walk		**0.79**			
This walk allows me to escape from more mundane routines and work		**0.76**			
The planting on this walk looks tidy			0.84		
The planting on this walk looks cared for			0.78		
The planting on this walk looks designed			0.78		
How many native UK plant species do you think there are in this planting?				**0.80**	
How many species of native UK insects (flies, butterflies, bees) do you think this planting will support?				**0.72**	
The planting on this walk looks familiar to me					−0.69
How structurally complex would you describe this planting?					0.58
How many different plant species do you think there are here?					0.56
Variance explained%	**30.56**	**12.40**	**9.75**	**6.39**	**6.27**

2.3. Semi-structured interviews

A smaller subset (n = 34) of questionnaire respondents volunteered to take part in a semi-structured in-depth interview. Interviews were conducted to better understand and interpret the questionnaire responses. This two-stage approach followed established methodology, (e.g., Jorgensen et al., 2007).

2.3.1. Interview design and procedure

The components emerging from the PCA informed the content and approach of the interviews. Themes relevant to this paper included 'attractiveness', 'feeling relaxed', (restorative effect), 'perceived invertebrate biodiversity' and 'colour and flowering'. Participants were presented with a range of panoramic photographs of planting types of varying structure and species character at the case study sites. These were of the same vegetation community they had originally walked through during the questionnaire phase (woodland, shrub or herbaceous) and acted as a cue to discussion. In addition, in order to understand more about the relationship between planting perceived as attractive and that perceived as relaxing (restorative), all participants were shown two images of planting at one case study site, 'the Punchbowl' (Valley Gardens), one when it was in full flower (in May), and one when it was predominantly green (in August), (Fig. 5). They were asked firstly which of these areas of planting they would find the most attractive to walk through, and secondly, which area they would find most relaxing to walk through. They were then asked to justify their views.

Interviews were semi-structured and flexible, allowing participants to diverge from the themes identified by the interviewer. An interview 'guide' was used (after Bryman, 2012) allowing the interviewer flexibility in the ordering and exact wording of questions. Following ethical clearance, 34 interviews representing walks at 24 sites (9 woodland, 8 shrub and 17 herbaceous) were conducted from 20th March-31st July 2014. With the exception of three pilot interviews which took place in the University, all interviews were conducted at the original walk sites. All interviews were audio-recorded and later transcribed in full.

2.3.2. Interview data analysis

Interview data were analysed via qualitative content analysis (after Saldana, 2013), using the interview themes above as initial deductive coding categories (after Mayring, 2014). Emergent themes were also coded, and extracts taking a particular slant or standpoint were grouped together using an indexing system to categorise data (after MacQueen, McLellan, Kay, and Milstein, 1998).

Table 4
Questionnaire participants' (n = 1411) demographic profile [a](valid%).

Gender (Overall missing values = 29 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
M	232 (39.9%)	114 (33.4%)	178 (37.4%)	524 (37.5%)
F	349 (60.1%)	227 (66.6%)	298 (62.6%)	874 (62.5%)
Age (Overall missing values = 34 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
18–24	38 (6.5%)	19 (5.6%)	33 (6.9%)	90 (6.5%)
25–34	35 (6.0 %)	28 (8.3%)	43 (9.1%)	106 (7.6%)
35–44	54 (9.3%)	29 (8.6%)	53 (11.2%)	136 (9.8%)
45–54	95 (16.4%)	48 (14.2%)	95 (20.0%)	238 (17.1%)
55–64	172 (29.6%)	82 (24.3%)	114 (24.0%)	368 (26.4%)
65+	187 (32.2 %)	131 (38.9%)	137 (28.8%)	455 (32.7%)
Educational Qualifications (Overall missing values = 123 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
None	87 (16.3%)	39 (12.3%)	66 (14.6%)	192 (14.7%)
GCSE/O' level (or equiv)	183 (34.3%)	76 (23.9%)	115 (25.4%)	374 (28.7%)
A level (or equiv)	86 (16.1%)	61 (19.2%)	83 (18.3%)	230 (17.6%)
Degree	127 (23.8 %)	104 (32.7%)	128 (28.3%)	359 (27.5%)
Masters' degree	36 (6.8%)	28 (8.8%)	49 (10.8%)	113 (8.7%)
Doctorate	14 (2.6%)	10 (3.1%)	12 (2.6%)	36 (2.8%)
Landscape professional? (Overall missing values = 482 respondents)				
	Woodland walks	Shrub walks	Herbaceous Walks	Overall
Yes	11 (3%)	10 (3.9%)	11 (3.4%)	32 (3.4%)
No	353 (97%)	246 (96.1%)	314 (96.6%)	913 (96.6%)

[a] Valid percentages given due to missing values.

Table 5
Interviewees' (n = 34) demographic profile.

Gender				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
M	5 (56%)	4 (50%)	5 (29%)	14 (41%)
F	4 (44%)	4 (50%)	12 (71%)	20 (59%)
Age				
25–34	0	1 (12.5%)	2 (12%)	3 (9%)
35–44	1 (11%)	0	2 (12%)	3 (9%)
45–54	3 (33%)	2 (25%)	2 (12%)	7 (21%)
55–64	5 (56%)	2 (25%)	4 (23%)	11 (32%)
65+	0	3 (37.5%)	7 (41%)	10 (29%)
Educational qualifications				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
None	2 (22%)	0	1 (6%)	3 (9%)
GCSE/O' level (or equiv)	1 (11%)	3 (37.5%)	2 (12%)	6 (18%)
A level (or equiv)	0	1 (12.5%)	7 (41%)	8 (23%)
Degree	6 (67%)	3 (37.5%)	4 (23%)	13 (38%)
Masters' degree	0	1 (12.5%)	2 (12%)	3 (9%)
Doctorate	0	0	1 (6%)	1 (3%)
Landscape or Environmental professional?				
	Woodland walks (n = 9)	Shrub walks (n = 8)	Herbaceous Walks (n = 17)	Overall (n = 34)
Yes	1 (11%)	2 (25%)	3 (18%)	5 (15%)
No	8 (89%)	6 (75%)	14 (82%)	29 (85%)
Landscape/ Environmental/Horticultural interests?				
Yes	9 (100%)	8 (100%)	17 (100%)	34 (100%)
No	0	0	0	0

3. Results

3.1. The demographic characteristics of the sample

The demographic profile (Table 4) of the large questionnaire sample (n = 1411) indicates a dominance of females over males. Participants were drawn from the older age groups and were from a wide range of educational backgrounds. The much smaller interviewee sample (n = 34) was a sub-sample of this larger group, and similar in profile (Table 5), yet contained a higher percentage of participants from landscape or environmental professions. The

Table 6
One-way ANOVA with the emergent perceptional principal components as dependent and planting and demographic variables as independent. Variables relating to significant values in bold were included for further analysis in multi-factor ANOVA.

	Perceptional principal components								
	Aesthetic effect (Colour, attractiveness, interest & invertebrate benefit)			Restorative effect			Perceived native plant & invertebrate biodiversity		
Planting variables	F	P-value	Variance explained%	F	P-value	Variance explained%	F	P-value	Variance explained%
Structure	7.84	<0.001	12.00	18.23	<0.001	2.80	10.93	<0.001	1.70
Species character	46.54	<0.001	6.90	2.75	0.06 (NS)	0.40	19.84	<0.001	3.10
Vegetation community	57.60	<0.001	8.40	5.29	0.005	0.80	33.68	<0.001	5.10
% Flower cover	81.93	<0.001	20.80	3.35	0.010	1.10	9.67	<0.001	3.00
Demographic variables									
Age	0.81	0.54 (NS)	0.30	2.65	0.022	1.10	0.54	0.74 (NS)	0.20
Gender	0.65	0.42 (NS)	0.10	12.60	<0.001	10.00	3.45	0.63 (NS)	0.30
Educational qualifications	1.09	0.37 (NS)	0.00	3.57	0.003	1.50	6.78	<0.001	5.10
Landscape professional?	0.52	0.47 (NS)	0.10	28.81	<0.001	3.30	1.59	0.21 (NS)	0.20

Table 7
Multi-factor ANOVA with perceptional principal components as dependent and significant planting and demographic variables as independent. Significant values are in bold.

	Perceptional principal components								
	Aesthetic effect (Colour, attractiveness, interest & invertebrate benefit)			Restorative effect			Perceived native plant & invertebrate biodiversity		
[a]Planting variables	F	P-value	Variance explained%	F	P-value	Variance explained%	F	P-value	Variance explained%
Structure	0.73	0.48 (NS)	0.10	**10.65**	**<0.001**	**2.80**	1.27	0.28 (NS)	0.20
Species character	**16.70**	**<0.001**	**2.80**	Not included as NS in one-way ANOVA			**22.40**	**<0.001**	**4.00**
Vegetation community	**27.15**	**<0.001**	**4.50**	1.31	0.27 (NS)	0.30	**29.82**	**<0.001**	**5.20**
% Flower cover	**88.79**	**<0.001**	**23.40**	2.24	0.06 (NS)	1.20	**5.52**	**<0.001**	**2.00**
[b]Demographic variables									
Age	Not included as NS in one-way ANOVA			0.52	0.76 (NS)	0.40	Not included as NS in one-way ANOVA		
Gender	Not included as NS in one-way ANOVA			**8.63**	**0.003**	**1.20**	Not included as NS in one-way ANOVA		
Educational qualifications	Not included as NS in one-way ANOVA			**4.37**	**0.002**	**2.20**	**6.43**	**<0.001**	**2.30**
Landscape professional?	Not included as NS in one-way ANOVA			**24.52**	**<0.001**	**3.20**	Not included as NS in one-way ANOVA		

[a] Following adjustment for significant demographic variables.
[b] Following adjustment for significant planting variables.

Table 8
Marginal mean (*MM*) scores on PCA factors (a) Aesthetic effect (Colour, attractiveness, interest & invertebrate presence), (b) Restorative effect and (c) Native plant & invertebrate biodiversity as a function of planting variables (Species Character, Structure, Vegetation Community and% Flower cover).

		Perceptional principal components					
		Aesthetic effect (Colour, attractiveness, interest & invertebrate benefit)		Restorative effect		Perceived native plant & invertebrate biodiversity	
Planting variables		MM	P-value	MM	P-value	MM	P-value
Planting structure:			NS		<0.001		NS
	Least natural	NS		2.35		NS	
	Moderately natural	NS		**2.74**		NS	
	Most natural	NS		**2.65**		NS	
Species character :			<0.001		NS		<0.001
	Least natural	**2.98**		NS		2.72	
	Moderately natural	2.71		NS		**2.97**	
	Most natural	2.56		NS		**3.18**	
Vegetation community:			<0.001		NS		<0.001
	Herbaceous	[*]2.85		NS		**3.28**	
	Woodland	2.80		NS		2.75	
	Shrub	[*]2.67		NS		2.84	
% Flower cover:			<0.001		NS		<0.001
	46+	**3.24**		NS		2.95	
	27-45	**3.17**		NS		2.98	
	10–26	2.84		NS		2.87	
	2–9	2.11		NS		[**]3.15	
	0–1	2.43		NS		[**]2.84	

Values in bold indicate categories with significantly higher scores than other categories of the same variable.
[*] Herbaceous planting scored significantly higher than shrub planting.
[**] % Flower cover 2–9% scored significantly higher than% Flower cover 0–1%.

strongly biocentric (nature-centred, after Ives and Kendal, 2014) focus of the interviewee sample is evident. Participants all showed some interest in the environment, landscape or horticulture.

3.2. Respondents' perceptions of the aesthetic qualities, restorative effect and perceived biodiversity value of the planting

The principal components analysis of questionnaire items extracted five components, together accounting for 65.33% variability in our participants' responses (Table 3). The three components relevant to this study were interpretable as: Aesthetic effect; Restorative effect; and Perceived native plant and invertebrate biodiversity. Individual questionnaire items loading onto these components are indicated (Table 3).

3.2.1. Aesthetic effect

The initial one-way ANOVA (Table 6) generated four significant planting variables (structure, character, % flower cover, vegetation community) yet no significant demographic variables. Subsequent multi-factor ANOVA (Table 7) indicated that three out of the four planting variables had a significant independent main effect on participants' perceptions of the aesthetic qualities of the planting: species character, vegetation community and the percentage flower cover. Planting structure had no significant independent main effect. Post hoc analysis (Table 8) revealed that participants perceived planting with the least natural species character as the most aesthetically pleasing, significantly more so than that with a moderate or most natural character. Planting with the most natural character was viewed as the least aesthetically pleasing (Table 8). Herbaceous planting was perceived as the most aesthetically pleasing of the three vegetation communities, significantly more so than shrub communities, which were perceived as the least pleasing. Percentage flower cover had the single largest main effect on aesthetic perceptions. Planting with a flower cover above a threshold of 27% was perceived as significantly more colourful, attractive and had a higher perceived invertebrate benefit than planting with a lower flower cover (Table 8).

3.2.2. Restorative effect

The initial one-way ANOVA (Table 6) indicated that three planting variables (structure, vegetation community and% flower cover) and all four demographic variables had a significant association with participants' self-reported restorative effect. The subsequent multi-factor ANOVA (Table 7) showed that one planting variable (planting structure) and three demographic factors (gender, educational qualifications and being a landscape professional) had significant independent main effects. Post hoc analysis (Table 8) indicated that participants perceived planting with a moderately natural or most natural structure as significantly more restorative than that with a least natural structure. Although planting with a moderately natural structure was associated with the highest restorative effect overall, the difference in perceived restorative effect between moderately and most natural planting did not reach significance. In general, women reported significantly higher restorative effect whilst walking through the planting than men (Table 9). Participants with GCSE/O'level/Scottish standard grade equivalent qualifications reported the highest levels of restorative effect, and those with a masters' degree or doctorate the lowest. Landscape professionals reported significantly lower levels of restorative effect than did other members of the public (Table 9).

3.2.3. Perceived native plant and invertebrate biodiversity

The initial one-way ANOVA (Table 6) indicated that all four planting variables and one demographic variable (educational qualifications) had a significant association with participants' perceptions of native plant and invertebrate biodiversity. The subsequent multi-factor ANOVA (Table 7) revealed three planting variables with independent main effects: species character, vegetation community and% flower cover. Educational qualifications also had a significant main effect (Table 7). Post hoc analysis (Table 8) showed that planting with the most natural species character was associated with the highest level of perceived native plant and invertebrate biodiversity, followed by moderately natural planting, then least natural planting. Planting with the least natural species character was associated with a significantly lower level of perceived native biodiversity than the other two categories. These results indicate that our participants recognised the three broad levels of actual nativeness demonstrated by our character types. Herbaceous planting was associated with the highest, and woodland and shrub planting a significantly lower level of perceived native plant and invertebrate biodiversity. Planting with a percentage flower cover of 2–9% was associated with the highest level of perceived native plant and invertebrate biodiversity (Table 8). Participants with no formal educational qualifications reported the highest levels of perceived native plant and invertebrate biodiversity, significantly higher than those with any level of tertiary qualification (degree, masters or doctorate, (Table 9).

3.3. Correlations between i) perceived attractiveness and perceived biodiversity, ii) restorative effect and perceived biodiversity and iii) perceived attractiveness and restorative effect

3.3.1. Perceived attractiveness and perceived biodiversity value

In the case of all vegetation communities, questionnaire data indicated significant correlations between perceived attractiveness and respondent perceptions for three of the four indicators of perceived biodiversity used in this study (Table 10). The strongest correlation was that between perceived attractiveness and the perceived value of the planting for butterflies, bees and other insects. There was no relationship between people's perceptions of attractiveness and the number of native UK plants they perceived to be present.

In the interviews 21/34 (62%) participants referred to the perceived biodiversity value of an area of planting when justifying why they considered it to be particularly attractive. Most comments focused on the perceived plant species or floral diversity visible in images (16/21), some referred to the perceived value of the planting to invertebrates or pollinators (10/21) and a smaller number of interviewees widened their comments to include perceived mammals (7/21), or bird populations (5/21).

3.3.2. Restorative effect and perceived biodiversity

In the case of shrub planting there was a significant low-moderate correlation between restorative effect and the number of different plant species people perceived to be present overall. In the case of herbaceous planting there was a significant low-moderate correlation between restorative effect and the perceived value of planting for butterflies, bees and other insects. In the case of woodland planting there was no correlation between restorative effect and perceived biodiversity (Table 10).

3.3.3. Perceived attractiveness and restorative effect

Significant correlations between perceived attractiveness and restorative effect were recorded in the case of all three communities (Table 10). In the case of woodland and herbaceous communities the correlation was low-moderate, whereas in the case of shrub planting it was moderate-substantial.

To focus specifically on the association between perceived i) Aesthetic effect and ii) Restorative effect in relation to flowering, these first two PCA components were plotted against each other (Fig. 6). Data points are colour coded to show the percentage flower

Table 9
Marginal mean (*MM*) scores on PCA factors (a) Aesthetic effect (Colour, attractiveness, interest & invertebrate presence), (b) Restorative effect and (c) Native plant & invertebrate biodiversity as a function of demographic variables (Gender, Educational qualifications, Landscape professional?).

		Perceptional principal components					
		Aesthetic effect (Colour, attractiveness, interest & invertebrate benefit)		Restorative effect		Perceived native plant & invertebrate biodiversity	
Demographic variables		MM	P-value	MM	P-value	MM	P-value
Gender:			NS		0.003		NS
	Male	NS		2.79		NS	
	Female	NS		3.21		NS	
Educational qualifications:			NS		0.002		<0.001
	None	NS		2.50		3.30	
	GCSE/O'level	NS		2.76		3.16	
	A'level/IB	NS		2.47		3.07	
	Degree	NS		2.65		2.96	
	Masters/doctorate	NS		2.41		2.80	
Landscape professional?;			NS		<0.001		NS
	No	NS		3.78		NS	
	Yes	NS		2.22		NS	

Values in bold indicate categories with significantly higher scores than other categories of the same variable.

Table 10
Correlations between (a) Perceived attractiveness and perceived biodiversity, (b) Self-reported restorative effect and perceived biodiversity and (c) Perceived attractiveness and self-reported restorative effect by vegetation community ** $p < .01$, *** $p < .001$.

(a) Perceived attractiveness and perceived biodiversity

	Perceived biodiversity measures			
Perceived attractiveness	Perceived no. different plant species	Perceived no. native UK plant species	Perceived value of planting for insects	Perceived no. native UK insects
Woodland	0.218***	NS	0.462***	0.278***
Shrub	0.170**	NS	0.416***	0.185**
Herbaceous	0.200***	NS	0.373***	0.279***

(b) Self-reported restorative effect and perceived biodiversity

Woodland	NS	NS	NS	NS
Shrub	0.168**	NS	NS	NS
Herbaceous	NS	NS	0.213***	NS

(c) Perceived attractiveness and self-reported restorative effect

Perceived attractiveness	Self-reported restorative effect
Woodland	0.161***
Shrub	0.401***
Herbaceous	0.267***

cover present on the walk at the time respondents completed their questionnaire. Each coloured circle represents one participant response at a site. The highest values for perceived aesthetic effect are found in sector C of Fig. 6 and are dominated by data points that describe high levels of flower cover >27% (coded blue and red) where scores for restorative effect are below the mean. The highest restorative effect values are associated with Sector A of the graph which is dominated by data points that describe low levels of flower cover (coded grey and black). Levels of restorative effect above the overall mean score are however also associated with walks with high flower cover values (coded red, sector B).

When presented with the two contrasting images of the Punchbowl (Fig. 6) most interviewees who expressed a view (20/32, 63%) said that they would find the Punchbowl in full flower the most attractive to walk through (Fig. 5), with a smaller number (12/32, 38%) selecting no flower cover as the most attractive walk. Considering restorative effect, 29/32 (91%) interviewees thought the Punchbowl would be more relaxing to walk through with no flower cover. Only 3/32 (9%) thought the Punchbowl would be most relaxing to walk through when in full flower.

4. Discussion

4.1. How are perceived attractiveness and perceived biodiversity related?

In the case of all woodland, shrub and herbaceous walks, the questionnaire results indicate a positive relationship between how attractive our participants perceived the planting to be and their perception of its benefits for butterflies, bees and other insects (Table 10). Individual questionnaire items relating to perceived colourfulness, attractiveness and the attractiveness of colour combinations loaded onto the same component as the item relating to perceived invertebrate benefit (Table 3), confirming that planting perceived as attractive and colourful, with attractive colour combinations, was also perceived as beneficial to insects. Campaigns in the media to halt the decline of pollinators by providing more flowers, for example, http://www.sarahraven.com/articles/how_to_create_a_mini_wild_flower_meadow.html); (accessed 23rd June 2015), plus the exposure of millions of visitors to extensive meadows at the 2012 London Olympic Games, appear to have enhanced UK residents' awareness of the value of flowering meadow-style plantings to invertebrates, particularly urban pollinators. Interviewees were particularly skewed towards biocentric cultural positions and themselves linked their aesthetic appreciation of meadows with pollinators.

The low-moderate correlation between perceived attractiveness and the perceived number of different plant species indicates that people were attracted to planting they thought was more varied. This provides some evidence of a relationship between perceived attractiveness and perceived plant diversity, yet our research shows there was no relationship between perceived attractiveness and perceived native plant biodiversity (Table 10), suggesting that perceived nativeness per se was not a criterion our participants used to gauge the attractiveness of the planting. This is confirmed by our earlier analysis (Table 8), which shows that planting perceived as providing the highest native biodiversity (most natural species character) was actually perceived as the least attractive.

In the previously cited Swedish study (Qiu et al., 2013) research participants gave the 'wild-looking' habitat with the highest biodiversity value negative preference comments, and the ornamental park style woodland with the lowest biodiversity value was most preferred. It is possible that in this study people's reactions may have been related more to the structural attributes or spatial arrangement of planting which impacted on aesthetics, making it appear 'wild', than biodiversity per se. Indeed the preference of urban people for more manicured, tidy landscapes has been documented (Gobster et al., 2007; Jorgensen et al., 2007, 2002; Nassauer 2011). In our study planting structure had no independent main effect on perceptions of aesthetic effect (Table 7) although it did have an effect on perceived restorative effect, with moderately and most natural planting structure viewed as significantly more restorative than the most tidy 'least natural' planting structure. Our findings are in contrast with those of Martens et al. (2011) who found that 'tended' forest conditions afforded greater restorative potential than 'wild' conditions, and those of Van den Berg et al. (2014) who found no significant difference in recovery between natural conditions. The two previous studies focused on woodland or trees, whereas our study incorporated woodland, shrub and herbaceous planting. Our interviewees were particularly positive about both the aesthetic and restorative effect of planting with a more natural structure. Although most lived in urban areas they were more biocentric than the norm (Table 4) and as previous research has indicated (Ozguner et al., 2007; Zheng et al., 2011) likely to be more positive than the general public about more 'messy' landscapes which diverge from the conventional horticultural norm.

4.2. How are restorative effect and perceived biodiversity related?

We found two low-moderate positive correlations between individual indicators of perceived biodiversity and restorative effect: one in the case of shrub planting (perceived number of plant species) and the other herbaceous planting (perceived value of planting for insects) (Table 10). The shrub planting our respondents perceived as more diverse in plant species was associated with higher levels of restorative effect. In the case of herbaceous planting the positive association between the perception of the value of herbaceous planting to insects and restorative effect reflects the increasing UK awareness that herbaceous plants are beneficial to pollinating insects, producing a 'feel good' emotion, a positive reaction to the walk experience. These positive associations support the claim made (Carrus et al., 2015; Fuller et al., 2007; Schipperijn et al., 2010) that people gain psychological benefits from increased biodiversity, or contact with green spaces they think are more biodiverse (Dallimer at al., 2012), yet in the case of our research, the correlation was much weaker than that between perceived attractiveness and perceived biodiversity (Table 10).

4.3. How are perceived attractiveness and restorative effect related?

For our questionnaire participants there was a correlation between perceived attractiveness and restorative effect, yet in contrast to some earlier findings, for example (Purcell et al., 2001), the relationship was not strong (Table 10). With reference to the Circumplex Model of Affect (Russell, 1980) evidence from both the questionnaire and interview data suggests that the lack of a strong association is partially because different landscape stimuli promote contrasting affective (emotional) responses. Our data indicate that bright, vivid, flowering displays of planting 'least natural' in species character are associated with a positive activated state associated with 'excitement' and 'elation'. This concurs with earlier evidence that flowers can induce powerful positive emotions (Haviland-Jones et al., 2005). Appreciation of colourful flowers has been explained by evolutionary theories (Heerwagen and Orians, 1995), as flowers are an indicator of a resource-rich environment, and in some cultures and contexts they act as 'cues to care' (Nassauer, 1995, 1988, 2011), 'evidence of human intention visible in the landscape'. In the Berlin study cited earlier (Palliwoda et al., 2017) park users who picked flowers for floral home decoration selected species with a special appearance. In other contexts individual knowledge may override evolutionary or culturally based response (Bourrassa, 1991) and preference for particular plants may be related to non-visual traits such as nativeness or drought tolerance (Kendal et al., 2012). Our data relate to a UK context, and in this study, percentage flower cover made the largest single contribution to people's perceptions of aesthetic effect of the planting. There is clear evidence (Table 10 & Fig. 6) of a threshold percentage of flower cover (27%), above which planting was viewed as particularly colourful, attractive and supportive of invertebrates, (sectors B & C, Fig. 6). In contrast, in sector A (Fig. 6) where the highest levels of restorative effect are recorded, the dominant percentage flower cover is much lower (2–9%), and the planting is perceived as below the mean in terms of aesthetic effect. This suggests that predominantly green planting with a lower percentage flower cover is associated with the highest levels of restorative effect, even though it is not considered particularly aesthetically pleasing (colourful, attractive or supportive of invertebrates). This subtle green planting induces the positive deactivated affective responses described in the Circumplex Model.

Interviews provided further insight into this relationship, although because our self-selecting interviewees were more biocentric than the typical urban Briton, so generalisation to the population as a whole requires a measure of caution. According to interviewees, 'attractive' planting was often more vibrant and colourful, had more detail, and demanded attention. In contrast, when choosing areas of planting they thought would be more relaxing to walk through, most interviewees chose predominantly green planting. Interviewees saw this as less detailed, providing the 'background' for other thoughts or conversations. Interviewees viewing the Valley Gardens 'Punchbowl' in full flower (Fig. 5 (a)) confirmed this:

Interviewer: Which would you find the most attractive to walk through, at which time of year, do you think?

M8***: Ahhh well, I think that's a no brainer. That one*** [Figure (a)]. . .***with the colour***

Interviewer: And which of those two do you think would be the most relaxing to walk through?

M8***: That one*** [Fig. 5(b), greens]. ***It's a question of interest or relaxation again. If I just want to walk somewhere and forget something dreadful, or think of something good, or just think of***

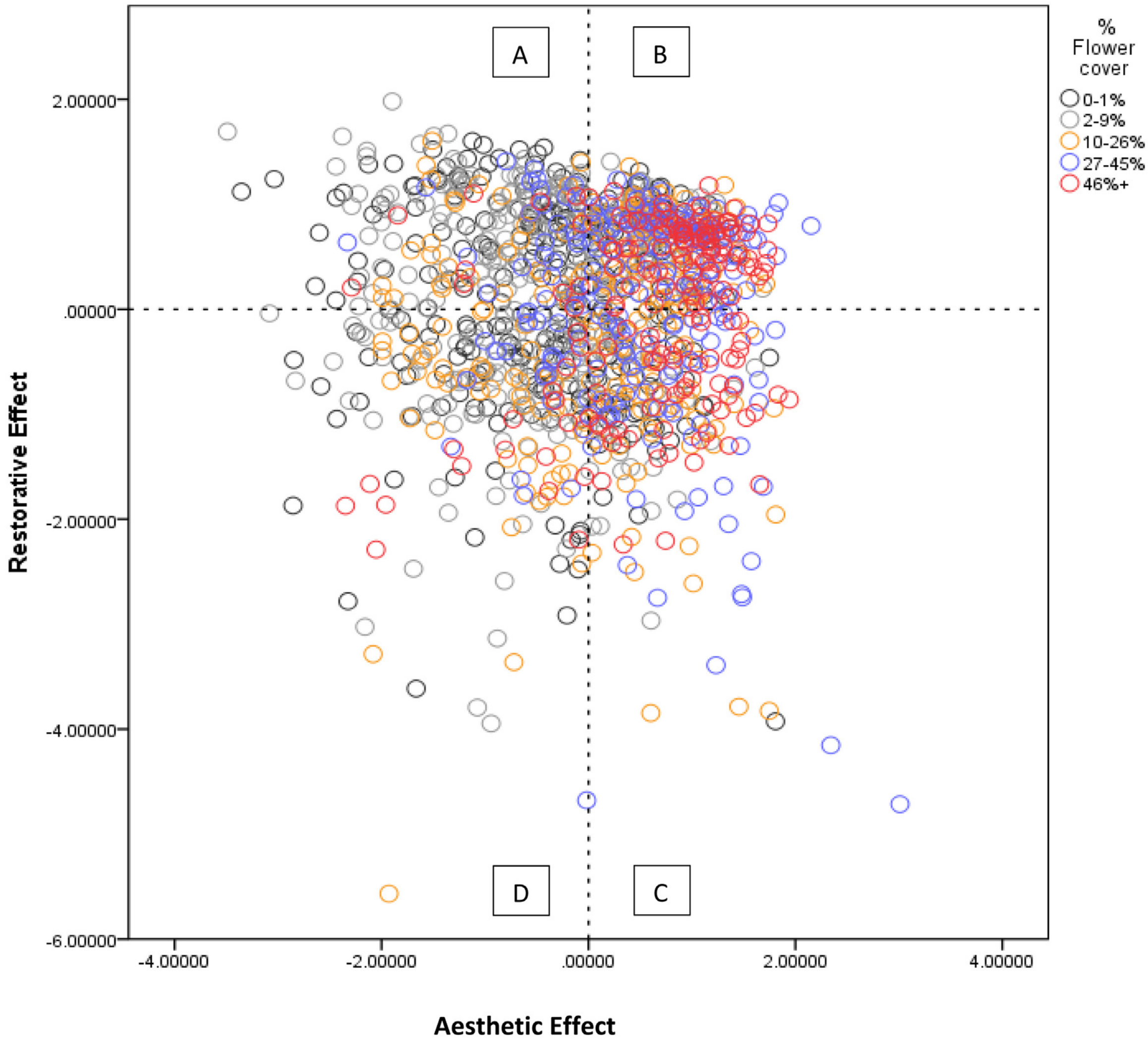

Fig. 6. The association between PCA Factor 1 Aesthetic effect (Colour, attractiveness and invertebrate benefit) and PCA Factor 2 Restorative effect, in relation to flowering. The% flower cover category of the 31 sites where individual participant responses is indicated by the coloured circles. The highest values for perceived attractiveness are found in sector C (data points that represent high levels of flower cover >27%, coded blue and red), where scores for restorative effect are below the mean. The highest restorative effect values are associated with Sector A of the graph which is dominated by data points that represent low levels of flower cover (coded grey and black). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

nothing, that's the place you go, [greens]. ***Because this is going to excite the brain.*** [Fig. 5(a) in flower]. ***That sounds a ridiculous thing!***

Interviewer: With the woodland areas you found some of the same areas to be attractive, and relaxing, didn't you, but when there's so much colour. . .

F3: ***I think then it can be too stimulating, so then it's not that relaxing, really. I don't think it's a very relaxing place to walk through, because, to be honest, it's an assault on the senses.it's so bright...I think you go there*** [Fig. 5(a)] ***for the 'wow factor', but you don't go there to relax. Here,*** [Fig. 5(b)] ***I think here if you wanted to have a relax and just wanted to sit, maybe listen to the birds or just generally stare into space, this is probably more relaxing, This*** [Fig. 5(a)] ***is almost unreal, as though someone's painted it but used the wrong colours.***

The second explanation for the lack of a strong relationship between perceived attractiveness and restorative effect appears to be related to the different mechanisms individuals used in the assessment of the attractiveness of the planting and restorative effect. Evidence from the ANOVA showed that our respondents' perceptions of both the aesthetic qualities of the planting and perceived plant and invertebrate biodiversity were related primarily to the characteristics of the planting itself (Table 7), i.e. species character, vegetation community, and the percentage flower cover. Respondents' demographic characteristics played a minor role, with only one factor, educational qualifications, having a significant effect on perceived native plant and invertebrate biodiversity. The opposite is true in the case of restorative effect, where just one planting variable, structure, had a significant effect on perceptions. Our respondents' demographic characteristics played a dominant role in explaining variability in restorative effect. In general, women experienced a significantly higher restorative effect than men whilst walking through the planting. Educational qualifications had a bearing, as did being a landscape professional, with members of these professions experiencing significantly lower level of restorative effect on walks than others. These outcomes suggest that perceptions of visual aesthetic qualities of the planting such as colour, attractiveness and native biodiversity are made externally and transitively in that the respondents are making an aesthetic judgement of an 'object', i.e., the planting, beyond themselves. In contrast, the assessment of restorative effect is reflective and internalised. Although the aesthetic experience of the planting may have a bearing on mood, ultimately, restorative effect and well-being are more dependent on influences including demographic factors as discussed here, as well as family income and employment. These factors have been shown to have a significant impact on mental distress and well-being at the individual level (Huynh, Craig, Janssen, and Pickett, 2013; White, Alcock, Wheeler, and Depledge, 2013).

5. Conclusion: implications for policy, practice and future research

Our findings indicate that ordinary members of the public are capable of distinguishing subtle differences between seemingly similar designed or natural vegetation. We show that a range of fine-grained planting types defined by structure, species character and with varying percentages of flower cover can elicit a range of significantly different public responses. Correlations were identified between attractiveness and three out of four indicators of perceived biodiversity in the case of all vegetation communities, with the strongest between perceived attractiveness and the perceived value of the planting for insects. Relatively weak correlations were identified between perceived biodiversity and restorativeness for two individual biodiversity indicators and vegetation communities (shrub and herbaceous). There was a correlation between perceived attractiveness and restorative effect for all vegetation communities, yet this was not strong. Our discussion of the role of flower cover in eliciting specific emotional responses with reference to the Circumplex Model of Affect (Russell, 1980) shows that colourful planting with bright flowers is viewed by most people as extremely attractive and stimulating. Flower cover over a critical threshold of 27% generates the 'wow factor'. In contrast, subtle greens are more conducive to quiet reflection, and induce a restorative effect.

The implications for urban greenspace design are considerable. Dramatic displays of flower colour enhance most people's aesthetic experience in the short term, yet psychological restoration is more likely afforded by 'background' green planting. This indicates that green planting has real value outside the relatively narrow flowering window of most species. Further work is required to understand the important role of spatial and temporal context in relation to the human need for stimulation versus deactivation and relaxation. In contrast to earlier studies, (Martens et al., 2011; Van den Berg et al., 2014) we found that planting moderately and most natural in structure was perceived as significantly more restorative than highly designed least natural planting. Our findings suggest that in the UK increasing public exposure to naturalistic meadow-style planting and its pollinator benefits may be increasing public acceptability of a more 'messy' urban planting aesthetic, yet future work is needed to understand nuances in acceptability in relation to specific urban contexts.

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