Biodiversity in the front yard: An investigation of landscape preference in a domestic urban context

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Abstract

It is being increasingly recognized that the success of efforts to preserve/ restore biodiversity in urban areas is highly contingent on the preferences of human urban dwellers. We investigated preference ratings for photos of high-versus low-habitat-providing garden landscapes among residents (n = 487) in two specific areas of Perth, Western Australia, and their relationship with general environmental concern and attitudes toward native plants and urban biodiversity. We also investigated the impact of localized descriptive gardening norms. The findings indicate that the distinction between high-/low-habitat-providing gardens was important to respondents' landscape preferences. The attitudinal variable with the strongest relationship to garden-type preference was residents' attitudes toward native plants. Preferences were also highly related to prevailing gardening norms in respondents' local area. We discuss our findings in relation to the structure and dynamics involved in human perceptions of and interactions with urban landscapes.

Keywords: gardens, attitudes, aesthetics, perception, urban

The protection and restoration of sustainable ecosystems is one of the critical issues currently confronting planet Earth (Millennium Ecosystem Assessment, 2005). In the Australian context, an increasing number of plant and animal species are under growing threat due to destruction of native habitat, despite the well-documented cultural, aesthetic, and recreational importance of native bushland to many Australians (Australian State of the Environment Committee, 2001). Furthermore, protection of biodiversity through native habitat provision in Australia is increasingly being raised as an issue of importance in urban areas as well as the "wilderness" areas that have more typically been

the focus in such discussions (Australian and New Zealand Environment and Conservation Council and Biological Advisory Committee, 2001; Miller, 2005). This trend is also evident in other nations such as the United Kingdom [Department of Environment, Food and Rural Affairs (DEFRA, 2002)]. Although the ecological importance of developing effective means by which to improve biodiversity in urban areas has been highlighted (Miller & Hobbs, 2002), the success of any such effort is inseparably linked to the ways in which *human* members of urban ecosystems perceive and interact with the urban landscape (Davies, Webber, & Barnes, 2004). Thus, the protection of biodiversity in urban areas is simultaneously an issue of both ecology and psychology. It is this relationship between urban landscape perceptions, attitudes, and behaviors and their significance for urban biodiversity that is the focus of the current study.

Landscape Preference

The examination within environmental psychology of the ways in which human beings perceive landscapes has been dominated by the study of what has become known as "landscape preference" (Gärling, 1998). Arguments from an evolutionary perspective have posited the existence of an inherent aesthetic preference among human beings for landscapes with smooth ground planes that enable easy movement across them (Kaplan, Kaplan, & Brown, 1989), and it has also been suggested that these types of landscapes are often more ecologically "degraded" (e.g., lack of plant understory; Gobster, 1994, 1995). This proposition has also gained support in some empirical work (e.g., Nassauer, 1993, 1995). However, the assumption that innate human landscape preference may be, somewhat paradoxically, skewed toward less ecologically beneficial landscapes does not hold always. For example, Williams and Cary (2002) found no evidence for a preference for landscapes of less ecological quality in a southeast Australian context. Lafortezza, Corry, Sanesi, and Brown (2008) also demonstrated in their examination of preference for different kinds of brownfield site rehabilitation that residents actually preferred visualizations of more ecologically functional sites. Similar findings have also been obtained in relation to public aesthetic preference for visualizations of river restoration

scenarios of differing eco- morphological quality (Junker & Buchecker, 2008). Thus, it would appear that there is no simple relationship between ecological quality and human landscape preference.

Another feature of the landscape preference literature has been the suggestion that humans prefer highly "natural" landscapes to those that are more human-dominated or "built" (Kaplan & Kaplan, 1989). Moreover, it has been suggested that exposure to such natural landscapes produces psychological and physiological benefits (Ulrich, 1986; van den Berg, Koole, & van der Wulp, 2003). At a more specific perceptual theory level, landscape preference research has examined the generalized perceptual structure of scenes and suggested a number of generic theoretical concepts that have been argued to underlie perception of all landscapes. The most dominant perceptual paradigm in this domain has been Kaplan and Kaplan's Landscape Preference Model (Kaplan, 1972, 1982, 1988, 1992; Kaplan & Kaplan, 1982, 1989), which argues, from a predominantly evolutionary perspective, that humans have adapted to prefer environments that are simultaneously (a) easy to comprehend (or "make sense of") and (b) challenging/involving.

Individual Differences in Landscape Preference

Of particular relevance to the research reported here, however, are the findings of Kaplan and Herbert's (1987) cross-cultural examination of landscape preference rating in which they had a range of photos of landscapes from southwestern Western Australia aesthetically rated by a sample of students from a Western Australian university, a sample from a Michigan university, and also a group of members of the Western Australian Wildflower Society. The resulting ratings showed that the *within*-culture differences in ratings between Western Australian students and the Western Australian Wildflower Society participants were greater than those between the Western Australian and Michigan students, highlighting the potential importance of knowledge and/or more attitudinal or ideological variables in response to landscapes. Indeed, as Zube observed in 1991, the majority of

landscape perception and preference research conducted in the past 25 years had suffered from a rather narrow focus that excluded analyses of

> how individuals and groups use these landscapes . . . the meanings they associate with them and . . . the relative importance of aesthetic values compared with the host of other landscape values such as ecologic, historic, economic and symbolic. (p. 331)

Since 1991, there have been some notable movements within the landscape preference literature toward addressing the extent to which preferences for particular *kinds* of landscapes might be moderated by demographic or attitudinal variables. For example, differences have been observed between farmer and nonfarmer groups in relation to beauty ratings of agrarian and wilderness scenes (Brush, Chenoweth, & Barman, 2000; van den Berg, Vlek, & Coeterier, 1998). Differences in landscape preference have also been observed as a function of specific attitudinal dimensions such as Thompson and Barton's (1994) Environmental Value Orientation (Kaltenborn & Bjerke, 2002). More specifically, Solvia and Hunziker (2009) have demonstrated that those who indicate higher concern for the conservation of species and natural processes show preference for reforested alpine landscapes over cultural landscapes, with preference for cultural landscapes being related to higher utilitarian values.

Despite this growing interest in the intersection between ideology and aesthetics in the context of rural landscapes, there has, until recently, been far less work examining such factors in the *urban* domain. Although many studies demonstrate a general preference for "natural" over built landscapes, less work has focused on preferences for different types of landscaping within the urban domain and the psychological factors that might produce individual and group differences in such preferences.

Landscape Preference and Urban Ecology

This historical tendency toward a nonurban focus of landscape preference research mirrors a similar historical bias among conservation biologists toward the study of non-(human) populated areas. As Miller and Hobbs (2002) highlight, this is despite the threat that urban expansion poses for the biodiversity values of a rapidly growing area of highly biodiverse land. Although some urban development does involve the retention of patches of remnant vegetation, the issue of habitat fragmentation poses a particular threat to the level of biodiversity within urban areas (Theobald & Hobbs, 2002). The establishment of "green corridors" (or "biodiversity corridors") to link up remnant patches of habitat is often proposed as a remedy to this situation (Niemela, 1999); however, such potential corridors in urban areas often comprise small plots of privately owned/occupied residential land (i.e., front/ backyards). Consequently, the success of attempts to establish green corridors in urban areas often relies heavily on the gardening activities that residents in a particular area adopt (e.g., the types of plants planted in gardens). Given that human activities have been shown to have overwhelming influence on garden vegetation, understanding residents' perceptions of and preferences for garden landscapes with differing levels of habitat provision therefore becomes crucially important (Goddard, Dougill, & Benton, 2009).

Much of the work that has examined interactions between humans and landscapes in the urban domain had been focused on *public* green spaces, both in terms of the ways in which they are perceived by residents (Bonnes, Uzzell, Carrus, & Kelay, 2007; Özgüner & Kendle, 2006) and the potentially restorative functions that they serve in relation to residents' health (Maller et al., 2008; Tzoulas et al., 2007; Van den Berg, Hartig, & Staats, 2007). Moreover, Fuller, Irvine, Devine-Wright, Warren, and Gaston (2007) have shown that the psychological benefit that urban dwellers derive from urban green space actually increases as a function of the species richness of the landscape in question. There has, however, been some suggestion that preference for more or less dense vegetation in contexts such as urban parks varies between individuals holding different attitudes. For example,

Bjerke, Ostdahl, Thrane, and Strumse (2006) found that respondents' ratings of the appropriateness of more densely vegetated parks increased as a function of their motivation to view wildlife and, to a lesser extent, their scores on a measure of general environmental orientation.

There has, however, been less quantitative research into *private* domestic urban landscape preference. Although a small amount of work has recently emerged in the North American context (Larson, Casagrande, Harlan, & Yabiku, 2009; Larsen & Harlan, 2006; Yabiku, Casagrande, and Farley-Metzger, 2008), this work has generally been more focused on the issue of water conservation than biodiversity preservation. As such, the quantitative literature dealing with "landscape preference" has not, to date, produced many studies that speak directly of the issue of biodiversity preservation and habitat provision in people's own back/front yards. However, this has not been the case within other academic disciplines. Disciplines such as anthropology, sociology, environmental history, and human geography contain a large body of highly relevant qualitative and ethnographic literature that addresses this issue more directly. Indeed, the highly "politicized" nature of landscape in postcolonial societies in the Southern Hemisphere such as Australia and New Zealand has been a topic of great interest within these disciplines (e.g., Head & Muir, 2004; Longhurst, 2006; Trigger, Mulcock, Gaynor, & Toussaint, 2007). Of particular relevance to the current research is Head and Muir's (2004, 2007) extensive program of research that analyzed Australian backyards (and their human inhabitants) using semistructured interviews, biogeographical mapping, and checklists of backyard contents. As part of their investigations around the issue of plant "nativeness," Head and Muir divided their sample of residents into four categories on the basis of attitudes expressed in the interviews and checklists of backyard contents. The emergent "gardener types" included "committed native gardeners" (who planted vegetation in their gardens that was native to Australia and often specifically endemic to their local area), "general native gardeners" (who planted a mixture of Australian natives and "exotic," internationally imported plant species), "nonnative gardeners" (who planted only exotics), and "nongardeners" (who never plant any plants in their garden). Head and Muir highlight the ways in which these different orientations to, and ways of interacting with, the backyard landscape are not

only relevant for their ecological significance, but also as a potential source of social tension in situations where suburban neighbors' landscape ideologies and gardening practices greatly differ. The ideological aspects of the domestic urban landscape have also received attention in the Northern Hemisphere, such as in Bhatti and Church's (2000) work in the United Kingdom highlighting how home gardens and gardening relate to wider sociocultural processes and Feagan and Ripmeester's (2001) and Robbins' (2007) works on ideological struggles over the "issue of lawn" in North America.

Given this recent explosion of interest within other social scientific disciplines and also the applied significance of the issue, it is surprising that the ideological or attitudinal aspects of landscape preference in the domestic gar- den domain have not been extensively examined from a quantitative perspective. One exception is the work of Joan Nassauer (1993, 1995). Nassauer and her colleagues have used computer-simulated images of front yards to highlight strong preferences among North American residents for domestic urban landscapes that signal what she terms intentions of "human care" (e.g., large sections of mowed turf).1 Although this work has not explicitly examined potential attitudinal influences on such preferences, it was found in one study (Nassauer, 1993) that residents who were members of a native plant society showed *less* tendency to rate more ecologically rich yard landscapes negatively. Furthermore, in a recent study (Nassauer, Wang, & Dayrell, 2009), it was found that residents' preference for different computer-generated front yard landscapes could be highly influenced by experimentally manipulating perceptions of the gardening norms of hypothetical neighbors. This work therefore suggests that (a) there may be a cultural normative preference for less habitat-providing garden landscapes in the North American context, (b) this tendency may be reduced among certain opinion-based groups, and (c) this tendency may be potentially overridden when local descriptive norms are perceived to prescribe more habitat-providing gardening styles.

The Current Study

The research reported here extends the work of Nassauer and colleagues in four ways. First, we investigate the possibility that the patterns of preferences identified in the North American context may not necessarily hold in different cultural contexts such as in Australia, as hinted at recently by Kirkpatrick, Daniels, and Davidson (2009). Second, although the distaste for "messy" high- habitat-providing gardens commonly identified by these researchers has been shown to be reduced in members of native plant societies, it is not clear exactly what might drive such individual differences in perception. Third, although Nassauer et al. (2009) have demonstrated that *experimentally* manipulating descriptive norms in a hypothetical (computer-simulated) neighborhood can influence landscape preferences for ecologically innovative versus conventional gardens, this has yet to be examined in real-field settings using naturally occurring geographical variation in local gardening practice norms. Finally, the relative influence of attitudinal variables and local norms have also not previously been looked at together in the context of the same study in a way that allows one to compare the relative strength of relationship between each and landscape preference.

The current study aimed to investigate the factors related to preferences for high-versus low-habitat-providing garden landscapes among residents currently living in two separate areas of the southern suburbs of Perth, Western Australia. The two study areas had been previously identified in the Perth Biodiversity Project as potential ecological corridors for reconnecting remnant bushland and green spaces by supporting conservation and biologically diverse choices on private land (Perth Biodiversity Project, 2007). In the current study, we asked residents living in these areas to rate a series of color photos of front gardens that had been previously identified by a sample of expert ecologists as being either high or low in habitat provision. We also investigated (by way of written survey items) the relationship between these preferences and the attitudinal variables of general environmental concern and attitudes toward native plants, preservation of urban biodiversity, and water conservation, as well

as self-reported current gardening practices. Our delineation of participants into different types of gardening practices draws heavily on Head and Muir's (2004, 2007) typology described earlier.

The two areas ("corridors") sampled were also located within two separate local government areas, Melville Council and Fremantle Council. The sample area within the two councils represented quite different physical environments, with the area in Fremantle having a higher proportion of gardens containing native vegetation and the area within Melville being highly dominated by gardens containing "exotic" plants and large sections of neatly kept, well-reticulated lawn. As such, we were also able to investigate (in an indirect way) the potential relationship between localized descriptive norms (Cialdini, 2003) relating to gardening practices and measures of aesthetic landscape preference. In addition, we examined the relevance of demographic variables such as gender, age, ethnicity, and household income.

In summary, this study examines the extent to which residents' aesthetic preferences for high-and low-habitat-providing garden landscapes are a function of demographic variables, local gardening norms, current gardening practices, and a set of gardening-relevant attitudinal variables.

Method

Sampling Procedures and Participants

Questionnaires were hand delivered to the postboxes of all households within each of the two geographically defined sample areas (1,000 within Melville and 1,000 within Fremantle). Of these 2,000 questionnaires, 250 Melville residents (25.0%) and 237 Fremantle residents (23.7%) responded through the reply-paid envelope supplied, giving an overall sample size of 487 respondents (overall response rate = 24.4%). There was a slight gender bias, with female respondents constituting 63% of

the sample. This bias was particularly strong in Fremantle (73.5%) and may potentially reflect a gender difference in levels of interest around gardening in general. Gardening is an activity that, itself, has a slight gender bias in the Australian context. The Australian Bureau of Statistics' (ABS, 2006) "How Australians Use Their Time" survey showed that women had a higher participation rate (37%) for grounds and animal care than men (22%).

Age data were collected in terms of age bands. The most populated age band in the sample of respondents was 46–55 years (29.6%), followed by 56–65 years (22.6%), 36–45 years (19.1%), more than 65 years (14.5%), 26–35 years (9.5%), and 18–25 years (4.3%). This age distribution was relatively equivalent between the two council areas. Comparisons with ABS census data from the census wards containing the two target areas indicated that our sample was slightly overrepresented by older age groups and slightly underrepresented by younger age groups. Again, we suspect that this discrepancy was a result of a greater interest in gardens and gardening among older age brackets.

Household income was also measured in terms of income bands. For the benefit of an international audience, we note that an annual income of 100,000 Australian dollars was equivalent (at the time of data collection) to approximately US$64,780, £45,548, or 50,880€. For the 72% of the sample who chose to complete the (optional) question relating to household income, the data suggest that the sample was slightly more affluent than the average for the areas targeted, with approximately half of the sample (49%) having an annual household income of more than 100,000 AUD as compared with an ABS figure for the equivalent census ward area of only 42% of residents having an income more than 100K per year.

Of those who responded to the survey, 82.9% lived in a home owned by themselves, their partner or one of their housemates, which was slightly higher than ABS census data figures for the area in

question, which suggests a 73% rate of home ownership. Again, we would suggest that those who own their own homes are also more likely to take an interest in gardening, which may explain the higher proportion of home owners in our sample. “Ethnicity” data were collected by asking participants to describe their ethnicity in their own words. Due to attitudes and behaviors in relation to native Australian plants being a key variable in our design, ethnicity responses were then placed in one of the following three categories: (a) White/Anglo Australian, 66.6% of the sample, (b) “Other Australian” (e.g., “Greek Australian” or “Chinese Australian,” 9.7% of the sample), and (c) “non-Australian” in cases where the term “Australian” did not appear in their ethnicity description (17.3% of the sample). None of our respondents self-categorized as Indigenous or Aboriginal Australian.

Observational Differences in Vegetation Environment Between Councils

The two sample areas were quite visually distinct from one another in terms of the vegetated landscape, with the Melville sample area having more manicured and domesticated gardens, which were generally lower in habitat provision due to the incorporation of mostly exotic plants and/or the predominance of large areas of paving or lawn. In contrast, many more gardens in the Fremantle sample area were found to contain a greater abundance of habitat-providing native plants and smaller amounts of lawn. This visual distinction between councils is illustrated with examples in Figure 1.

Measures

The first section of the questionnaire contained 24 color photographs of different front gardens (taken front on), which participants were asked to rate on a 10-point scale in relation to how much they liked the garden depicted (1 = *dislike very much*, 10 = *like very much*) and to what degree they would want it in their own garden (1 = *would not want it at all*, 10 = *would want it very much*). Each photograph measured 9.5 cm × 7 cm and there were six photos presented per page.

Development of stimulus materials. To ensure that the photographs used within the questionnaire were an accurate representation of both high- and low-habitat gardens, six expert ecologists were asked to rate a larger set of 100 photographs of front gardens on a scale from 1 to 10 (1 = *very little provision of habitat*, 10 = *very high provision of habitat*). From the responses given, a set of 12 high- and 12 low-habitat photos were compiled for use in the community survey. High-habitat photos had a mean habitat provision rating of 7 or above with no ratings less than 5 by any ecologist rater. Low-habitat photos had a mean habitat rating of 3 or below with no ratings above 3 by any ecologist rater. The actual houses within the pictures were blurred out to ensure that the built aspects of the depicted front yard did not influence participants' ratings of the gardens. Examples of high- and low-habitat garden photos used are given in Figure 2.

A series of written questions followed, all of which used a 5-point Likert-type scale ranging between 5 = *strongly agree* and 1 = *strongly disagree*. Participants' attitudes toward urban biodiversity (six items) and native plants (nine items) were measured using specially constructed scales (see appendix). Items on the urban biodiversity scale were designed to measure the extent to which the respondent valued the preservation of biodiversity in the urban environment. Items on the native plant attitude scale were designed to tap into respondents' general attitudinal position regarding the overall merits of native plants in the domestic urban landscape. These scales were pilot tested on a small group of local residents before the wider survey being mailed out. Water conservation attitudes were measured using a single item ("residents should try to use as little water as possible on their gardens due to the scarcity of water supplies in Perth"). General environmental concern was measured with the 15-item Revised New Environmental Paradigm (NEP) scale (Dunlap, Van Liere, Mertig, & Jones, 2000).

Reliability analyses using Cronbach's alpha[2] on the three multi-item scales indicated that all represented reliable scales that appeared to measure one unidimensional latent construct—NEP (α = .86) and attitudes toward native plants (α =.83) and urban biodiversity (α =.78).

Participants' current gardening practices were measured by asking residents to choose the (one) description that best described their current gardening practices from a list containing five options ("I prefer a mixture of native and exotic [nonnative] plants in my garden," "I prefer to plant only exotic plants in my garden," "I prefer to plant only native plants in my garden," "I am not sure whether the plants I plant in my garden are native or exotic," and "I never plant new plants in my garden"). Answers to this question were used to categorize respondents as either "mixed gardeners" (60.4% of sample), "exotic gardeners" (9.8% of sample), "native gardeners" (12.9% of sample), "unaware gardeners" (9.3% of sample), or "nongardeners" (7.7% of sample), broadly following Head and Muir's (2004, 2007) category system referred to earlier. Finally, demographic questions were included relating to the participants' age, gender, income, ethnicity, and household ownership status.

Procedure

The questionnaires were hand delivered to the postboxes of all households within our target areas in Melville and Fremantle, both of which were located within the proposed ecological linkages outlined in the Perth Biodiversity Project (1,000 per target area). Each questionnaire was accompanied with a cover letter describing the study as a project interested in investigating residents' gardening attitudes, practices, and preferences. No mention of biodiversity issues was made in the cover letter. Each questionnaire package included a reply-paid envelope that participants were instructed to use to mail the questionnaires back once completed. Reminder flyers were also hand delivered a week later to the same 2,000 households to encourage replies from those who had intended to return the survey but had not yet done so.

Results

Overall Levels of Aesthetic Landscape Preference for High-Versus Low-Habitat Gardens

Because ratings of how much participants "liked" the photos and how much they "would like to have a garden like this at their home" were extremely highly correlated ($r = .98$, $p < .001$), we chose to only analyze the "like" data. Reliability analyses using Cronbach's alpha indicated that both the 12 low-($\alpha = .92$) and 12 high-habitat photos ($\alpha = .96$) represented reliable scales in terms of the liking ratings obtained. Moreover, a principal component analysis of the like ratings of all 24 photos (together) revealed a one-factor solution, with all 12 high-habitat photos loading positively on this ("preference for high habitat") factor and all 12 low-habitat photos loading negatively on this same factor.

An index of "preference for high-habitat gardens" was then calculated for each participant by subtracting their mean like rating (on the 10-point scale) for the 12 low-habitat photos from their mean like rating (on the same 10-point scale) for the 12 high-habitat photos. Thus, a score of 0 on this index (referred to from now on as "landscape preference") indicated no overall preference for either type of garden (midpoint of the scale), scores toward the positive end of the scale indicated an overall preference for high-habitat gardens, and a negative score indicated an overall preference for low-habitat gardens. This landscape preference index was considered an appropriate representation of preference for each participant on account of an observed negative correlation between individuals' mean scores for the low- and high-habitat photos, $r\,(460) = -.40$, $p < .001$. Thus, it was indeed the case that the more respondents liked high-habitat photos, the less they liked low-habitat photos and vice versa. This, combined with the clear factor structure outlined earlier and also the split-half reliability (i.e., Cronbach's alpha) scores of more than .95 for the like ratings of high- and low-habitat photos, led us to conclude that the use of such an index was appropriate.

For our overall sample, landscape preference fell just above the midpoint of the scale ($M = +0.99$, $SD = 3.23$), indicating that, on average, there was a very slight preference for high-habitat gardens. Examination of the histogram indicated that preferences were relatively normally distributed around this mean and ranged from −7.17 to +9.0.

Scores on the Attitude Scales for the Sample as a Whole

Mean scores on the NEP and attitudes toward native plants and urban biodiversity were calculated for each participant by reversing the negatively worded items and then calculating the mean across all items on the scale. As mentioned previously, a single-item measure was used to measure attitudes toward water conservation. As such, scores on each scale ranged from 1 to 5, with higher scores indicating higher levels of endorsement of the "proenvironmental" position on each issue, respectively.

Scores on the Urban Biodiversity scale (M = 4.31, SD = 0.61) and Water Conservation scale (M = 4.32, SD = 0.76) were both skewed toward the "proenvironmental" end of the scale. Scores on the NEP scale were closer to the midpoint of the scale (M = 3.68, SD = 0.56), with mean scores for attitudes toward native plants being the closest of all the scales to the scale midpoint of 3 (M = 3.24, SD = 0.69).

Correlations

Correlations were conducted to examine the bivariate relationships between all four attitudinal measures as well as between each of these measures and landscape preference. As can be seen in Table 1, scores on the three attitude scales (Urban Biodiversity, Native Plants, and NEP) were moderately (but significantly) positively correlated with one another (rs ranging from .48 to .55). Attitudes toward water conservation were also significantly positively correlated with these three scales but to a lesser magnitude (rs ranging from .23 to .34).

In terms of the relationship between the four attitudinal variables and preference for high-/low-habitat garden landscapes, attitudes toward native plants showed the strongest (positive) bivariate relationship to landscape preference, r (450) = .69, $p < .001$. Attitudes toward urban biodiversity was the next most positively correlated with landscape preference, r (452) = .54, $p < .001$, followed by general environmental concern (NEP), r (440) = .49, $p < .001$. Finally, attitudes toward water conservation showed a relatively weak (but significant) positive relationship with landscape preference, r (459) = .28, $p < .001$.

Differences in Landscape Preference Across Gardener Types

Before conducting our multivariate analysis of landscape preference, a preliminary between-groups analysis of variance (ANOVA) was conducted to examine whether landscape preference differed (in a univariate sense) between residents who reported having different current gardening practices. Results of this analysis indicated a significant difference between the current gardening practice groups, F(4, 401) = 4.3, p = .002, $\eta p2$ = .041, the nature of which is depicted in Figure 3.

A Model of Landscape Preference

A hierarchical multiple regression was performed to examine the unique contribution of each of our various attitudinal and demographic variables to variation in landscape preference among respondents. In the first step, we included the demographic variables (ethnicity, gender, age, and income). In the second step of the regression, we added council area to ascertain how much unique variance was accounted for by the different physical environment (i.e., gardening norms) in each of the two sample areas, above and beyond any demographic differences. In the third step, we added the dummy-coded variables relating to current gardening practices. “Native gardeners” was used as the omitted/reference category when dummy coding the five levels of the current gardening practice variable due to this group displaying the highest landscape preference index scores (as shown in

Figure 3). In the final step, we added our four attitudinal variables (native plants, NEP, urban biodiversity, and water conservation) to examine the extent to which these further added to the predictive power of the model and to test whether current gardening practices remained a significant predictor after the inclusion of the attitudinal variables. Theoretically speaking, in this final step, we wished to ascertain whether respondents' current behavioral practices had an influence on landscape preferences that was independent of any potential overlap with the attitudinal variables. Such a finding would, for example, suggest that native gardeners may have simply had more exposure to habitat-providing gardens and plants through the particular kinds of gardening activities that they have been involved with in the past. We refer the reader to the summary of this hierarchical regression analysis provided in Table 2, including all relevant statistical findings. In the interest of being economical with space, we do not reproduce the numerical information in the table in our account of the regression findings presented later in the section.

The overall model accounted for almost two thirds of the variance in landscape preference and was highly significant. In Step 1, we see that, of the demographic variables entered, ethnicity had the strongest relationship with landscape preference, with those who identified as "Australian" showing greater preference for high-habitat gardens than those who did not. Age and income were also significant (negative) predictors of landscape at this first step, such that being younger or less wealthy was related with higher net preference for high-habitat gardens. Gender, however, had no discernable influence. Overall, these four demographic variables accounted for 15% of the variance in landscape preference.

When council area was added to the model at Step 2, we see that it becomes by far the strongest predictor of landscape preference in the model and adds an additional 25% of explained variance to that which was accounted for by the demographic variables at Step 1. Ethnicity remains a significant predictor, although its reduction in beta weight from .33 to .18 implies that some of the effect of

ethnicity can be accounted for by council area. Age and income drop out completely as significant predictors with the addition of council area to the model, suggesting that the effect of these variables can be accounted for by common variance with council area.

The addition of current gardening practices to the model in Step 3 produces no dramatic change in the explanatory power of ethnicity and council area. Current gardening practices is shown at this step as a significant independent predictor of landscape preference, with all of the dummy-coded variables relating to the two-way comparison with native gardeners being significant. The addition of this variable at Step 3 accounted for an additional 7% of the variance in landscape preference. However, importantly, current gardening practices completely drops out as a significant predictor when our four attitudinal variables are added to make up the full model in Step 4. This suggests that there was little variance explained by current gardening practices that could not simply be accounted for by that which it shared in common with the attitudinal variables. The addition of the attitudinal variables accounted for an additional 20% of the variance in landscape preference, over and above the demographic, geographical, and behavioral variables entered in the previous three steps. In the full model at Step 4, we see that native plant attitudes becomes the strongest independent predictor of landscape preference, followed by council area. The NEP and ethnicity are the only other variables that remain significant predictors, although only marginally in the latter case ($p = .04$).

Given that council of residence was shown to be related to landscape preference, we also took the precaution of testing whether this effect of council might have been influenced by how long a respondent had lived in his or her council area, which would again indicate a potential "mere exposure" effect. To this end, a Council Area × Length of Residency (less than 1 year vs. 1–5 years vs. more than 5 years) ANOVA was performed with landscape preference as the dependent variable. This analysis showed no significant main effect of length of residency, $F(2, 452) = .42$, $p = .66$, and,

most importantly, no significant interaction between length of residency and council area, $F(1, 452) = .15$, $p = .87$.

Discussion

The purpose of the current study was to investigate suburban residents' landscape preferences for high- versus low-habitat-providing front yard landscapes in an Australian context. In addition, we sought to examine how such preferences might be related to levels of general environmental concern and attitudes toward native plants, preservation of urban biodiversity, and water conservation, as well as self-reported current gardening practices. Moreover, we were interested to see whether the differing local descriptive norms around gardening practices in the two areas sampled may also be related to residents' reactions to visual representations of different types of urban landscapes.

The Distribution of Preference for High-and Low-Habitat-Providing Landscapes

The first conclusion that we draw from our findings is that the distinction between high- and low-habitat-providing gardens was important in terms of our respondents' urban landscape preference, as evidenced by the clear one-factor structure that emerged from our principal component analysis and the fact that this one factor was loaded onto positively by the high-habitat photos and negatively by the low-habitat photos. Contrary to Nassauer's (1993, 1995) findings in North America, however, our sample of respondents did not show a strong bias toward more traditional, orderly, low-habitat-providing urban landscape images. Rather, preferences were fairly normally distributed around a mean that actually fell slightly toward the high-habitat-providing side of the scale midpoint. Although some may seek to question whether we may have just happened to receive replies to our survey from a more ecologically minded set of participants, the fact that only 12% of the sample reported staunchly "native" garden practices would tend to suggest that this was not necessarily the case.

Attitudes and Landscape Preference

Given the high degree of variability in residents' preference for high-versus low-habitat garden aesthetics, the key theoretical question becomes one of attempting to explain or predict this variability. The *attitudinal* variable with the strongest relationship with landscape preference in the current study was residents' attitudes toward the merits of native plants in the urban landscape, with a much weaker (but still significant) influence being found in relation to a more global environmental attitude/ethic (as measured by the NEP), and attitudes toward the importance of promoting urban biodiversity more generally were found not to be a significant independent predictor. Those residents who endorsed attitudinal items relating to the aesthetic and ecological merits of planting native plants were much more likely to respond positively to images of high-habitat gardens in comparison with low-habitat gardens. This result has some resonance with the arguments of Kaiser, Wolfing, and Fuhrer (1999), among others, that attitudes can be found to predict environmental behaviors but often only when one measures both the attitude and the behavior at the same level of *specificity*. For example, attitudes toward catching the bus might predict bus-ridership behavior, but general environmental concern is less likely to predict bus ridership. Our findings here would seem to suggest that more specific attitudes are also more strongly related to the ways in which people react to urban landscapes of differential ecological quality. It is interesting to note that this also supports Bjerke et al.'s (2006) finding mentioned earlier, whereby residents' engagement with wildlife observation was a stronger predictor of preference for more densely vegetated urban parks than their scores on the NEP. What appears to be most strongly relevant to urban landscape preference, at least in the Australian context, is not necessarily some form of general environmental ethic *per se* or even an appreciation of the importance of urban biodiversity but rather residents' *specific* stance regarding the issue of "planting native."

Of the four issues investigated in our attitude scales, attitudes toward native plants also appeared to be the issue over which residents were most divided, with scores being widely distributed around a mean

that fell very close to the midpoint of the scale. Head and Muir's (2004, 2007) research has suggested that residents' attitudes toward the issue of native planting tend to be highly divided in Australian suburbs, and our findings here support this suggestion. Attempting to change residents' gardening practices toward practices that entail more "gardening for habitat" is likely to be far more difficult than simply educating them in the ecological benefits of doing so. The majority of our participants expressed relatively high levels of endorsement for the merits of promoting urban biodiversity (in *principle*). However, different attitudes toward the merits of plant "nativeness" seem to correspond with fundamentally different responses to particular garden aesthetics, with potentially large implications for how residents garden, in *practice*.

Of course, we must note that the correlational nature of the current study does preclude us being able to draw definitive conclusions regarding the direction of the causal relationship between landscape preferences and attitudinal variables. This is a problem that can also be identified in relation to the between-group differences in landscape preferences observed between native plant society members and the more general population by Kaplan et al. (1989) and Nassauer (1993) outlined earlier. In both these studies, and our own research reported here, a key question becomes whether individuals who hold particular attitudes toward plant "nativeness" come to perceive landscapes in a fundamentally different way as a result or whether those predisposed to a certain kind of landscape aesthetic are more likely to endorse a native planting ethic (and be more likely to get involved in native plant societies) as a result. Teasing apart this issue of direction of causality should be an important focus of future research because it would appear to hold important practical implications. If attitudes do drive reactions to landscapes, for example, then the key focus of efforts by policy makers, practitioners, and researchers should be developing ways of changing attitudes toward the merits of native plants. If more "unconscious" aesthetic preferences drive attitudes to native plants, however, then the path forward in terms of promoting urban biodiversity may well be much more difficult. A useful first step toward addressing these questions would be longitudinal investigations of potential changes *over time*

in landscape preferences among, for example, students enrolled in ecology-related university courses in comparison with control groups enrolled in nonecology-related courses.

Landscape Preference and Current Gardening Practices

When analyzed in terms of simple effects, garden landscape preferences were found to be highly related to the current gardening practices engaged in by the respondents. As one might expect, self-identified "native gardeners" showed a visual preference for high-habitat gardens, whereas "exotic gardeners" showed a preference for low-habitat gardens. What is perhaps more surprising, however, is that those residents who reported planting a *mixture* of native and exotic plants in their garden (and who constituted 60% of the respondents) *also* showed a mean preference for high- over low-habitat gardens. Although this preference was not as strong a preference as observed among the "native gardeners" group, this is nevertheless an encouraging finding for those engaged in the promotion of "gardening for habitat" in urban areas. It suggests a degree of positive aesthetic evaluation of high-habitat garden landscapes that extends beyond merely those residents who are already firmly committed to native gardening practices. As our multivariate regression analyses revealed, however, these differences in landscape preference between those engaged in different types of gardening practices become nonsignificant when entered into a model containing our other (demographic and attitudinal) variables. Specifically, as shown in our hierarchical regression analyses, the variance in landscape preference explained by gardener type overlapped very strongly with that explained by our four attitudinal variables (with native plant attitudes, of course, being the strongest predictor of the four). Thus, attitudes toward native plants (and to a lesser extent, general environmental concern) appear to be highly related to both how residents respond to the aesthetics of habitat-providing front yard landscapes and also the types of gardening practices that they are engaged in.

Local Gardening Norms

The significant differences in landscape preferences between the Fremantle and Melville geographical areas were particularly interesting, with residents in Fremantle (where high-habitat gardens were more normative) showing a mean preference for high-habitat gardens and residents in Melville (where low-habitat gardens were more normative) showing a mean preference for low-habitat gardens. Of particular interest is our finding that this effect of local norms remained significant even after controlling for all other variables in our model, many of which might have been strong candidates for explaining the between-council differences in landscape preference, such as ethnicity, current gardening practices, or our attitudinal variables. It is particularly fascinating, we believe, that which council respondents lived in remained the second strongest of only four significant independent predictors of landscape preference in the final step of our hierarchical regression. It would appear, therefore, that there was simply something about living in Fremantle versus Melville that influenced urban landscape preference above and beyond all the other variable measures here.

Two potential explanations for this influence of geographical location could be (a) visual exposure/familiarity and (b) the influence of local descriptive norms, as previously suggested in the experimental simulation work of Nassauer et al. (2009). In relation to the former, we might hypothesize that, given the differences in visual landscape within the two geographical areas, the residents in Melville were simply more used to seeing low-habitat front yard landscapes in their day-to-day lives as compared with the Fremantle residents, who were more commonly exposed to high-habitat front yard landscapes. However, our failure to find a significant interaction between council and length of residency does not really support such an explanation. Localized descriptive norms, however, are (theoretically speaking) something that individuals can "read off" the social world that surrounds them (Ford, Armstrong, Boxer, & Edel, 2008). As such, they would be less likely to require long periods of exposure/acquisition to influence perceptual preference. As such, the influence of council area on landscape preference may be partly a function of residents being affected by their perceptions of what most other local residents *do* (in relation to gardening), that is, local descriptive norms. Thus, our findings here would appear to provide field validation for Nassauer et al.'s (2009)

recent experimental demonstrations of the powerful influence of local descriptive norms on residents' domestic urban landscape preferences.

Formation of Local Norms

On an even more fundamental level, however, it is interesting to consider where "geographical" differences in attitudes, preferences, and gardening practices might originally stem from. That is, might it be that residents of a particular "ideological bent" tend to be attracted to an area like Fremantle and, once there, somewhat autonomously garden in particular ways? Another factor that may warrant consideration is the *history* of a suburban area in terms of when it was established and the particular gardening "fashions" that may have prevailed in the wider society at that particular time (see Seddon, 1997). A way of potentially integrating these accounts might be to postulate a process of dynamic social impact (Latane, 1996; Latane & Liu, 1996) being at play. Such an account would propose a network of residents (or "agents," in the language of agent-based modeling) interacting in an interdependent fashion over a period of time to bring about a particular (potentially skewed) distribution of both physical garden landscapes and attitudes across physical space. Along this line, our ongoing follow-up work aims to study the specific geographical distribution of preferences, attitudes, and practices to the level of the household (cf., Fernandez, Brown, Marans, & Nassauer, 2005), with these data being overlaid [using Geographical Information System (GIS) techniques] with observational ecological data relating to structural features of front gardens across the same area (using a similar approach to Alessa, Kliskey, & Brown, 2008). Having established these baseline "maps," we then plan to study emergent properties of the networks in response to the targeting of specific "nodes" (or "champion households") through community-based intervention/behavior change strategies.

Conclusion

The current study has demonstrated that, in the context of urban gardens, the distinction between garden landscapes that provide high levels of habitat for native wildlife and those that do not is highly implicated in residents' garden landscape preferences. Moreover, our findings suggest that garden landscape preferences appear to be related to more than simply generic perceptual reactions to visual structure attributable to (potentially genetically inherited) perceptual processes. As is being increasingly recognized in both the field of environmental psychology and other social scientific disciplines, human perceptions of, and interactions with, the urban landscape are highly imbued with social psychological, ideological, and sociocultural meaning. Our results also highlight that although the attitudes of individuals appear to be important to the ways in which people perceive and interact with urban landscapes, such preferences and practices are also highly influenced by the local social and environmental context. Gaining a greater understanding of the structure and dynamics of such psychological and social factors promises to form a crucial part of ongoing interdisciplinary efforts to preserve biodiversity in the urban landscapes within which an increasingly large number of us live and work.

Appendix

*Attitudes Toward Native Plant Items (*Indicates reversed items)*

1. Native plants are often unsuitable for the spaces available in smaller gardens*.

2. Residents should consider removing established plants from their garden if the plants are not native to the area.

3. Residents should try to grow plants for their garden from locally sourced seed.

4. I think gardens that contain exotic (rather than native) plants look more green and lush*.

5. It is important for residents to try to choose plants for their garden that are native to their specific local area.

6. The problem with native plants is that they often look scraggly and untidy*.

7. It is best to plant native plants in the garden because they attract birds.

8. Residents should plant native plants in their gardens because they require less watering.

9. I think that exotic plants such as roses are prettier than native plants*.

*Attitudes Toward Urban Biodiversity Items (*Indicates reversed items)*

1. We do not need to worry too much about the impact of human-built urban developments on animals*

2. The choices that residents make about the types of plants that they put in their gardens have implications for the surrounding environment.

3. Habitat protection is not really a particularly important environmental issue in cities*.

4. It is important that native animals in urban areas be provided with appropriate natural habitat.

5. The issue of biodiversity is only relevant to wilderness areas such as National Parks*.

6. It is important to me that areas of bushland in my suburb are retained, rather than being developed for housing.

Acknowledgment

The authors would like to acknowledge Michelle Sermon, Sophie Rothwell, and David Edwards for their contribution to the collection of data for this project. We would also like to acknowledge the in-

kind support provided by the two local government authorities involved in the research (City of Fremantle and City of Melville), as well as the WA Local Government Association (WALGA).

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

Funding

The author(s) received no financial support for the research and/or authorship of this article.

Notes

1. It is interesting to note that similar findings relating to the aesthetic importance of markers of "human intent" has also been found in simulation studies relating to brownfields rehabilitation sites (Hands & Brown, 2002).

2. This statistic represents, conceptually, the average intercorrelations between scores on all items on the scale.

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Bios

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Figure 1. Photographs illustrating prototypical urban landscape for both (a) The Fremantle sample area and (b) The Melville sample area

Figure 2. Examples of (a) high-and (b) low-habitat garden photos used in the questionnaire

Figure 3. Mean level of landscape preference, as a function of respondents' current gardening practices (positive scores denote net preference for high-habitat images, negative scores denote net preference for low-habitat images)

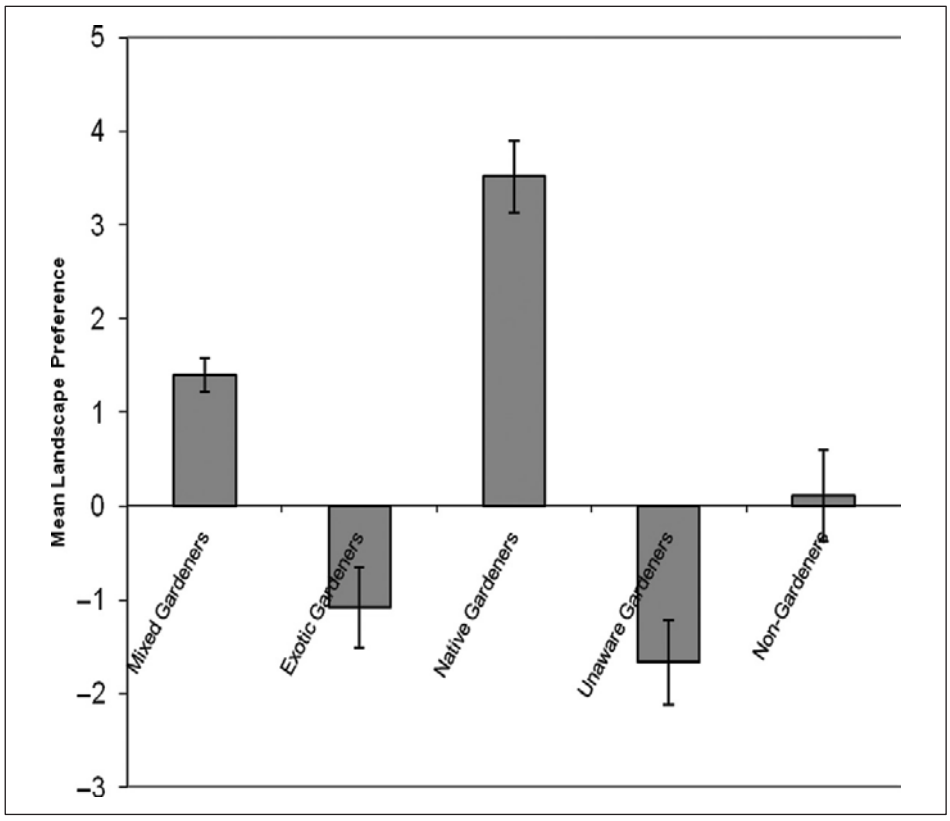

Table 1. Correlation Matrix for the Attitudinal Variables and Landscape Preference

	Landscape preference	Urban biodiversity	Native plants	NEP	Water conservation
Landscape	1	0.542[a]	0.694[a]	0.490[a]	0.275[a]
Urban		1	0.545[a]	0.548[a]	0.233[a]
Native plants			1	0.480[a]	0.347[a]
NEP				1	0.321[a]
Water					1

[a]Correlation is significant at the .01 level (two-tailed).

Table 2. Summary of Multiple Hierarchical Regression Analyses for Landscape Preference on Demographic Variables, Council Area, Current Gardening Practices, and Attitudinal Variables (Standardized Betas Marked for Significance Level)

	β	*SE b*	Standardized β
Step 1			
Ethnicity (0 = *non-Australian*, 1 = *Australian*)	2.90	0.49	.33***
Gender (0 = *female*, 1 = *male*)	−0.49	0.38	−.07
Age	−0.49	0.15	−.19**
Income	−0.21	0.10	−.12*
Change statistics	$R^2_{ch} = .15, F_{ch}(4, 285) = 12.27, p < .001$		
Step 2			
Ethnicity	1.58	0.43	.18***
Gender	−0.06	0.32	−.01
Age	−0.12	0.13	−.05
Income	0.07	0.09	.04
Council area (Fremantle = 0, Melville = 1)	−3.64	0.33	−.56***
Change statistics	$R^2_{ch} = .25, F_{ch}(1, 284) = 119.70, p < .001$		
Step 3			
Ethnicity	1.01	0.43	.12*
Gender	−0.13	0.30	−.02
Age	−0.22	0.12	−.08
Income	0.06	0.08	.03
Council area	−3.20	0.33	−.49***
Native gardeners (0) versus mixed gardeners (1)	−1.049	0.42	−.16*
Native gardeners (0) versus exotic gardeners (1)	−1.99	0.63	−.18**
Native gardeners (0) versus unaware gardeners (1)	−2.92	0.64	−.26***
Native gardeners (0) versus nongardeners (1)	−2.97	0.63	−.25***
Change statistics	$R^2_{ch} = .07, F_{ch}(4, 280) = 8.50, p < .001$		
Step 4 (full model)			
Constant	−10.58	1.51	
Ethnicity	0.69	0.34	.08*
Gender	0.18	0.25	.03
Age	−0.13	0.1	−.05
Income	0.11	0.07	.07

(Continued)

Table 2 (continued)

	β	*SE b*	Standardized β
Council area	−1.9	0.28	−.30**
Native gardeners versus mixed gardeners	0.36	0.35	.05
Native gardeners versus exotic gardeners	0.68	0.55	.06
Native gardeners versus unaware gardeners	−0.54	0.55	−.05
Native gardeners versus nongardeners	−0.98	0.52	−.08
Native plants attitudes	2.24	0.25	.46**
NEP	0.81	0.25	.14*
Urban biodiversity attitudes	0.43	0.26	.08
Water conservation attitudes	−0.08	0.18	−.02
Change statistics	$R^2_{ch} = .20, F_{ch}(4, 276) = 42.03, p < .001$		
Overall model	$R^2_{Adj.} = .65, F(13, 276) = 42.61, p < .001$		

Note: NEP = New Environmental Paradigm.

*$p < .05$. **$p < .01$. ***$p < .001$.