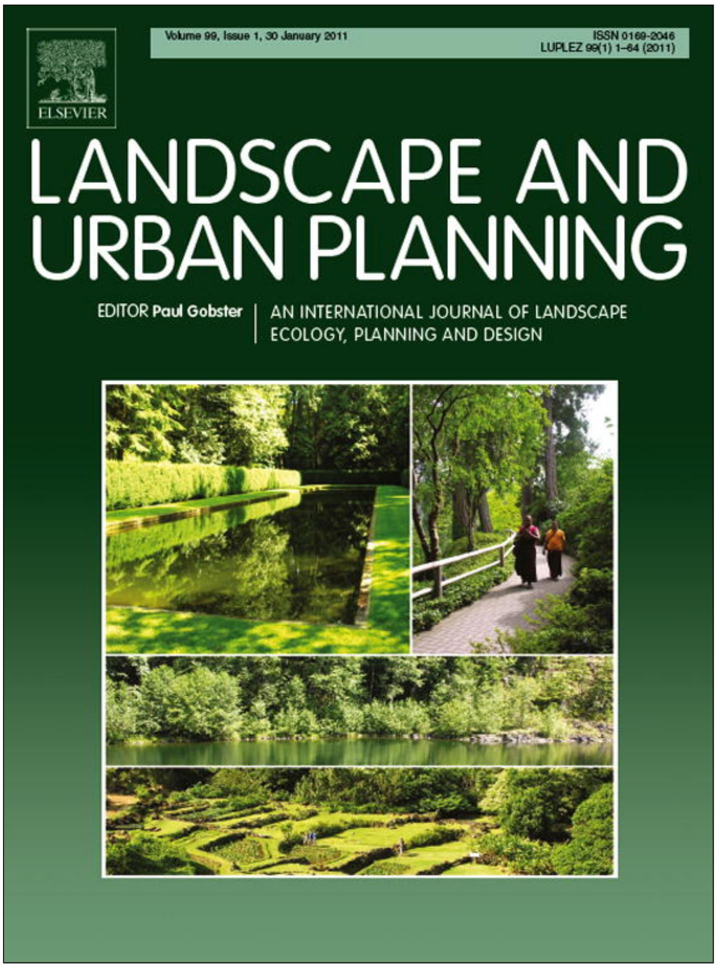
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Preference to home landscape: wildness or neatness?

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ABSTRACT

This study explores students' preferences toward natural and wild versus clean and neat residential landscapes using preference survey data. Based on the rating scores of four housing landscape designs, multinomial logit models were used to explore the potential influential factors on people's preferences, especially the wildness or neatness of the home landscape. The results suggest that students in agricultural economics, horticulture, and social sciences are more inclined to choose a neat, well-kept environment around their homes. In contrast, wildlife science students prefer more natural landscapes. This study also found that senior students and students from large cities also prefer well-maintained and artificial landscapes. Also, students who are members of an environmental group, and those whose parents have a better education, are more likely to choose a more natural landscape. The results would provide additional information for planners, developers, engineers, architects and foresters in building more livable communities which are aesthetically appealing but also ecologically sound.

1. Introduction

Landscape, which includes topography, vegetation and associated plants and soil, water bodies, and their spatial configuration, is one of the most visual needs by people. Human–nature interactions lead human beings to have contrasting preference on the surrounding landscape and environment because a pleasing landscape can bring mental and physical benefits to people (e.g., Kaplan et al., 1998; Kaplan and Kaplan, 1989; Ode and Fry, 2002). Consequently, a landscape is constantly modified due to people's preferences (Erickson et al., 2002; Luzar and Diagne, 1999; Schroeder, 1988), causing further complex feedbacks with policy making and planning processes (Kaiser et al., 1999). Clearly, understanding people's preferences for their surrounding landscapes and how the preferences shaped the environment is not only an academic challenge but also critical for policy making and implementation. For example, knowledge of the preferred landscape would enable planners and developers to construct more appealing neighborhoods while enhancing ecological services.

Scientific investigation of the preference to landscape is challenging due to the complexity of land mosaics, its design and change over time. There are many attributes (e.g., vegetation and associated plants, spatial configuration of landscape elements, the topography, bodies of water, etc.) that determine the quality of a visual landscape. Additionally, the role of each attribute is dependent of the context and its interaction with the other attributes (Chen et al., 2006; Lindenmayer and Franklin, 2002). Another challenge arises from the heterogeneous and dynamics nature of people's preferences for the landscape (i.e., preference is temporally, spatially and personally specific), suggesting that cultural background needs to be included in sound analysis of people–landscape interactions (Nassauer, 1995). In urban landscapes, for example, landscape architects often struggle with the balance between wildness and neatness in designing a neighborhood in the context of broader urban landscape. In general, neatness seems more appealing, but often has lowered ecological services (Gobster et al., 2007; Martin, 2001; McPherson et al., 1989). This suggests that pleasing alone might not be a good design from an ecological perspective (Gobster et al., 2007). Incorporating urban forestry and greenness into the planning, designing and implementing of public policy pertaining to suburbs (or edge cities) is increasingly challenged to promote not only aesthetically appealing but also ecologically sound communities.

Investigation of people's preferences on landscape has been broadly conducted in recent years (Carlson, 1999, 2006; Wessels, 1997), including studies of individual preference. Individuals' tastes on environmental appreciation are often shown to be linked to a person's training, their previous experiences and personal characteristics such as age, personal emotional experience, social status and education (Buttel, 1987; Brunson and Reiter, 1996; Lindhagen, 1996; Ma and Bateson, 1999; Silvennoinen et al., 2002; Van den Berg and Koole, 2006). More than two decades ago, Dearden (1984) found that familiarity with general landscape types appeared to have a positive correlation with landscape preferences, but none

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of the socio-economic variables – gender, age, income, education and occupation – were significant. Rauwald and Moore (2002) reported that country and gender differences existed in environmental attitudes, while Brody et al. (2004) further indicated that environmental perceptions differed by location because of the information gaps between any two sites. From people's preferences perspective, Abello and Bernaldez (1986) found that certain aspects of personality had significant correlation with landscape preference. Recently, Nassauer et al. (2009) concluded that cultural norms for landscape appearance may affect preferences for and adoption of ecological design of residential landscape.

Education has been shown to be the most consistent predictor for environmental concern (Wall, 1995). Much of the work indicates that individuals with high levels of education tend to care more about the environment (Ewert and Baker, 2001). Most of the differences in perception with various academic disciplines are also ascribed to the "lack of information." Each academic major is corresponding to some specific "knowledge" and this "knowledge" may act as a mediating variable (Baron and Kenny, 1986) in the preference-shaping process, suggesting that schooling in different majors may serve as a mechanism to "transmit" the beliefs or attitudes of that cultural domain. Assessment of the effect of academic disciplines can be found in a wide array of literature. For example, Smith (1995) found that students majoring in business or economics were less likely to take action to protect the environment. Brown and Harris (1998) also found that professional foresters had a different environmental concept from their colleagues in ecology, wildlife, fishery, geology or recreation. Finally, it seems that different educational backgrounds refer to not only the level of education but also the type of education.

One of important features of landscape in the context the residential landscape is wildness versus neatness. Previous studies support a general conclusion that people in general prefer a neat environment. Nassauer (1988) claimed that neatness is one of the most important factors for an attractive landscape although trimmed bushes are not usually good for biological diversity (Nassauer, 1995). An over-emphasis of the "garden" aspect of the garden city has resulted in the excessive planting of trees (Tuan, 1990). Perfect green lawns may not be ecologically healthy (Steinberg, 2006). Additionally, it is argued that people have different perceptions about wilderness: "One man's wilderness may be another's roadside picnic ground" (Nash, 2001). Clearly, the bias in preference of our surrounding world might be ascribed to many factors. While the ability to know the world is limited by our knowledge and experience, public preferences are deeply embedded in class position and the relative economic, cultural and social capital (Bourdieu, 1984; Fraser and Kenney, 2000; Grusky and Wheedon, 2001).

To resolve the conflict needs for aesthetically appealing and ecological services, we studied people's preferences to natural/wild mosaics and the clean and well-maintained landscapes using both approaches. To explore the potential influential factors, hypothetical landscapes with different green space, designs and policy were generated using multinomial logit models based on our preference survey. We hypothesized that individuals with different educational backgrounds and level have different preferences to their housing landscapes.

2. Methods

2.1. Preference survey

Two approaches are broadly used to investigate individual preference. Surveys using a questionnaire are the conventional method (e.g., Getz et al., 1982; Zhang et al., 2007). The visualization method has also been widely applied to landscape design and investigations of attributes influencing people's landscape preferences. For example, Tyrväinen et al. (2006) used computer-based visualization and landscape laboratory methods to help the public better perceive the surrounding environment. Ode et al. (2008) established links between landscape aesthetic theory and visual indicators. A computer-generated visualization survey was further conducted and the perceived indicators of naturalness were found to be the more important drivers of preference than demographic factors (Ode et al., 2009). The two methods have their own weaknesses and strengths. Using verbal questions may not effectively illustrate the real landscape preference, while using a visual survey might lead to misinterpretation of the information of the visual appearance.

In this study, the primary data was obtained from both visual and verbal preference surveys, which include preference rating on visually designed landscapes (i.e., pictures) and providing verbal answers regarding their preferences to the landscapes and their socio-demographic characteristics. We created fourteen designs for single-housed landscapes. The photographic materials used for the designs were taken from Alabama and Georgia, indicating that the house style and surrounding environment in these designs is representative of the residential landscape common to the Southern U.S. We modified the picture with Adobe Photoshop 7.0 software to obtain a consistent house style, sky, front lawn and pathway. The landscape designs were shown slide by slide using Powerpoint 2007 in a time controlled manor (30 s/slide). For comparison purposes, six designs were presented in the same slide at one time. Three designs in the previous slide were replaced by three new designs in the following slide, creating various combinations of scenes. Altogether, we had ten slides, ensuring that each design was compared with other at least four times. The survey was conducted in various classrooms where students were asked to rate the different landscape designs according to a Likert scale from 1 to 5 (1 = least preferred; 5 = most preferred).

Four out of the fourteen designs were selected to present the variety of tree presence, with a particular focus on cleanliness of the environment and, such as wild vs. natural-looking landscape (Fig. 1). H1 demonstrated no tree; H2 for a clean, neat and well-maintained landscape; H3 for a natural, ecological, wild-looking; and H4 for a messy, wild-looking landscape. The four landscapes were assumed to be independent in our analysis. Based on the average rating of these four designs, we ranked them to create a variable (Y^1) to identify the most favorable design. For example, if the first design received the highest average rating, Y^1 was given a value of 1. If the third design received the highest average rating, Y^1 was given a value of to 3.

Respondents were also asked to answer verbal questions to elicit information on people's preferences to tree size, species, amount and the level of open space, and wildness/nature. Additionally, participants were asked to rate the importance of some characteristics of trees such as seasonal color, shape, and growth. Each individual's demographic information was also collected to examine the variation due to people's background. The following question was asked:

In your opinion, which is the most important factor in the following kinds of urban trees and landscaping?

(1) To increase tree canopy by planting more trees.
(2) To keep trees pruned and well-maintained.
(3) To plant flowering shrubs, perennials and annuals using more artificial landscape.
(4) To keep a more natural and wild-looking landscape.

The dependent variable Y^2 is equal to the most favored alternatives, coding from 1 to 4. For example, if the fourth alternative was chosen, Y^2 was set as 4.

Fig. 1. Landscape design. (a) Landscape design H1, mean value = 1.84 and std. dev = 1.20 (N = 333); (b) landscape design H2, mean value = 3.19 and std. dev = 0.86 (N = 333); (c) Landscape design H3, mean value = 3.65 and std. dev = 1.40 (N = 333); (d) Landscape design H4, mean value = 3.33 and std. dev = 1.20 (N = 333).

2.2. The models

Two multinomial logit models were separately applied to the four landscape designs (Y^1) and the four verbally stated alternatives (Y^2). The multinomial probit model is not often used due primarily to the practical difficulties in estimating model coefficients (Park, 2005). Both Y^1 and Y^2 are functions of the characteristics of the individual making the choice. Our purpose was to compare the relative importance among the landscape characteristics (i.e., natural/wild and cleanness). Because the four categories are unordered, multinomial logistic regression was used to answer the central question: "What is a person's preference as compared to the other three alternatives?" In the multinomial logit model, one of the four alternatives was chosen as the reference. The probability of membership in other categories was compared to the probability of membership in the reference category. Our multinomial logit model (Greene, 1993) was

$$\Pr(Y_i^j = m) = \frac{\exp(Z_{mi})}{1 + \sum_{h=2}^{M} \exp(Z_{mi})} \tag{1}$$

where m refers to the other categories except for the reference category (equal to 1, 2, 3), i refers to observations (varies from 1, 2, ..., n), and j refers to the two separate multinomial logit models for landscape design and four alternatives in the questionnaire, respectively (set as 1, 2). For the reference category:

$$\Pr(Y^j = 4) = \frac{1}{1 + \sum_{h=2}^{M} \exp(Z_{hi})} \tag{2}$$

where Y^j represents the dependent variables in the two models, Y^1 is the corresponding favorite choice of the four landscape designs with the fourth design (coded as 4) set as the reference category. Y^2 is the corresponding favorite selection of the four alternatives and the fourth choice (i.e., to keep a more naturalized landscape) is designated as the reference and coded as 4. The independent variables X_{ik} represent respondents' personal characteristics and family background, such as age, major, grade, race, gender, family income, city of residence, parents' education and if they were a member of an environmental group. The terms β_{mk} are the empirical coefficients to be estimated for the respective variables.

In estimating each model, the coefficients of the reference group are normalized to zero (Maddala, 1990; Greene, 1993). This is because the probabilities for all the choices must sum up to unity (Greene, 1993). Consequently, only three distinct sets of parameters can be identified and estimated for the four choices.

The natural logarithms of the odd ratio of Eqs. (1) and (2) give the estimation as

$$\mathrm{Ln}\frac{P(Y^j = m)}{P(Y^j = 4)} = \alpha_m + \sum_{k=1}^{K} \beta_{mk} X_{ik} = Z_{mi} \tag{3}$$

Table 1
Descriptive statistics of choice alternatives and demographic characteristics.

Variable	Frequency (%) (N = 333)
$Y^1 = 1$	46 (13.81%)
$Y^1 = 2$	49 (14.71%)
$Y^1 = 3$	196 (58.86%)
$Y^1 = 4$	42 (12.61%)
$Y^2 = 1$	77 (23.12%)
$Y^2 = 2$	71 (21.32%)
$Y^2 = 3$	61 (18.32%)
$Y^2 = 4$	124 (37.24%)
Major	
Wildlife science (base)	72 (21.62%)
Forestry	98 (29.43%)
Horticulture	54 (16.22%)
Social science	109 (32.74%)
Age (<20 years old)	54 (16%)
Family income (in thousand dollars)[a]	64.05 (30.27)
3rd and 4th year student	219 (66%)
Male	246 (74%)
White	299 (90%)
City of residence	
Rural area (base) (population <2000)	95 (28.52%)
Small city (2000–50,000)	150 (45.05%)
Large city (>50,000) (base)	88 (26.43%)
Environment group member	76 (23%)
Parents' education	
<=High school (base)	33 (9.91%)
College/bachelor's degree	190 (57.06%)
Graduate degree	110 (33.03%)

[a] In mean and standard deviation.

This denotes the relative probability of each of group 1, 2 and 3 to the probability of the reference group. The estimated coefficients for each choice therefore reflect the effects of "X_i"s on the likelihood of the respondents choosing that alternative relative to the reference group.

SAS 9.1.3 was used to estimate the multinomial logit model. The marginal effects were estimated by differentiating Eqs. (1) and (2) (Greene, 1993).

$$\frac{dP_{ih}}{dX_{imk}} = b_k P_{ih}(1 - P_{ih}) \tag{4}$$

3. Results

3.1. Data description

A total of 360 students of University in Alabama from different departments participated in the survey (Table 1). Five of them did not complete the survey because of their early departure. Prior to our analysis, the observations with missing values were deleted, reducing the final sample size to 333. Students were grouped into four programs: wildlife science, forestry, horticulture (including landscape design, building science, recreation management and architecture), and social science (including history, agriculture economics, psychology, education). Among the students, 84% were older than 20 and 66% were third- and fourth-year students. Twenty-three percent of the students were members of environmental groups.

In the 2008 U.S. Census, whites accounted for 71% of Alabama's population with 48% as male. In this study, the sampled population was 90% white and 74% male. Approximately half of the students were from small cities with populations ranging from 2000 to 50,000. The family background information indicated that the students were from relatively wealthy families with an average income of $64,050 (the median household income is $42,586 in Alabama). Most of the students' parents had a college degree.

H1 contained no tree and received low mean score of 1.84. H2 was well-maintained and neat compared to H4, receiving a mean score of 3.19. H4 presented wildness, with 80% of the picture being covered by trees, or houses hidden behind large trees although they looked messy because of the defoliation, straggly stems, bushes and dead wood. Nevertheless, H4 received the second highest mean score of 3.33.

H3 received the highest score among the four designs. In H3, more than 80% of the slide was covered by trees. The use of white stone edging seemed appealing, likely because the landscape was maintained. While both H3 and H4 had the understory dominated by shrubs and small trees, the white stone fence in H3 served as a good "cue to care" for the students. It seems supported by the argument made by Nassauer (1988, 1995) that perceived care of the landscape is a primary determinant of landscape attractiveness and "cues to care" can improve the appearance of some "messy" landscapes.

3.2. Multinomial logit model: landscape design

Our modeling based on the multinomial logit regression showed significant influence of four landscape designs (p = 0.05, Likelihood ratio = 52.80), with Y^1 as the respondents' choices for the four landscape designs (Table 2). H4 was selected as the referenced category. Among the four majors in this study, wildlife science was chosen to be the base category. For the model output, a positive significant coefficient on a variable for a particular equation indicates that the variable is associated with a higher probability of being in the group choice relative to the reference group. Preference differences were found in the students with different academic backgrounds. Horticulture students preferred H3 more than H4. H3 had good edging (i.e., an indication of some maintaining by the owners) and fit the training of horticulture students. Students majoring in social science preferred the well-maintained and clean designs in H1 and H2. Students majoring in social science appeared to believe clean residential areas were good enough for human beings. Residential landscape is the closest environment surrounding us and it should "work" for humans. A wild, forested look may represent danger and appear uncivilized.

Marginal effects of each variable for the four landscape designs were presented in Table 3. The marginal value interprets the difference in the predicted probabilities, or the effect of one unit change in X on the probability of each design outcome when all other variables are held constant at sample mean values. For example, the probability that students majoring in social science choose design H1 was 0.18 higher than the wildlife science students. The probability of choosing design H3 is 0.06 higher for wildlife science students than the social science students. Again, wildlife science students seemed preferring natural and wild-looking environments where maintained white stone edging was in the picture.

Preference of an individual differed by academic background (Table 3). However, family background and personal characteristics appeared no effect on individuals' perceptions regarding the landscape designs. Interestingly, we found that students from families with higher household income did not prefer H1 (i.e., no trees).

3.3. Multinomial logit model for alternatives

The multinomial logit model for the four alternative landscapes showed significant at P value of 0.01, with a likelihood ratio of 94.18 (Table 4). The dependent variable Y^2 represent respondents' choices for the alternatives where "To keep a more naturalized landscape" was set as the referenced category. Among the four student groups,

Table 2
Maximum likelihood estimation of multinomial logit regression for four landscape designs.

Parameter (std. error)	Multinomial logit model ($N = 333$)		
	1 $\mathrm{Ln}\,\frac{P(Y_i^1=1)}{P(Y_i^1=4)}$	2 $\mathrm{Ln}\,\frac{P(Y_i^1=2)}{P(Y_i^1=4)}$	3 $\mathrm{Ln}\,\frac{P(Y_i^1=3)}{P(Y_i^1=4)}$
Intercept	0.7829 (1.8208)	2.2202 (1.7293)	1.2072 (1.4223)
Log(income)	−0.2598** (0.4097)	−0.6368 (0.3803)	−0.1185 (0.3091)
Forestry	0.7156 (0.7246)	0.6600 (0.5803)	0.7710 (0.4915)
Horticulture	1.0389 (0.8428)	1.1065 (0.7421)	1.0910* (0.5948)
Social Science	1.8382*** (0.7007)	1.3189** (0.6526)	0.9670* (0.5273)
3rd and 4th year student	−0.1957 (0.5433)	−0.5423 (0.5167)	0.0211 (0.4299)
Environmental group	−0.1561 (0.5800)	−1.6153 (0.5903)	0.0561 (0.4268)
Male	−0.4283 (0.5495)	−0.1991 (0.5508)	−0.2803 (0.4515)
AgeLe20	1.2452 (0.7732)	0.3042 (0.8336)	0.9397 (0.6818)
White	−0.9010 (0.7693)	0.2940 (0.8643)	0.1989 (0.7007)
Bachelor degree	−0.2388 (0.8137)	−0.0416 (0.7813)	−0.2564 (0.6326)
Graduate degree	0.9472 (0.8696)	1.0542 (0.8385)	0.3893 (0.6973)
Small city	0.3707 (0.5689)	−0.3589 (0.5285)	0.2813 (0.4231)
Large city	0.3374 (0.6243)	−0.1270 (0.5893)	−0.0359 (0.4917)
Likelihood ratio	52.80**		

*** Significant at 0.01 level.
** Significant at 0.05 level.
* Significant at 0.10 level.

students of wildlife science were chosen as the base category, which was compared to the other three majors.

Log (income) is a significant factor for Y^1 ($p < 0.05$). The log of the ratio of the two probabilities, $P(Y^2 = 1)/P(Y^2 = 4)$ was 0.7784, suggesting that higher-income families preferred landscapes with more trees and vegetation. This was consistent with the results of the multinomial logit regression in visual landscape design. The marginal effects (Table 5) further suggested that, while Log (income) increased by only one unit (i.e., 10,000 dollars) the probability to choose "planting more trees" increased by 0.13 and the probability to choose a natural and wild landscape increased by 0.12.

Although there was no difference between the wildlife science and forestry students, our models indicated significant differences in preference among students of the four majors. It seemed that horticulture students favored significantly more toward well-maintained landscapes than wildlife science students, as the probability to choose a well-maintained landscape for horticulture students (i.e., marginal effect) was 0.19 higher than wildlife science students (Table 5). In another word, horticulture students were less likely to choose "keep a more naturalized landscape" and prefer "to keep trees pruned and well-maintained." This result was consistent with the surveys in visual designs. Similarly, students of social science preferred clean and well-maintained landscapes (marginal value = 0.25).

Seniority of the student (i.e., education level in our hypothesis) was expected to have some influence on students' attitudes because the junior/senior students would have more advanced knowledge than freshman/sophomore students. This hypothesis was accepted as the "third- and fourth-year student" was significant at $p = 0.05$ for both models (Eqs. (1) and (2); Table 4). Both logs of the ratio were, suggesting that senior students preferred "to keep trees pruned and well-maintained" or "to plant flowering shrubs perennials and annuals, using more artificial landscape". This was further supported by the marginal value of 0.06, which was higher than that of freshman/sophomore students whose marginal value was 0.02.

Participation of environmental group was a significant factor in Eqs. (2) and (3). More importantly, the sign of the log of ratio was negative, suggesting that these students would be more likely to choose a natural landscape than other students. The probability to choose a natural and wild landscape increased as high as 0.26 for those without an environmental group membership (Table 5). However, to increase tree canopy seemed more important for male students. The odds (ratio of the probability) of choosing "plant more trees" over a naturalized landscape increased by exp (0.7547) = 2.13 in Eq. (1). The marginal value for the first alternative was 0.07. Males also liked well-maintained landscape. The odds of the second alternative over the fourth were 0.8886, and the marginal value was 0.09 for the second alternative.

Variable "AgeLe20" was also significant in Eq. (1) and had a positive sign, suggesting younger students were more likely to choose a landscape with more trees. The probability to choose more trees increased by 0.23 for students younger than 20. Race was also a significant factor as both logs of the ratio are negative in Eqs. (1) and

Table 3
Marginal effect estimation for four landscape designs.

	$Y_i^1 = 1$ (Design H1)	$Y_i^1 = 2$ (Design H2)	$Y_i^1 = 3$ (Design H3)	$Y_i^1 = 4$ Reference group (Design H4)
Log(income)	−0.0139	−0.0545	0.0258	0.2680
Forestry	0.0180	0.0070	0.0785	0.1220
Horticulture	0.0208	0.0298	0.0850	0.0897
Social science	0.1790	0.0340	−0.0617	0.0742
3rd and 4th year student	−0.0176	−0.0539	0.0515	0.2454
Environmental group	−0.0055	−0.1138	0.0899	0.2548
Male	−0.0315	0.0031	−0.0270	0.2808
AgeLe20	0.0988	−0.0557	0.0791	0.1032
White	−0.1027	0.0404	0.0735	0.2142
Bachelor degree	−0.0131	0.0180	−0.0434	0.2638
Graduate degree	0.0781	0.0929	−0.0738	0.1282
Small city	0.0381	−0.0599	0.0563	0.1910
Large city	0.0596	−0.0217	−0.0306	0.2181

Table 4
Maximum likelihood estimation of multinomial logit regression for four alternatives.

Parameter (std. error)	Multinomial logit model, $N = 333$		
	1	2	3
	$\mathrm{Ln}\,\frac{P(Y_i^2=1)}{P(Y_i^2=4)}$	$\mathrm{Ln}\,\frac{P(Y_i^2=2)}{P(Y_i^2=4)}$	$\mathrm{Ln}\,\frac{P(Y_i^2=3)}{P(Y_i^2=4)}$
Intercept	−2.6844* (1.6223)	−1.5941 (1.6458)	−0.2523 (1.6742)
Log(income)	0.7784** (0.3713)	0.4422 (0.3686)	0.1211 (0.3756)
Forestry	−0.3475 (0.4770)	0.4684 (0.5803)	0.8044 (0.5352)
Horticulture	0.0206 (0.5226)	1.1763** (0.5946)	0.6612 (0.5688)
Social Science	0.3501 (0.4611)	1.3290** (0.5530)	0.0876 (0.5605)
3rd & 4th year student	0.8650** (0.4186)	0.9478** (0.4487)	0.6287 (0.4364)
Environmental Group	−0.2003 (0.3704)	−1.4455*** (0.5003)	−1.1763*** (0.4709)
Male	0.7547** (0.3848)	0.8886** (0.4309)	0.0342 (0.4264)
AgeLe20	1.0371** (0.4662)	0.1542 (0.5617)	0.0370 (0.5634)
White	−2.0969** (0.8793)	−2.9219*** (0.8766)	−1.3223 (0.9729)
Bachelor degree	−0.7051 (0.5527)	−0.4125 (0.5765)	−0.9651 (0.5580)
Graduate degree	−0.9748 (0.6110)	−1.2297* (0.6666)	−1.7116*** (0.6558)
Small city	0.3923 (0.3867)	0.7232* (0.4170)	0.7522* (0.4307)
Large city	0.5755 (0.4400)	0.8236* (0.4842)	1.0542** (0.5043)
Likelihood ratio	94.18***		

*** Significant at 0.01 level.
** Significant at 0.05 level.
* Significant at 0.10 level.

(2). Compared with black students, white students preferred the artificial landscape less often. The probability to choose the natural and wild landscape was 0.61 higher for white students than the black students (Table 5).

There were significant differences between students from rural and urban settings. Compared to students from a rural area, those from urban area were more inclined to choose "to keep trees pruned and well-maintained," and "to plant flowering shrubs, perennials and annuals using more artificial landscape". The magnitude of the log of ratio became larger as the population increases. Finally, there was an increase in the probability to choose alternative 2 and 3 for students from urban areas against students from rural areas (Table 5).

Parents' backgrounds (i.e., education level) were expected to have some influence on students' preferences. We found that parents' education was statistically significant in Eqs. (2) and (3) with the logs of the ratio of parents' education as negative, suggesting that the students with well education parents were more inclined to choose a natural landscape. For example, students' parents who had graduate degrees were less likely to choose pruned trees (marginal value = −0.07) and artificial landscape (marginal value = −0.13).

4. Discussion

This study explored students' preferences in urban landscapes with wild or clean characteristics surrounding the houses. To some extent, college students' preferences represent the general public's opinion (Zheng, 2009) and political attitudes (Ceci and Kain, 1982; Kaplowitz et al., 1983; Mutz, 1992). In addition, college students are future home buyers and their preferences will influence the landscape design of the future. Therefore, to understand and interpret their preference has profound implications. Our attention was also given to how preference might be affected by educational background, including students in different grades (first- and second-year students/third- and fourth-year students), affiliation with environmental groups, academic major, as well as family backgrounds such as family income, parents' education and place of residence.

Overall, we found that students preferred more trees and neat landscapes. Neatness, a feature of aesthetic appreciation, also appeared important. For example, a manicured lawn, clipped shrubs and colorful flowers indicate the owner's care for the community. This is consistent with earlier studies that residents prefer natural-looking but managed landscapes (e.g., Axelsson-Lindgren, 1995; Ribe, 1989). Woodlands with logging residues, dead snags and decayed wood were not appreciated by the students.

Students with wildlife science major were more inclined to choose wildness/natural environments surrounding the houses. Our conclusion was further supported by verbal answers of the wildlife science students. In contrast, horticulture students were less likely to choose a wild landscape. This difference may come from the education through which wildlife science students are more knowledgeable or more appreciating of ecological systems, or

Table 5
Marginal effect estimation for four alternatives.

	$Y_i^2 = 1$ (planting more tree)	$Y_i^2 = 2$ (well-maintained)	$Y_i^2 = 3$ (artificial landscape)	$Y_i^2 = 4$ Reference group (nature and wild landscape)
Log(income)	0.1324	0.0007	−0.0661	0.1215
Forestry	−0.1560	0.0448	0.1598	0.1400
Horticulture	−0.1393	0.1993	0.0222	0.1063
Social science	−0.0735	0.2567	−0.0978	0.1031
3rd and 4th year student	0.0531	0.0632	0.0200	−0.0922
Environmental group	0.2279	−0.1622	−0.1387	0.2616
Male	0.0769	0.0991	0.0969	−0.1094
AgeLe20	0.2339	−0.0702	−0.0897	0.1145
White	−0.1965	−0.1987	−0.0316	0.6153
Bachelor degree	−0.0590	0.0238	−0.0892	0.3129
Graduate degree	−0.0379	−0.0758	−0.1398	0.4420
Small city	−0.0399	0.0537	0.0628	0.1119
Large city	−0.0388	0.0313	0.1026	0.0935

more concerned with wildlife. They were probably better-informed about the notion that "messy is good."

The affiliation with environmental groups and having better parents' education played important roles for student to choose a preferred landscape. Logically, students with a greater knowledge of nature should prefer more ecologically sustainable landscape (Daniel, 2001). Recent developments in information theory (Bandura, 1986, 2001; Klapper, 1960; Watt and van den Berg, 1978) also suggest that preferences can be influenced by media and education—a potential way to change public preference through awareness and ecological education. In our study, we found that male students with a higher level of education showed more preference for neatness; and the students from larger cities also favored a clean and artificial landscape.

The results from this study suggested that there exists trade-offs between aesthetic values and ecological services. Considering residential landscape as the closest environment around us, the culture and preference over-emphasis of the neatness may be sinister. For example, the obsessive quest for the perfect green lawn in the U.S. has caused environmental problems, such as groundwater pollution (Robbins and Birkenholtz, 2003). Moreover, the pursuit of neatness is costly (e.g., time and maintenance fees). It is suggested that Americans spend $40 billion a year on lawn care (Steinberg, 2006). Meanwhile, landscape design and management might be not acceptable if one ignores the social and cultural requirements. To incorporate people's preferences (e.g., the neatness-look) with ecological function is consequently needed. Nassauer (1997)'s design strategies, i.e. "vivid care" is a good choice in this regard. Vivid care draws attention to the human presence in healthy landscapes in order to sustain ecological health over time. These strategies bring aesthetic expectation in a way that benefits landscape ecology. Given people perceived attractiveness related with neatness (e.g., white stone edging, pathway and horticultural plants), a landscape designer might explore a way to make "wildness" look "neat."

A more proactive way to coordinate aesthetical landscapes and ecological landscapes is to use education and information to shape people's preferences toward designing ecologically sound landscape. Werner (1999) proposed five critical factors for improving sustainability: awareness of the problem, knowledge about behavioral solutions and motivations engaged, forces that make the motivation salient, opportunities to engage in the behavior and skill and perceived competence to engage in the behavior correctly. Based on our study, education is also needed to achieve our long-term goal. One challenge is that future educational material should include both beauty and landscape sustainability. An improved understanding of the consequences of residential landscaping behavior should affect our preference. As Nassauer (1997) stated, "appreciation based on knowledge is the only way to avoid aesthetic omissions and deceptions" (p. 89). Clearly, encouraging the public's participation in ecological activities (i.e., education) would increase the participant's ecological knowledge and thus would change their preferences toward management of urban landscapes.

America's growing population is increasingly spreading into the countryside and expanding to the rural–urban interface. City planners, policy makers, academics and the general public are calling for "smart growth"—in which growth is managed and directed in a sustainable way that minimizes damage to the environment and builds livable towns and cities. Understanding of public preferences will help to avoid the influences of misleading preferences and the information should be helpful for the balance of landscape planning and conservation biology (Nassauer, 2006). The information derived from this study would be useful for policy makers to design health, sustainable landscapes. Regardless of our efforts in visual preference survey with verbal questionnaires, future research are needed to validated our results in other urban setting with controlled design and extend the sampling to a variety of citizens.

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