ACCOUNTING FOR PREFERENCES AND ATTITUDES TO URBAN TREES AND RESIDENTIAL LANDSCAPES

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THESIS ABSTRACT

ACCOUNTING FOR PREFERENCES AND ATTITUDES TO URBAN TREES AND RESIDENTIAL LANDSCAPES

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To explore individual's preferences and attitudes toward the environment, this study used a survey method to analyze personal preferences toward the green space in single home communities. Survey was conducted at three levels: single housing landscapes, streetscapes and woodlots. Both on-line and in-class survey data were collected. ANOVA, logit model and other statistical methods were applied in the analyses. The results from our survey suggest that most people have similar preferences regarding residential landscapes aesthetic. There was no difference in preferences to residential landscapes between students and the general public. Significant differences were observed among respondents from different educational backgrounds, such as different academic disciplines, parents' education level, and participation in environmental groups. Findings of this study also indicated that people in general prefer to live in neighborhoods with more trees. More specifically, individual preferred medium size trees with round shape of canopy. Most people showed a preference for a clean and well-maintained residential environment. However, education background made a significant difference in preference regarding to a wild/neat landscape design. Students majoring in history are less likely to choose “keep more naturalized landscape” comparing with Wildlife Science students. Results may provide helpful in the planning of future housing developments.

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CHAPTER I INTRODUCTION

The balance of economic production and environmental quality is a critical issue in urban development. Much of the work in environmental economics focuses on the application and performance of incentive regulatory practices, such as pollution tax systems, pollution allowance markets, and the political economy of environmental policy (Hackett, 1998; Kneese, 1995; Kula, 1994). Some economists and sociologists also notice that preferences play an important role in economics and other social sciences studies (Hammond, 1976; Karni & Schmeidler, 1990; Rabin, 1998), such as welfare analysis (Pollak, 1978), voting (Bowen, 1943), and policy making (Dau-Schmidt, 1990). Scitovsky (1977) proposed that society can save resources by changing consumer's preference without reducing social welfare. Thus, the study of landscape preference will provide a way to examine the relationship between environment and economy from a new perspective, and the results can provide important information for city and landscape planners with regard to housing development.

Beginning in the 1960s, researchers addressed the question of individual's preferences for landscapes. The collective evidence from environmental psychology and landscape research has shown that individual preference is an influential factor in shaping land use change (Schroeder, 1988; Luzar & Diagne, 1999; Erickson et al., 2002; Zhang et al., 2007). It is also a powerful tool in determining human response to policies and planning decisions (Kaiser, et al, 1999). However, as a conceptualization of environment, preference and attitude are considered to be a "complex construct with cognitive (knowledge), affective (feeling) and conative (behavioral) components" (Walmsley, 1984; quote from Balram & Dragicevic, 2005:147). As a consequence, preference is formed and influenced by socio-economic, cultural and biophysical interactions which cannot be directly observed.

Preferences usually are based on how people perceive the surrounding world. Human beings perceive the surrounding through all senses (seeing, hearing, smelling, tasting, touching) simultaneously, and through the information processing system. Those sensed data that can be further organized to help to understand and structure the world (Simon, 1979). Dialectical materialism argues that ideas are simply a reflection of the independent material world that surrounds us. "All ideas are taken from experience, are reflections –true or distorted of reality" stated Engels (Sewell, 2002). Tuan (1990) also believes that the images of topophilia are derived from the surrounding reality. Even if the environment does not "determine" them, it provides the sensory stimuli to our joys and ideals.

Landscape is a reflection of the surrounding world. There are many different interpretations of the term "landscape". Carlson (2006) indicates landscape as the conceptualization of the environment. The development of individual perception of environment plays an important role in shaping individual preferences and attitudes to the landscape. Carlson (2006) also suggests that landscape is conceptualized by the eyes and the minds from both traveler and resident's perspective. The appreciator is central to the concept. This is to say, a landscape is, in some sense, essentially a view or a scene from the standpoint of the appreciator.

As a conceptualization of people's mind, preference of landscape is an important part of assessment of landscape quality, and much work has been done with landscape appreciation (Lothian, 1999). Danial et al. (1978) focused on the scenic beauty estimation method. Kaplan and Kaplan (1989) studied the information processing model of landscape aesthetics, and Urlich (1983) worked on the development of affective theory. Furthermore, Carlson (1999) argued that appropriate appreciation of human environments also depends on their functions and their roles in our lives. In a word, both beauty and function are important factors for landscape appreciation.

Moreover, people's perceptions of beauty and function are not static, which can be problematic. On the one hand, the ability to know the world is limited by our knowledge and experience. On the other hand, public preferences are deeply embedded in class position and the relative economic, cultural, and social capital (Bourdieu, 1984; Fraser & Kenney, 2000; Grusky & Wheedon, 2001). What is perceived as aesthetically pleasing may, in fact, not be best ecologically (Gobster et al., 2007).

Therefore, accounting for public preferences to the greening in community is complicated. The aesthetic quality and environmental services of a community—such as water, fresh air, sense of neighborhood identity—are not bought and sold in the market. Thus, for policy making, the main problem is how to differentiate the different preference since it is always not directly observable.

Previous studies have employed strategies such as inferred cues and interrogation using surveys to account for attitude measurements (Dawes, 1972). The common questionnaire approach to studying landscape-related attitude includes a range of semantic-differential (with good/bad options) and Likert items (with agree/disagree options) (Kerlinger, 1992). Both of these methods help to construct the attitude structure. Therefore, similarly, in this study, we use a combination of a visual preference survey and a questionnaire to obtain a full scope of public perception for residential landscape.

In the visual preference survey, the goal was to determine if respondents were capable of assessing different housing landscape alternatives created as combinations of simple aesthetic and environment attributes, and whether the differences in the alternative designs were meaningful to them. The primary goal was focused on the following five attributes capturing environment and aesthetic features of a single home community: i) the proportion of the trees in the slide, ii) the open space around the housing measured by the location of the front trees-far away or close to the house, iii) the shape of the tree, iv) the size of the tree, v) the relative wilderness vs. well maintained neatness.

The specific objectives of this study were:

1) To find out the difference in public preferences toward urban trees in residential landscape.

2) To explore the tree factors and individual demographic characteristics contributing to the differences of public preferences and attitudes in green space.

3) To explore individual's preference to wilderness/neatness in residential landscape.

In the questionnaire, questions were asked to obtain more detailed information about an individual's residential landscape perception and his or her personal information. Our goal was to determine if people's responsiveness to various attributes depended on knowledge and econ-demographic context. It was hypothesized that preferences vary from person to person, and were affected by the demographic variables. In addition, questionnaires were used to see if individual perceptions differed by academic disciplines.

In summary, through this study, information about residential landscape perception is obtained from both a design and a social-economic perspective. The results of this study will meet the pressing need of the stakeholders including ecological environmentalist, urban development planners, landscape designers, environmental policy makers, educators and the general public. Good urban planning with consideration of public's perception of residential landscape is critical for sustainable development of a green city which has both ecological function and aesthetic beauty.

CHAPTER II ACCOUNTING FOR TASTE

Environment as a Production and Consumption Factor

According to the Merriam-Webster dictionary, environment is a “complex of physical, chemical, and biotic factors (as a form of climate, soil, and living things)...”. But in the eyes of economists, environment is more than a physical existence. Economic activity usually depends on environmental resources, including ecological systems that produce a wide variety of goods. The economy transforms those materials together with human effort into final products that meet different needs of human consumption. Meanwhile, the environment and its natural resource systems provide the air, clean water, raw materials, waste cycling, and other processes necessary for the health of living organisms. Economists also notice that environmental resources can restrict economic growth to some extent. And many researchers have begun to study the relationship and key factors between them (Lopez, 1994; Jaffe et al., 1995; Arrow et al., 1995).

Consistent with conventional neoclassical assumption, we assume that we can define an aggregator function of capital, labor and technology for each industry of the form

$$f_i = f_i(K_i, L_i; t, z) \quad \text{i=1,2,...n} \tag{1}$$

where K_i and L_i are capital and labor in industry i, and t is an index of technology. z represents the environmental factor, for example, air, soil, climate, water, etc. (Becker, 1996). Environmental factors contribute to production in many ways and the impacts are widely observed, such as transportation, energy supplement, etc. Monteith and Moss (1977) suggest that temperature and water supply are the main climatic constraints on crop production efficiency. For example, people living in coastal Indonesia usually develop fisheries (Pet-Soede et al., 1999). The modes of production are usually associated with restriction of nature resources.

On the other hand, environment is also a consumption factor. It is easy to notice that people consume air and water all the time, and the demand for environmental products has been increased. According to the American Consumer Survey, the expenditure of recreation keeps on increasing from 1919 to 1999 (Costa, 1999), and this trend will continue (Cordell, 2004). The main issue is that whether the change of preference will change the utility or not. Classical economics usually treat preference as endogenous because price change results in utility change, but Becker (1996) suggests an extending utility function:

$$U = f(x; P; S) \tag{2}$$

where x stands for consumption goods, P is personal capital, and S is social capital. Here the utility defined over goods x is conditional on the two stocks of capital held by the consumer. This function is stable over time, that is to say, any change in tastes toward consumption goods can be attributed to changes in the capital stocks, P and S. By this way, preference influences consumption behavior and can be fed into the utility function.

Preference and Attitude to Landscape

Residential landscape is the closest environment around us. Housing landscape plays an important role in maintaining good environments and providing amenities for neighborhoods. But landscape is not only a physical part of environment. It is also the result of interaction between human and nature. Landscapes are parts of the outdoor environment and they may include humans and man-made components. As a conceptualization of the surrounding environment, landscape connects human beings to the outside world.

First, landscape is the conceptualization of the environment. That is to say, the landscape changing process is a procedure that people use to change the environment according to their perceived ideal. For example, individuals have to have a concept of beauty before they can build a beautiful landscape. The appearance of a garden shows the owner's view of beauty. Thus, landscape reflects ideological components. And residential landscape, in the long history of human interaction with nature, it is one of the most highly conceptualized environments.

Second, landscape is a result of the economizing process to natural landscape by human beings. In changing the landscape, people try to maximize their welfare, minimize cost, and are subjected to environmental constraints. For example, how many trees and what kind of trees people would like to have in their home garden may depend on the cost of maintenance, and the benefits generated from the trees. After all, it is a way that people try to optimize their welfare. Residential landscape is a highly economized environment.

And also, the perception of landscape does not only reflect individual behavior. It is embeded in a social and cultural context. Residential landscapes around the world have different styles and usability. Houses in cold areas are usually designed with heat preservation, while houses in tropical region are usually well ventilated. Understanding the way people appreciate environment is vital for landscape preference study.

Aesthetic beauty is an influential factor deciding landscape preferences. The notions of "beautiful," "sublime," and "picturesque" are widely accepted for the appreciation of nature (Conron, 2000). Specifically, the art-like, traditional picturesque landscape appreciation remained a dominant influence on popular aesthetic experience of nature during the entire 19th and 20th centuries. The landscape model of nature appreciation proposes that we should aesthetically experience nature as we appreciate landscape paintings. Such art-oriented models of the aesthetic appreciation of nature are defended in some recent work in environmental aesthetics (Crawford, 1983; Stecker, 1997; Leddy, 1995).

Additionally, the value of beauty can also be found when it comes to functionalism. Carlson (1999) argues that appropriate aesthetic appreciation of human environments also depends on their functions and their roles in our lives. Taking the family farm as an example, the traditional farm of the mid-20th century looks like a painting with tidy and patterned fields, fenced rows, and a diversity of animals and plants. But modern agriculture has been referred to as the "dull, barren, and monotonous sameness" (Carlson, 1999:187). However, considering that the elaborate equipment and vast uniform fields are all necessary and inevitable in the modern world to fulfill human needs, it also expresses people's preferences for "the seriousness, rightness, and appropriateness of necessity" (Carlson, 1999:189, quoted from Hettinger, 2005: 67).

Furthermore, to understand a group of people's attitudes and preferences, it is necessary to understand the cultural history and experience in the context of its physical setting. For example, European gardens usually have open space, but a Japanese gardens are commonly small because of the limitation of the territory of this island country (Grossman, 2003). Kaplan and Kaplan (1982) indicate that most Japanese gardens are created chiefly with stones and sand, which is meant to induce philosophical thoughts and the appreciation of tranquility, deeply inherent in Japanese culture.

Generally, people appreciate a landscape based on both its aesthetic and functional value. But sometimes people like certain kinds of landscapes unconsciously. Tuan (1990) proposes that the seashore, the valley, and the island appeal strongly to the human imagination. The inherent reason can be ascribed to the pursuit of security, food and leisure. Some evidence comes from an evolutionary perspective. For example, some researchers suggest that people love savanna landscape, where the security, anonymity, the natural food supply promises survival (Kaplan & Kaplan, 1982; Wilson, 1986).

Individual's Preferences to Landscape Differ

Landscape as an image visioned by the appreciator, and it is not always static. Personal traits, such as personal emotion, social status, education level, family values, gender, ethnicity and political ideology may contribute to individual perception of their surrounding world (Buttel, 1987; Ma & Bateson, 1999). The study of Rauwald and

Moore (2002) shows that country and gender differences exist in environmental attitudes. Brody et al. (2004) suggests that environmental perceptions differ by location, and the main reason is that individuals receive different sources of information between two sites. Abello and Bernald (1986) propose that certain aspects of personality show significant correlation with landscape preference.

Of the many factors studied, education has proven 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. In this study, it is hypothesized that individuals with different educational backgrounds and interests have different preferences to housing landscapes. The different educational backgrounds refer to not only the levels of education but also the type of education.

Most of the differences in perception with different academic disciplines are ascribed to the "lack of information". Each academic major is corresponding to some specific "knowledge," and this "knowledge" may act as mediating variables (Baron & Kenny, 1986) in the preference shaping process. That is to say, schooling in different majors may serve as a mechanism to "transmit" the beliefs or attitudes of human being.

Assessment of the effect of academic disciplines can be found in much 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) found that professional foresters had a different environmental concept comparied to their colleagues in ecology, wildlife, fishery, geology, or recreation. And Ewert and Baker (2001) found that individuals majoring in different academic disciplines had significant different levels of concerns to for environment. However, Ray (1994) indicated that there was no significant difference in the perception of scenic beauty of forest scene under different timber harvest types.

The question that academic disciplines may change individual's perception was also discussed from an economic perspective. Economists are concerned whether studying economics discourages cooperation or not. Marwell and Ames (1981) showed that economics students are more likely to behave self-interest when compared to other students. Carter and Michael (1991) suggested that after the exposure to the self-interest model, students display an uncooperative behavior in the surveys and games about cooperativeness. Frank et al.'s (1993) study suggested a similar result.

Economists appear to behave less cooperatively than non-economists. This difference in behavior might result from training in economics; or maybe people who chose to major in economics were initially self-interested. Yezer et al. (1996) proposed that in the "real world", the argument-"economics student behave in self-interested ways"-was not true, however, doubt was raised.

Review of Preferences Research

Stamps and Nasar's (1997) experiments revealed different public preferences to different architectural styles. They used five sets of photo stimuli: a sample of houses which were exempt from review, a sample of houses which passed review, a sample of high style houses to compare with exempt and design review houses, a sample of popular houses, and a second sample of high style houses to contrast with the popular houses.

Demographic factors like city, politics and ethnic origin were examined in this study. Results indicate that architectural components of style or individual buildings make a difference in public preference.

Purcell et al. (2001) investigated two different types of outdoor scenes based on the Perceived Restorative Scale (PRS). Two example scenes were chosen from one of the five scene types including industrial zone, houses, city streets, hills, and lakes. Responses were recorded based on a familiarity scale and two preference scales: the extent of liking the place and preference relative to all other places where the individual had been. An analysis of variance was carried out to examine the relationship between preference, familiarity, and the PRS and scene type. The results indicated that Preference and the Perceived Restorative Scale score correlated 0.81; familiarity and the Restorative Scale correlated 0.31, and preference and familiarity correlated 0.32.

Todorova et al. (2004) focused on the preferences of street vegetation, especially the compositions of flowers and trees. He used color photos as stimulations. Those photos have the same background with only the planting models differing. The base photo represented a typical residential district of Sapporo, and on the right side was an apartment building and on the left side were the various street-planting models. The questionnaire consisted of structured items in the form of a rank list, all of which were related to perceptions of street flowers. Respondents were asked to rank each item on a five-step rating scale from “strongly agree” to “strongly disagree”. Factor analysis was applied to estimate the relationship. The results indicated that flowers were the most preferred element beneath street trees.

Wolf (2005) investigated how consumers respond to the urban forest in central business districts of cities of various sizes. He conducted three four-concept framework guided surveys which started with a preference ratings exercise, using up to 30 images that depicted streetscapes with varying urban forest character. Respondents were asked to rate their level of agreement with statements using a Likert scale, and a pricing assessment was done using a contingent valuation method to understand the impact of streetscape trees on local economics. The study revealed that trees had a positive effect on visual quality. Also trees can significantly influence individual's consumer behavior.

Lohr and Pearsonmins' (2006) study tried to prove savanna hypothesis. Slide images of spreading, rounded, or columnar trees, or inanimate objects in two urban scenes were created, and preferences and emotional responses to those images of 206 participants were measured. A shortened version of the self-report Zuckerman Inventory of Personal Reactions-State Test II was used to monitor general emotional or psychological states. More specifically, the skin temperate and blood pressure were recorded as an indicator of stress variation. Results suggested that scenes with trees were more attractive than scenes with inanimate objects, and spreading trees were more attractive than rounded or columnar trees. This finding was consistent with savanna hypothesis.

In sum, the available literature indicates that people usually apply similar methodologies for the measurement of attitude and preference. However, since attitude may also be influenced by the spatial surrounding environment (Downs & Stea, 1977), the challenging part is how to select representative variables for our survey in a simple but effective way.

CHAPTER III RESEARCH METHOD

In this study, a visual preference survey was first conducted. Then we used a questionnaire to obtain more detailed information about individual residential landscape perceptions and his or her personal information. ANOVA, multiple regression and multinomial logit regression methods were used in this study.

Visual Preference Survey

In this project, a visual preference survey was used to evaluate public preference of overall images or features. As the name implies, this technique is based on the development of one or more visual concepts of a proposed plan or project. Visual preference survey methods have been widely used as a research tool by forest managers, environmental psychologists, and landscape architects. Typical uses of visual preference surveys include helping the community define preferences for architectural style, signs, building setbacks, landscaping, parking areas, size/scope of transportation facilities, surfaces finishes, and other design elements (see Ulrich, 1983; Schroeder, 1988; Kaplan & Kaplan, 1989; Shaffer & Anderson, 1983; Nasar, 1987; Ewing, 2001).

The common way to assess preferences is with rating/scaling methods (Ewing, 2001). Scenes are displayed slide by slide and assigned ratings on a Likert scale. The most common scale is 1 to 5 (1 = least preferred; 5= most preferred), but some variation are found in the literature, for example, -2, -1, 0, 1 to 2, and so on. In our rating exercise, a simple 1 to 5 scale was used on the theory that viewers would have trouble distinguishing among finer gradations.

A simple method of analysis is to average the ratings given by viewers to pictures of different types. It provides the basic information of the data within specific sample groups. This method is widely used in many surveys by new urbanist planners (Ewing, 2001). However, the useful information from this analysis is limited, and it is never clear whether differences in average ratings are significant or which features of scenes are responsible for high or low ratings.

Most visual preference studies use analysis of variance to test for significant differences across scenes and use multiple regression analysis to explain differences in terms of different influential factors (see Herzog et al., 1982, 1986; Briggs & France, 1980; Nasar, 1981-1982; Anderson & Schroeder, 1983; Schroeder & Anderson, 1984; Ulrich, 1986). Multiple regression analysis enabled us to relate housing landscape ratings to features of the trees and their surroundings.

Some visual preference studies use ordinal ranking method and forced choice between scenes in paired comparisons. However, ranking is not often used because the common medium alternative precludes side-by-side comparisons of more than a few scenes. Similarly, although paired comparisons are more commonly used and considered more reliable than rating methods, a large number of comparisons might be required when there are many pictures. Therefore, a rating/scaling method was used in this study, and the study design also emphasized the comparisons among different landscape designs.

Based on the information from scaling, we can also simply analyze a paired comparison with the ANOVA test.

Survey Design

In this study, we combine a visual preference survey and verbally stated questionnaires. The purpose of the survey was to collect information regarding public preferences and attitudes towards trees and green space in single family residential communities. In order to assess preferences comprehensively, we have three settings: 1) single house landscapes, 2) streetscapes, and 3) woodlots. The main focus is single house landscape level.

Stimuli

Within each setting, we had different designs. To begin with, we selected 200 photographs from thousands of color photographs. Among these photographs, 120 slides were of housing landscapes, 40 slides were of streetscape, and 40 slides were of woodlots. These slides were taken around Alabama, Georgia and Florida without any specific aesthetic considerations or constraints. The selection of the photographs was based on the following criteria: the presence of natural landscapes and a common housing style; good photographic quality with little distortion; and horizontal photographic shots taken at approximately eye level without looking up or down. All the photographs were taken from August to September, 2007.

The next step was to design specific scenes based on these 200 slides. The scenes were designed to generate the attributes in Table 1. In order to exclude other visual factors such as house style, lawn and sky, we modified the pictures with Adobe Photoshop 7.0 software to obtain a consistent house style, sky, lawn, and path way. To create the alternative scenes, we first created the full factorial design, i.e., all of the possible combinations of attribute levels. This gave a total of 26 alternative scenes. Among them, 14 designs were for single house landscapes and 6 designs were for streetscapes and woodlots respectively.

Table 1 Variables of attributes of urban trees in suburban community

Variable	Description
At single home level	
Amount of trees	By the amount of trees canopy (%)
Tree shape	1=Round 2=Conoid 3=Columnar
The location of trees (front)	0=close to the home 1=far away from home
Size of the trees	0= small 1=medium 2=big
Wilderness vs. well maintained neatness	0=wilderness 1=neatness
At Streetscape level	
Amount of trees	By the amount of trees canopy (%)
Tree species	0=Single specie 1=Mixed species
The location of trees	0=close to the home 1=far away from home
Wilderness vs. well maintained neatness	0=wilderness 1=neatness
At Woodlot level	
Amount of trees	By the amount of trees canopy (%)
Tree species	0=Single specie 1=Mixed species
The location of trees	0=close to each other 1=far away from each other
Wilderness vs. well maintained open spac	0=wilderness 1=neatness

For comparison purpose, we first grouped a 6-scene page to be shown on screen. Among the 14 designs of single houses, three designs in the previous slide were replaced by new designs in the following slide. Such a procedure is to provide various combinations of scenes. In total, ten slides were produced to account for the single house, and each design was compared with the other designs at least four times. Since we only had six designs of streetscapes and woodlots, we made six of them in one slide respectively. A sample slide of an individual home design is shown in Figure 1, a sample slide of streetscape design is shown in Figure 2, and a sample slide of woodlots design is shown in Figure 3.

Figure 1 A sample of an individual home design (one out of ten slides)

Figure 2 Streetscape design (totally one slide)

Figure 3 Woodlots design (totally one slide)

Questionnaire design

To better investigate the attributes of urban trees in a suburban community and get more information on some specific questions, a two pages questionnaire (Appendix II and Appendix III) was used. The questionnaire was designed to elicit information on the size, species, numbers of trees, and the level of open space and wilderness/nature. The viewers were asked to rate the importance of some characteristics of trees: seasonal color, shape of trees and growing rate.

Other information included socio-demographic information such as the respondent's income, age, education, city of residence and family background information. Since the survey was conducted in two groups: university student and residents, different questions based on the two groups were asked. For students, the major and grade information were collected. For residents, the employment status was collected.

Procedure

Corresponding to the student and resident's format, the survey was performed in two forms. One is in-class student survey, and another one is outdoor resident survey. We compared the results for each form and tried to identify bias.

In the class students survey was conducted in a classroom equipped with a projection machine and Office PowerPoint 2007. Prior to starting, instructions were given based on a slide of example pictures. Each slide was shown for a limited time, and then it was replaced by a new slide automatically. A short beeping sound was set up to remind the switch of slides. After some pretest, timing was set up based on the following rules: the first 5 slides for individual home were shown for 30 seconds, and the other 5 slides were shown for 25 seconds each. We shortened the showing time based on the experience that individual get familiar with the designs after the first 5 slides. The slides for streetscape and woodlot were still shown for 30 seconds. In total, 12 slides took 5 minutes and 45 seconds to show. This time was enough for people to make a choice. After people got used to the procedure and pictures, speeding up a bit made people more comfortable.

After completing the visual preference questions, participants were asked to answer the questionnaire. It usually took 5 minutes to complete this part. In total, students completed both parts of the study within 10-15 minutes.

Secondly, the outdoor resident survey was conducted in the rest area near Montgomery on Interstate 85 South. A color poster of 26 landscape designs (single housing, streetscape and woodlot) were shown and people were asked to rate them in a 1-5 scale. In total, 37 individuals agreed to participate

CHAPTER IV ANALYSIS AND RESULTS

Our statistical models of the responses to the choice questions indicated that the preferences depended on the attributes of the alternatives in predictable ways. They also indicated that the attributes are valued differently by the respondents, depending on the personal demographic background.

The Econometric Model

In this study, a Multiple Regression Model was used to investigate differences in preferences and the influential attributes.

The composite mean score for preferences (measured by Likert scale) was entered into a multiple regression equation with two sets of variables, greening characteristics and personal characteristics, as the following conceptual model proposed:

Preference =f (Greening Characteristics, Personal Characteristics) (3)

It was hypothesized that people's preferences are a function of greening characteristics and personal characteristics. The empirical model has the following form:

$$PREF = \beta_0 + \beta_i GC_i + \beta_j PC_j + \varepsilon \quad (4)$$

The dependent variable was measured at the mean value of the rating for each design. The sets of greening characteristic variables (GC) used in the study included the amount of trees, the shape of trees, the location of trees, the size of trees and the presence of wilderness/neatness. Personal characteristics (PC) included age, family income, major, grade, number of siblings, number of family members under 18 years old, race, gender, city of residence, environmental group participation, parents' education and parents' occupation.

Table 2 Variables description

Variable	**Description**
Preference	Mean score of Likert scale
Amount of trees	By the amount of trees canopy (%)
Tree shape	Round, Conoid and Columnar (base)
Location of trees	0=close to the home 1=far away from home
Size of the trees	Big, Medium and Samll (base)
Wilderness/neatness	0=wilderness 1=neatness
AgeL20	AgeL20=1 if <20 years old; else Age=0
Family income (in log form)	Measured in thousand dollars, taking the value of 10, 30,55,85,120
Major	Dummy variable
	Agricultural Economics
	Wildlife Science (base)
	Forestry
	Landscape design
	Engineering
	Management
	Architecture
	History
Grade	0= Freshman 1= Senior
Number of brothers/sisters	Continuous variable
Number of members < 18 years old	Continuous variable
Race	White=1 if respondent is white; else White=0
Gender	Male=1 if respondent is male; else Male=0
City of residence	Dummy variables
	Rural area (population <2000)

	Small city (2000-50,000)
	Large city (> 50,000) (base)
Environment Group	Group=1 if belong to any environmental group, else group=0
Parents' education	Category variable, from 1-5
	Less than 12^{th} grade =1
	High school completed =2
	Some college =3
	Bachelor's degree =4
	Graduate degree =5
Parent's occupation	Professional, Technical and Skilled worker (base)

Results

Description of the Data

In total, there were 239 responses for the in-class student survey and 37 responses for the resident survey. The descriptive statistics were reported in Table 3. Most students were more than 20 years old (83%), and 57% of them were higher than senior level. Students had different academic disciplines, and they were grouped into 7 majors: forestry, wildlife science, agriculture economics (including business and accounting), engineering, recreation management, architecture (including building science and horticulture) and history (including history, psychology and education). Also, 24% of the students were a member of an environmental group.

Table 3 Descriptive data

Variable	Average or percent for student survey (Std. dev) N=239	Average or percent for resident survey (Std. dev) N=37
Age (less than 20 years old)	17% (N=233)	
Family income	72.41 (23.36)	62.24 (32.21)
Major		
Agriculture Economics	22.98% (N=235)	
Forestry	39.57% (N=235)	
Wildlife	16.17% (N=235)	
Architecture	6.81% (N=235)	
Management	5.96% (N=235)	
Engineering	3.83% (N=235)	
History	4.68% (N=235)	
Senior	57% (N=233)	
Number of brothers/sisters	2.59 (1.37)	2.31 (1.24)
Number of members < 18 years old	0.37 (0.74)	0.28 (0.88)
White	96.14% (N=233)	67.57% (N=37)
Male	79.83% (N=233)	54.05% (N=37)
City of residence		
Rural area (population <2000)	23.85% (N=239)	
Small city (2000-50,000)	50.21% (N=239)	
Large city (> 50,000) (base)	25.94% (N=239)	
Environment Group	24.03% (N=233)	13.51% (N=37)
Parents' education	3.97 (0.89)	3.44 (0.65)
Parent's occupation		
Professional	75% (N=232)	
Technical	8.62% (N=232)	
Skilled worker (base)	16.38% (N=232)	
Employee status		
Full-time		47.22% (N=36)
Part-time		30.56% (N=36)
Retired		11.11% (N=36)
Unemployed		11.11% (N=36)
House price		
Apartment		16.67% (N=36)
<$10,000		13.89% (N=36)
$10,000<price<$15,000		11.11% (N=36)
$15,000<price<200,000		16.67% (N=36)
>$200,000		41.67% (N=36)

Most of the respondents were white (96 %) and male (80%). Half of them lived in a small city with populations from 2000-50,000. The family background information indicated that students usually had1-4 siblings, and the average education level of their parents was in Bachelor's degree. Most of their parents were professional.

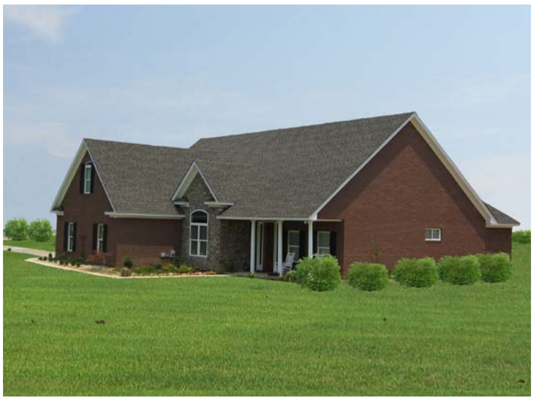
The mean value of Likert scale of each single housing landscape design for student survey and resident survey was shown in Table 4. As for student, it suggested that H3, H11 and H2 were the three favorite slides, and H1 was the least favored one. On the other hand, for local residents, H3, H11 and H13 received the highest scores, and H4 received the lowest score. For streetscape and woodlot, both students and residents preferred S4 and W3.

Basically, the students and local residents shared similar preferences toward housing landscape. A two sample t test also suggested that there was no significant difference between these two groups. Previous studies had found that individuals with different backgrounds still tend to rate scenes similarly when perceptual preference was an important consideration (Daniel & Boster 1976).

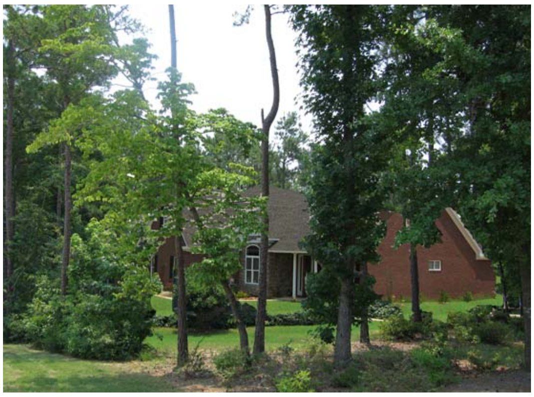
Table 4 Mean value of Likert scale for single housing landscape

Variable	Mean value for in class survey (Std. dev) N=239	Mean value for resident survey (Std. dev) N=37
Single House Landscape		
H1	1.80 (1.19)	2.38 (1.18)
H2	3.41 (1.14)	2.83 (1.43)
H3	3.86 (0.87)	3.78 (1.06)
H4	2.31 (0.83)	2.23 (1.11)
H5	2.15 (1.06)	2.50 (1.35)
H6	3.18 (0.73)	3.10 (1.02)
H7	3.21 (0.83)	3.53 (1.13)
H8	3.29 (0.88)	3.34 (1.08)
H9	2.37 (0.96)	2.70 (1.19)
H10	2.53 (0.86)	2.84 (1.21)
H11	3.57 (0.90)	3.75 (1.13)
H12	2.32 (1.08)	2.53 (1.23)
H13	3.74 (1.34)	3.66 (1.45)
H14	2.09 (0.82)	2.72 (1.52)
Streetscape		
S1	2.77 (1.03)	3.15 (1.27)
S2	2.68 (1.09)	3.13 (1.12)
S3	1.78 (1.21)	2.44 (1.35)
S4	4.03 (1.13)	3.85 (1.18)
S5	3.61 (1.10)	3.58 (1.18)
S6	3.74 (1.10)	3.85 (1.36)
Woodlot		
W1	3.51 (1.22)	3.60 (1.49)
W2	1.97 (1.32)	2.50 (1.36)
W3	3.64 (1.14)	3.83 (1.08)
W4	3.02 (1.09)	3.65 (1.30)
W5	3.27 (1.52)	2.83 (0.71)
W6	3.57 (1.05)	3.10 (0.63)
F-value (df=26)	0.79	
P-value	0.38	

Single house landscape level:



H1: Mean value=1.92 Std.dev=1.22 Tree Attribute: Amount: 1% Round=1 Small=1 Faraway=1 Neatness=1

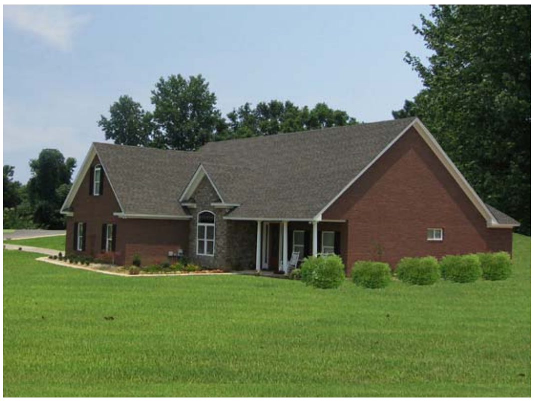


H2: Mean value=3.29 Std.dev=1.21 Tree Attribute: Amount: 80% Columnar=1 Big=1 Faraway=0 Neatness=0

H3: Mean value=3.83 Std.dev=0.89 Tree Attribute: Amount: 60% Round=1 Big=1 Faraway=1 Neatness=1

H4: Mean value=2.30 Std.dev=0.90 Tree Attribute: Amount: 15% Round=1 Big=1 Faraway=1 Neatness=1

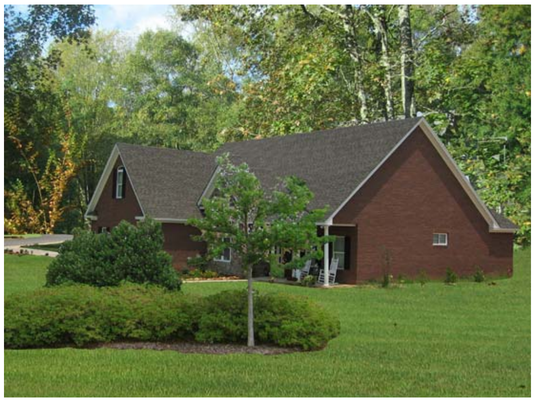
Figure 4 Mean score value for H1-H4 at single house level



H5: Mean value=2.23 Std.dev=1.14
Tree Attribute: Amount: 20% Columnar=1
Small=1 Faraway=1 Neatness=1

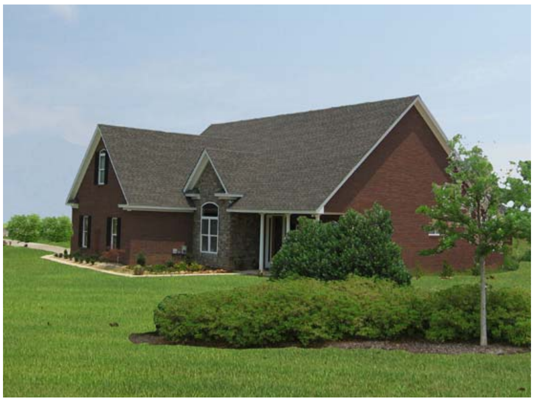
H6: Mean value=3.16 Std.dev=0.79
Tree Attribute: Amount: 40% Columnar=1
Big=1 Faraway=0 Neatness=1

H7: Mean value=3.25 Std.dev=0.89
Tree Attribute: Amount: 50% Columnar=1
Big=1 Faraway=1 Neatness=1

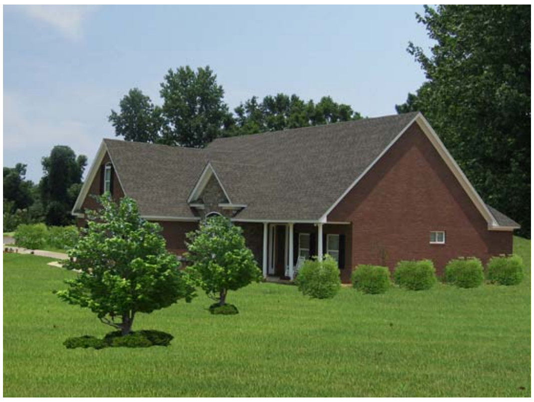


H8: Mean value=3.29 Std.dev=0.92
Tree Attribute: Amount: 80% Conoid=1
Medium=1 Faraway=0 Neatness=0

Figure5 Mean score value for H5-H8 at single house level

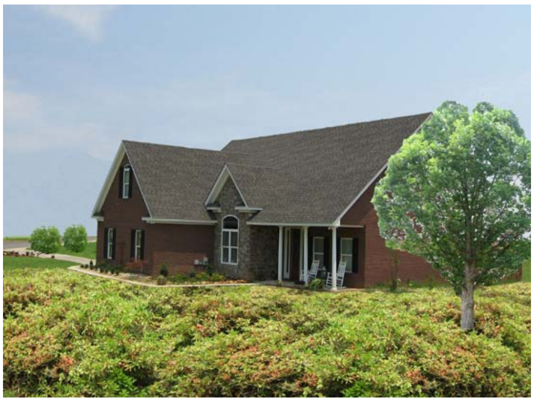


H9: Mean value=2.42 Std.dev=1.02
Tree Attribute: Amount: 20% Conoid=1
Small=1 Faraway=1 Neatness=1



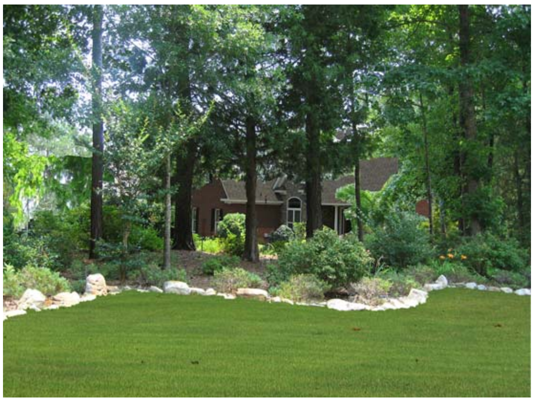
H10: Mean value=2.60 Std.dev=0.94
Tree Attribute: Amount: 35% Conoid=1
Small=1 Faraway=0 Neatness=1

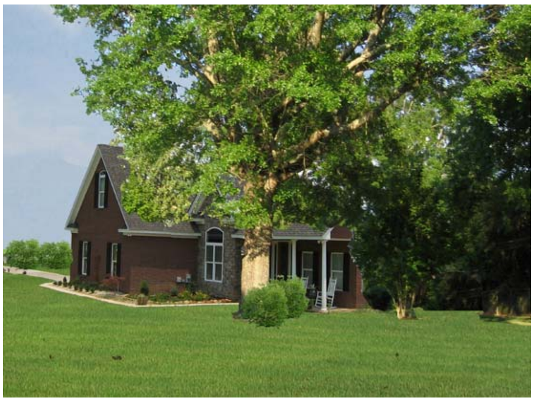
H11: Mean value=3.60 Std.dev=0.94
Tree Attribute: Amount: 60% Conoid=1
Big=1 Faraway=0 Neatness=1



H12: Mean value=2.35 Std.dev=1.11
Tree Attribute: Amount: 10% Round=1
Medium=1 Faraway=1 Neatness=0

Figure 6 Mean score value for H9-H12 at single house level





H13: Mean value=3.74 Std.dev=1.36
Tree Attribute: Amount: 90% Columnar=1
Big=1 Faraway=0 Neatness=1

H14: Mean value=2.85 Std.dev=0.97
Tree Attribute: Amount: 40% Round=1
Big=1 Faraway=0 Neatness=0

Figure 7 Mean score value for H13-H14 at single house level

Street level:

S1: Mean value=2.85 Std.dev=1.07
Tree Attribute: Amount: 40% Mixed=0
Faraway=0 Neatness=1

S2: Mean value=2.76 Std.dev=1.11
Tree Attribute: Amount: 30% Mixed=1
Faraway=0 Neatness=1

Figure 8 Mean score value for S1-S2 at street level

S3: Mean value=1.88 Std.dev=1.26
Tree Attribute: Amount: 10% Mixed=1
Faraway=1 Neatness=0

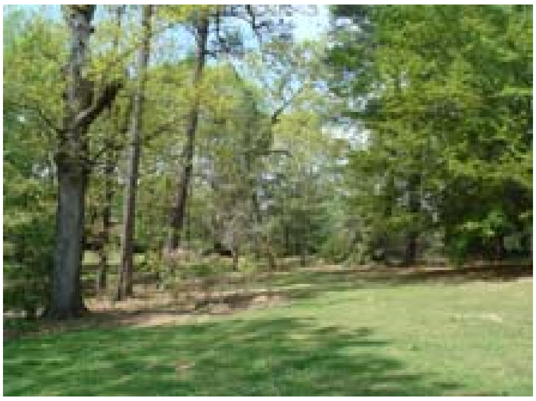
S4: Mean value=4.02 Std.dev=1.14
Tree Attribute: Amount: 60% Mixed=0
Faraway=0 Neatness=1

S5: Mean value=3.60 Std.dev=1.11
Tree Attribute: Amount: 30% Mixed=1
Faraway=1 Neatness=0

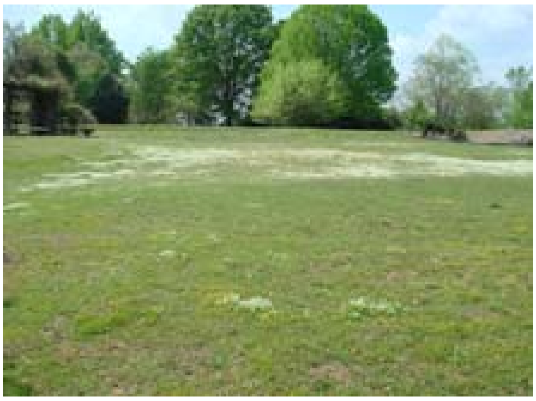
S6: Mean value=3.75 Std.dev=1.14
Tree Attribute: Amount: 50% Mixed=0
Faraway=0 Neatness=1

Figure 9 Mean score value for S3-S6 at street level

Woodlot level:



W1: Mean value=3.57 Std.dev=1.24
Tree Attribute: Amount: 50% Mixed=1
Faraway=1 Neatness=0



W2: Mean value=2.07 Std.dev=1.35
Tree Attribute: Amount: 20% Mixed=0
Faraway=1 Neatness=0

W3: Mean value=3.66 Std.dev=1.12
Tree Attribute: Amount: 40% Mixed=0
Faraway=1 Neatness=1

W4: Mean value=3.11 Std.dev=1.14
Tree Attribute: Amount: 50% Mixed=0
Faraway=1 Neatness=1

Figure 10 Mean score value for W1-W4 at woodlot level

W5: Mean value=3.24 Std.dev=1.42
Tree Attribute: Amount: 70% Mixed=0
Faraway=0 Neatness=0

W6: Mean value=3.49 Std.dev=1.00
Tree Attribute: Amount: 60% Mixed=1
Faraway=0 Neatness=0

Figure 11 Mean score value for W5-W6 at woodlot level

Statistic Analysis

A Multiple Regression Model was used to investigate the relationship between preferences and tree attributes at a single house landscape level. Four models were included in this study. The first model had 3346 observations from the student survey, including the 239 responses for 14 single house designs. The second model used the pooled data with both student and residences' survey data. There were 3850 observations in the full dataset, including 275 responses for 14 single house designs.

In the third model, to explore whether forestry and wildlife students were different in rating those pictures, the major dummy (Forestry=1 if the students major in forestry; Forestry=0, if the students major in Wildlife) and the corresponding interaction term with 'Amount' and 'Neatness' were used. Also, in the fourth model, the grade dummy (Senior=1 if the students are senior or graduate student; otherwise Senior=0) and the corresponding interaction term with 'Amount' and 'Neatness' were used.

To specify the model, Ramsey's joint test was performed. The result suggested that there was a misspecification problem in the original linear model ($F_{3,3335}$=18.95). Thus, we decided to include the quadratic form of 'Amount^2' in the model. After that, we conducted Ramsey's test again, and the results suggested that we cannot reject the null hypothesis of non-specification problem in this model. That is to say, the final model passed the Ramsey's test at a 0.01 significance level.

Despite the relative large number of observations, the White's test and Breusch-Pagan test were performed to check the homogeneity. For model 1, the White's statistic LM=176.8 with df=13; Breusch-Pagan test statistic LM=134.3 with df=2. The null hypothesis of homoskedasticity was rejected at a 0.01 significance level. For model 2, the White's statistic LM=171.4 with df=13; Breusch-Pagan test statistic LM=118.9 with df=2. The null hypothesis of homoskedasticity was rejected at a 0.01 significance level. For model 3, the White's statistic LM=76.10 with df=13; Breusch-Pagan test statistic LM=52.98 with df=2. The null hypothesis of homoskedasticity was rejected at a 0.01 significance level. For model 4, the White's statistic LM=190.0 with df=13; Breusch-Pagan test statistic LM=139.0 with df=2. The null hypothesis of homoskedasticity was rejected at a 0.01 significance level.

Despite the unbiasedness and consistency of the OLS estimators, they became inefficient with heteroskedasticity. More importantly, the standard errors were biased and statistic inferences based on t, F test were misleading. Therefore, the Robust White estimates provided by SAS were used in the following four models to correct the heteroskedasticity problem. The results were shown in Table 5.

Table 5 Single house landscape regression results

Variables	**Model (1)** N=3346 **Coefficient (Robust Std. err)**	**Model (2)** N=3850 **Coefficient (Robust Std. err)**	**Model (3)** N=1834 **Coefficient (Robust Std. err)**	**Model (4)** N=3346 **Coefficient (Robust Std. err)**
Intercept	1.11355*** (0.09280)	1.21694*** (0.09039)	0.94986*** (0.14834)	1.32218*** (0.15974)
Amount	0.04793*** (0.00391)	0.04527*** (0.00387)	0.05526*** (0.00532)	0.04612*** (0.00439)
$Amount^2$	-0.0002754*** (0.000037)	-0.000256*** (0.000037)	-0.0002863*** (0.000049)	-0.0002754*** (0.000037)
Round	0.21148*** (0.04557)	0.20005*** (0.04532)	0.16983*** (0.05978)	0.21148*** (0.04553)
Conoid	-0.19496*** (0.06489)	-0.14785** (0.06446)	-0.24174*** (0.08553)	-0.19496*** (0.06480)
Big	0.26561*** (0.06303)	0.20447*** (0.06282)	0.28261*** (0.08276)	0.26561*** (0.06296)
Medium	0.38772*** (0.07321)	0.31869*** (0.07286)	0.32522*** (0.09675)	0.38772*** (0.07304)
Faraway	-0.01370 (0.04141)	0.01126 (0.04204)	-0.03612 (0.05569)	-0.01370 (0.04138)
Neatness	0.30118*** (0.04789)	0.30695*** (0.04753)	0.23395** (0.09579)	0.30088*** (0.11016)
Forestry			-0.03836 (0.13304)	
Forestry*Amount			-0.00382** (0.00211)	
Forestry*Neatness			0.13494 (0.10510)	
Senior				-0.24088* (0.14763)
Senior*Amount				0.00209 (0.00224)
Senior*Neatness				0.00034667 (0.11325)
F-Value	163.97***	146.33***	98.84***	120.47***
Adj-R2	0. 2805	0.2322	0.3699	0.2821

Note: Astricks***, ** and *denote significance at the 1%, 5% and 10% levels, respectively.

The regression result for the first model suggested that the five tree attributes had significant influence on students' preferences toward single house landscape, and they explained 28% of the rating score variation. The amount of trees had a significant quadratic relationship with the preference value. The turning point was 87 percent. It suggested that people like house landscapes with more trees, but that does not necessarily mean the more the better. When the amount of trees was more than 87% in the whole picture, the amount of trees had a negative impact on preference rating.

As for the shape of tree, this study found that people loved round trees which were usually accompanied with a large amount of shade. The average rating increased 0.21 compared to those pictures with columnar tree shape. Conoid shape was the least preferred style. When considering the size of trees, the results indicated that people preferred medium and large sized trees. Basically, the pictures with bigger trees got a 0.27 increase in the average rating, and the pictures with medium size of trees got a 0.39 increase in the rating over the picture with small trees.

The openness of the house landscape had no significant impact on preference rating. This makes sense according to the answer to the question regarding openness. Some respondents indicated that they liked more openness for a better view, but they also liked some trees in front of the house to get some kind of 'cover'. So the critical issue is how to balance openness and privacy. The finding also suggested that people significantly preferred a neat environment. The pictures which were messy, wild-looking received a 0.30 lower rating on average.

The results from the second model with both students and residents data shared a similar finding with model 1. This makes sense because the finding of the t-test in Table 4 suggested that the student and local residents shared similar preferences toward housing landscape.

In model 3, we compared the difference in rating between Forestry students and Wildlife Science students. While other tree attributes still had similar effects on model 1, the interaction term of Forestry major and tree amount had a significant positive effect on single house landscape preferences at a 0.05 significance level. The result suggested that Forestry students were more inclined to give a lower score (-0.04) to the pictures with more trees compared with students majoring in Wildlife Science. Thus, even though people preferred housing landscape with more trees, the preferences might be different in different majors.

The difference between senior students and first year students was compared in model 4. The finding indicated that the overall rating from senior students were 0.24 lower on average than the rating from fresh students. This finding suggested some bias between senior and first year students in the overall rating. Usually the senior students were more critical of the man-made changes in the landscapes which they observed.

To further examine the effect of academic major and the other variables on visual preferences, a one-way ANOVA was performed on each individual item. Because of the exploratory nature of the study, we were willing to accept a higher possibility of committing a Type I error and used an LSD procedure (Klockars & Sax, 1986). The results were listed in Table 6.

Table 6 One-Way ANOVA with multiple comparisons

		Discipline (Mean value) N=238						
Item	F-value	1	2	3	4	5	6	7
H1	3.69***	1.54 (3,5)	1.67 (3,5)	2.14 (1,2,3,5)	1.49 (3,5)	3.13 (1,3,4,6,7)	1.54 (5)	1.98 (5)
H2	4.23***	3.87 (3,5,7)	3.47 (5,7)	3.21 (1,5)	3.34 (5)	2.19 (1,2,3,4,6)	3.73 (5,7)	2.73 (1,2,6)
H3	1.59	4.11 (7)	3.84	3.76	3.99	3.39 (1)	3.98	3.48 (1)
H4	3.25***	1.98 (3,7)	2.25 (3,7)	2.54 (1,2)	2.31 (7)	2.49	2.24 (7)	2.98 (1,2,4,6)
H5	4.13***	2.09 (3,5)	2.03 (3,5)	2.57 (1,2,4,6)	1.80 (3,5)	3.00 (1,2,4,6)	1.54 (3,5)	2.16
H6	1.11	3.21	3.25 (7)	3.12	3.07	3.06	3.39 (7)	2.77 (2,6)
H7	1.54	3.40 (5)	3.13	3.13	3.32	2.71 (1,6)	3.49 (5)	3.36
H8	0.67	3.52	3.22	3.31	3.16	3.22	3.16	3.30
H9	3.55***	2.11 (3,5)	2.15 (3,5)	2.68 (1,2)	2.54	3.08 (1,2)	2.44	2.66
H10	1.68	2.62	2.38 (3,5)	2.74 (2)	2.46	3.00 (2)	2.38	2.52
H11	1.57	3.77 (5)	3.58	3.42	3.56	3.03 (1,6)	3.92 (5)	3.41
H12	4.23***	2.22 (5,7)	1.98 (3,4,5,6	2.50 (2)	2.65 (2)	3.06 (1,2)	2.73 (6)	2.98 (1,2)
H13	1.87*	3.97 (7)	3.81 (7)	3.55	4.15 (7)	3.11	3.97 (7)	2.89 (1,2,4,6)
H14	1.49	2.76	2.79	2.94	3.09	3.28	3.20	3.14
S1	0.85	2.74	2.73	2.91	2.59	3.33	2.56	2.82
S2	3.21***	2.53 (3)	2.59 (3)	3.13 (1,2,4,6)	2.29 (3,7)	2.56	2.19 (3,7)	3.18 (4,6)
S3	2.92***	1.45 (3,5)	1.70 (3)	2.28 (1,2,4,6)	1.53 (3)	2.33 (1)	1.44 (3)	1.55
S4	3.61***	4.11 (5	4.26 (3,5)	3.87 (2)	3.71 (5)	2.78 (1,2,3,4,6)	4.38 (5)	3.64

S5	1.98*	3.95 (3,5,7)	3.65 (7)	3.46 (1)	3.82 (7)	3.11 (1)	3.69	2.91 (1,2,4)
S6	3.67***	3.89 (3,5)	3.92 (3,5)	3.33 (1,2,6)	3.88 (5)	2.78 (1,2,4,6)	4.19 (1,2,3,5)	3.64
W1	0.59	3.82	3.51	3.39	3.53	3.33	3.56	3.27
W2	1.51	1.95	2.02	2.09	1.41	2.44	1.38	2.36
W3	0.73	1.54	3.67	3.70	3.65	3.44	3.13	3.91
W4	1.03	3.87	3.11 (4)	3.13 (4)	2.47 (2,3)	3.11	2.81	3.00
W5	2.63**	4.11 (7)	3.14 (4,6)	3.28	4.00 (2,5,7)	2.78 (4)	4.00 (2,7)	2.18 (1,2,3,4,6)
W6	3.02***	1.98 (7)	3.82 (3,5,7)	3.37 (2)	3.71 (7)	3.11 (2)	3.31	2.73 (1,2,4)

Note: Values are based on a scale of 1 to 5, with 1=least preferred, and 5=most preferred. Values in the same row with differing major codes are significantly different from each other at a 0.05 level. The 7 majors include 1=Wildlife, 2=Forestry, 3=AgEcon, 4=Management, 5=Engineering, 6= Architecture, 7=History.

The one-way ANOVA results implied that the student major difference was significant in single house design of H1, H2, H4, H5, H9, H12, and streetscape design of S2, S3, S4, S6, and woodlot design of W5, W6. Each slide was compared between seven majors in a pair by mean value. H1 received the lowest score in all the 14 designs on average mean score, however, students majoring in engineering rated it as 3.13. And it was significantly different from the students majoring in wildlife science, agriculture economics, recreation management, architecture and history.

H2 was one of the top 3 preferred designs and the mean score is 3.41. However, students from engineering and history gave a relative low score for them. The mean value from engineering students is 2.19, and for history students, it was 2.73. Both of these two majors' students held different preferences from forestry and wildlife science students.

For streetscape, S4 was the most preferred design on average. But engineering students also showed a significant different view from other students for this specific design.

In sum, people expressed a similar taste for most of our designs in this study. However, for some specific designs, including the most liked or less liked designs, students from different majors showed significant differences in preference.

To explore the question of whether there is a difference between forestry majors and those in other natural resource fields (NRES) or outside of natural resources and environmental studies (non-NRES), the sample was aggregated into three groups: 1) forestry majors, 2) majors in a natural resource field other than forestry, including wildlife, agricultural economics and recreation management, 3) majors in non-natural resource disciplines. Moreover, we also wanted to explore the difference between rural and urban residences. The results of this analysis were listed in Table 7 and supported the previous suggestion that there was a relationship between academic major and housing landscape visual preferences.

Three groups' comparison results indicated that the preferences for H9, H10, H12, H14, S4 and W6 were significantly different among forestry, NRES, and non-NRES students groups. There was no significant difference in preferences between urban and rural residences.

Table 7 Three-Group Comparisons

Item	Group				Location		
	(a) Forestry N=94	(b) NRES N=109	(c) Non-NRES N=36	F-value	Rural N=57	Urban N=182	F-value
H1	1.66	1.83	2.07	1.60	1.85	1.78	0.15
H2	3.49 c	3.46	3.04 a	2.21	3.32	3.43	0.40
H3	3.85	3.92	3.68	1.04	3.77	3.88	0.72
H4	2.24	2.31	2.53	1.58	2.34	2.31	0.09
H5	2.02	2.28	2.09	1.61	2.19	2.14	0.07
H6	3.26	3.14	3.12	0.75	3.12	3.20	0.60
H7	3.13	3.26	3.26	0.61	3.20	3.21	0.00
H8	3.23	3.36	3.22	0.71	3.09	3.35	3.97**
H9	2.14 b,c	2.46 a	2.67 a	5.11***	2.41	2.35	0.15
H10	2.37 c	2.65	2.58 a	2.88**	2.54	2.53	0.00
H11	3.58	3.56	3.54	0.02	3.50	3.59	0.41
H12	1.97 b,c	2.43 a,c	2.89 a,b	11.45***	2.29	2.33	0.07
H13	3.82	3.79	3.42	1.23	3.54	3.81	1.75
H14	2.78 c	2.90	3.20 a	3.47**	2.82	2.93	0.81
S1	2.71	2.80	2.83	0.25	2.70	2.79	0.33
S2	2.59	2.79	2.58	1.04	2.60	2.70	0.41
S3	1.70	1.87	1.69	0.60	1.75	1.78	0.03
S4	4.27 b,c	3.93 a	3.75 a	3.69**	4.00	4.04	0.07
S5	3.64	3.69	3.31	1.69	3.53	3.64	0.44
S6	3.93 b	3.61 a	3.67	2.15*	3.65	3.77	0.57
W1	3.49	3.56	3.42	0.21	3.56	3.49	0.13
W2	2.01	1.94	1.94	0.09	1.88	1.99	0.34
W3	3.68	3.66	3.44	0.61	3.68	3.62	0.13
W4	3.10	2.97	2.94	0.42	3.11	2.99	0.49
W5	3.14	3.43	3.14	1.11	3.12	3.32	0.72
W6	3.82 b,c	3.51 a,c	3.08 a,b	7.00***	3.56	3.57	0.00

Note: Values are based on a scale of 1 to 5, with 1=least preferred, and 5=most preferred. Values in the same row with differing letters are significantly different from each other at a 0.05 level.

Although differences existed among different major groups, it was hard to tell how much the difference was by the ANOVA comparison results. Also, there is a doubt that the demographic characteristics such as age, income, education level, etc. may have impact on the preference rating.

Based on the ANOVA comparison results, this study further explored the personal characteristics' effects on designs of H1, H2, H4, H9, H12, H13, H14 at single house level, and S3, S4 at streetscape level, and W4, W6 at woodlot level. A regression was performed for the value of each design. The independent variables were students' personal factors including Log(Income), family size, number of Child<6, major dummy, fresh student, white, environmental group, male, less than 20 years old, and parents' education. The results were shown in Table 8.

Table 8. OLS Regression results

Variables	Model (N=231)									
	Single house landscape						Streetscape		Woodlot	
	H1	H2	H4	H5	H9	H12	S3	S4	W4	W6
Intercept	1.82*	3.55***	2.25***	3.14***	3.47***	2.02**	1.58	4.64***	3.80***	3.87***
	(1.04)	(1.00)	(0.75)	(0.91)	(0.83)	(0.94)	(1.09)	(1.00)	(1.01)	(0.89)
Log(Inc)	0.12	-0.09	0.07	-0.16	-0.13	0.26	0.03	-0.23	-0.13	-0.30*
	(0.22)	(0.21)	(0.16)	(0.19)	(0.17)	(0.20)	(0.23)	(0.21)	(0.21)	(0.19)
Family Size	0.11	-0.11*	-0.01	0.09	0.08	0.02	0.06	-0.03	0.10	0.0022
	(0.07)	(0.06)	(0.05)	(0.06)	(0.05)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)
Child<6	-0.15	0.14	0.0008	-0.18*	-0.05	0.08	-0.06	0.05	-0.15	-0.23**
	(0.12)	(0.11)	(0.08)	(0.10)	(0.09)	(0.11)	(0.12)	(0.11)	(0.11)	(0.10)
Forestry	-0.04	-0.35	0.19	-0.22	-0.18	-0.44**	0.14	0.21	0.14	0.29
	(0.24)	(0.23)	(0.17)	(0.21)	(0.19)	(0.22)	(0.26)	(0.23)	(0.24)	(0.21)
AgEcon	0.52**	-0.57**	0.57***	0.46**	0.57***	0.12	0.81***	-0.12	0.22	-0.12
	(0.27)	(0.26)	(0.19)	(0.24)	(0.21)	(0.24)	(0.28)	(0.26)	(0.26)	(0.23)
Management	-0.17	-0.44	0.31	-0.44	0.32	0.34	-0.01	-0.37	-0.53	0.02
	(0.34)	(0.33)	(0.25)	(0.30)	(0.27)	(0.31)	(0.36)	(0.33)	(0.33)	(0.29)
Engineering	1.21***	-1.42***	0.44	0.52	0.70**	0.74*	0.76	-1.13***	-0.13	-0.26
	(0.46)	(0.44)	(0.33)	(0.40)	(0.36)	(0.41)	(0.48)	(0.44)	(0.44)	(0.39)
Architecture	-0.16	0.01	0.28	-0.65**	0.23	0.47	-0.01	0.28	-0.23	-0.37
	(0.36)	(0.35)	(0.26)	(0.31)	(0.29)	(0.32)	(0.38)	(0.34)	(0.35)	(0.31)
History	0.17	-1.08***	0.97***	-0.18	0.25	0.48	-0.12	-0.26	-0.03	-0.60*
	(0.42)	(0.40)	(0.30)	(0.36)	(0.33)	(0.37)	(0.43)	(0.40)	(0.40)	(0.35)
Senior	-0.10	0.10	-0.23	0.28	-0.47	-0.80**	-0.25	-0.04	0.21	0.34
	(0.40)	(0.38)	(0.28)	(0.34)	(0.31)	(0.36)	(0.41)	(0.38)	(0.38)	(0.34)
White	-1.23**	0.86**	-0.51*	-1.29***	-0.69**	-0.26	-0.68	0.77*	-0.38	0.21
	(0.44)	(0.42)	(0.31)	(0.38)	(0.35)	(0.39)	(0.46)	(0.41)	(0.42)	(0.37)
Environment	-0.18	0.28	-0.01	-0.21	-0.19	-0.16	-0.18	0.07	-0.01	-0.11
Group	(0.19)	(0.18)	(0.14)	(0.17)	(0.15)	(0.17)	(0.20)	(0.18)	(0.19)	(0.16)
Male	0.08	0.03	0.19	0.15	0.22	0.04	0.01	0.09	0.01	0.28*
	(0.21)	(0.20)	(0.15)	(0.18)	(0.16)	(0.18)	(0.21)	(0.20)	(0.20)	(0.17)

Age<20	0.39	0.06	0.01	0.77***	0.36	-0.27	0.11	-0.28	0.39	-0.01
	(0.33)	(0.32)	(0.24)	(0.29)	(0.26)	(0.30)	(0.35)	(0.32)	(0.32)	(0.28)
Parents' Edu	0.08	-0.04	0.01	0.10	0.0039	0.04	0.15*	-0.08	-0.09	0.08
	(0.09)	(0.09)	(0.06)	(0.08)	(0.07)	(0.08)	(0.09)	(0.09)	(0.09)	(0.08)
F-value	2.56***	2.46***	1.74**	3.43***	3.04***	2.43***	1.70**	1.93**	0.85	2.75***
Adj-R^2	0.09	0.09	0.05	0.14	0.12	0.09	0.04	0.06	0.06	0.10

For the single house landscape H1, there was only a house in the middle of the picture without any trees. The regression results suggested that Agricultural Economics students rated it 0.52 more than Wildlife Science students. Engineering students also liked it more than Wildlife Science students. Wildlife Science students showed a relative low preference to this picture. We postulate this was because a flourishing forest environment usually is accompanied by high biodiversity, and H1 was too barren in the eye of Wildlife Science students.

In design H2, 80% of the picture was trees. The house was hidden behind some big trees, and it looked messy because of the defoliation, straggly stems and bushes. However, H2 received the third highest score in the 4 designs with mean score 3.41. It was hypothesized that students having a natural resource background were more inclined to rate it highly because messy was good from an ecological perspective. The regression result confirmed our assumption. Students majoring in agricultural economics, engineering and history rated H2 lower than students majoring in wildlife science. Family size had a significant negative impact on preference rating. For respondents that had one or sibling, the average rating decreased by 0.11. This finding suggested that family with more children did not like the messy environment. Generally White individual rated H2 higher.

H4 was a big tree with round shape was far away from the house, so it suggested an open space around the house. Frumkin et al. (2003) proposed that people preferred open space. However, in this study, the preference to openness was not very significant.

Agricultural Economics students and history students liked this kind of design more than Wildlife Science students. And the impact for White individuals was negative.

In H5, there was no tree in front of the house but there were some big trees in the back of the house. This kind of design suggested a house with a green lawn and open space. The regression result indicated that families with more children under 6 years old would rate the score 0.18 lower on average. Agricultural Economics students rated it 0.46 higher than Wildlife Science students. And architecture students rated it 0.65 lower. White individual did not like this kind of design, significantly, and the mean value was 1.29 less than black individual. Also students less than 20 years old were more inclined to rate it highly.

Agricultural Economics students rated H9 0.57 higher than Wildlife Science students. In H12, there were a large amount of bushes in front of the house with a single median size tree. The regression results suggested that Forestry students less preferred it comparing with Wildlife Science students. And senior students also less preferred this kind of landscape than first grade students.

On the streetscape level, S3 and S4 were two designs with different configuration. In S3, houses were dispersed in the community and they were not very close to each other. There were little trees spread around the houses, so the space was quite open. On average, S3 was the least preferred design. But Agricultural Economics students rated it 0.81 higher than Wildlife Science students. On the other hand, in S4, well maintained large trees were planted on the roadside, and the houses were behind the trees. This clear, green design received the highest score on average. Engineering students rated it 1.13 lower than Wildlife Science students.

On the woodlots level, W4 and W6 were chosen for regression in this study. In W6, trees were close to each other without thinning. Also, trees were not well shaped, and there was some dead wood and brush on the ground. In W4, the ground was clean and trees are well maintained. The regression results suggested that family with child less than 6 years old was less likely to prefer W6. This makes sense because the messy environment may not good for children to play around. For children’s safety, people prefer a clean, well maintained woodlot environment.

CHAPTER V PREFERENCE BETWEEN WILD AND NEAT LANDSCAPES

There are many factors might contribute to the difference in individual landscape perception, such as personal emotion, social status and education level. The study of Rauwald and Moore (2002) proposes that country and gender differences exist in environmental attitudes. Brody et al. (2004) suggests that environmental perceptions differ by location, and the main reason is the different information source between two sites. Moreover, Ewert and Baker (2001) propose that there are significant differences between academic majors and reported attitudes about the environment.

However, sometimes people's perceptions of landscape might be problematic. On the one hand, the ability to know the world is limited by our knowledge and experience. On the other hand, public preferences are deeply embedded in class position and the relative economic, cultural, and social capital (Bourdieu, 1984; Fraser & Kenney, 2000; Grusky & Wheedon, 2001). Thus, what looks good might be not good from an ecological perspective (Gobster et al., 2007).

For examples, Nassauer (1988) proposes that neatness is one of the most important factors for an attractive landscape, but usually a well-trimmed landscape is not good for biological diversity (Nassauer, 1992, 1995). An over-emphasize of the "garden" aspect of the garden city has resulted in the excessive planting of trees (Tuan, 1990). And the

perfect green lawns may not be ecological healthy (Steinberg, 2006). The American single house and green lawn landscape style may not appropriate in China (Barboza, 2005). Also, Nash (2001) indicates that people have different perceptions about wilderness, "One man's wilderness may be another's roadside picnic ground." (Nash, 2001: 1).

Therefore, it is a new challenge for landscape design and management to balance ecological function and human preferences. Using preferences survey data, the purpose of this chapter is three-fold. First, to find which kind of single home landscape people prefer: the nature/wild one or the clean, well maintained one? Second, a logit model is used to explore factors that influence people's preference for wilderness or neatness. Third, a multinomial logit model is used to further compare the importance of five urban trees and landscaping alternatives.

This chapter puts focus on differences in educational background, including university students in different grades (Junior/Senior), environmental group participation and different academic majors. Family backgrounds, such as income, family size, parents' education and occupation, and place of residence are also examined. The results will provide basic information to guide residential green space designing and land-use planning. The comprehensive understanding of public preferences will also help to avoid the influence of misleading preferences. And the information should be helpful for the balance of landscape planning and conservation biology (Nassauer, 1989, 2006). Policy makers will possibly achieve both popular acceptance and an ecologically healthy, sustainable landscape.

Data

Primary data for this study were obtained from a visual preferences survey. The average ratings of designs in previous studies were also used in this study. Moreover, in the questionnaire, viewers were asked to rate the importance of some characteristics of trees, such as seasonal color, shape of trees and growing rate. It was designed to elicit information on tree size, species, amount, and the level of open space and wilderness/nature. This study is focused on the following two questions:

Question 1: Woodlot near or within your subdivision, which one would you like?

a) More natural and wild status (mixed species) with some dead wood and grass on the ground.
b) Clean ground and well managed with most of the trees planted with similar size.

Question 2: The following kinds of urban trees and landscaping you would agree (Range from strongly disagree-1 to strongly agree-5)

A. To increase tree canopy by planting more trees
B. To keep trees pruned and well maintained
C. To plant flowering shrubs, perennials, annuals
D. To keep more naturalized landscape
E. To have a good mix of conifers and deciduous trees

Rank the Top 3___, ___, ___

NOTE: The alternative F has zero frequency and weight was excluded since they do not contribute to the analysis.

For the first question, the dependent variable is the choice of a) or b), if people choose a), then CHOICEQ1=1, otherwise CHOICEQ1=0. For the second question, the dependent variable CHOICEQ2 is equal to the top rank of the five alternatives, coding A-E as 1-5. For example, if the top rank is alternative D, then CHOICEQ2=4. The independent variables are students' personal characteristics, including age, log of family income, major, grade, number of siblings, number of family members under 18 years old, race, gender, city of residence, environmental group participation, parents' education and parents' occupation.

The descriptive statistics are listed in Table 9. In total, we have 239 respondents, while in analysis the observations with missing value were deleted. Most of the students are more than 20 years old (83%), and 57% of them are higher than senior level. Students are from different departments, with majors in forestry, wildlife science, agriculture economics (including business and accounting), engineering, recreation management, architecture (including building science and horticulture), and history (including history, psychology, education) .

Most of our respondents are white (96%) and male (80%). Because of the unbalanced of race composition, WHITE is not used as an independent variable. Half of students live in small city with population from 2,000-50,000. The family background information indicates that the students usually have 1-4 siblings, and the average of their parent's education is Bachelor's degree. Most of their parents are professional, which may imply a good education opportunity for their children.

Table 9 Descriptive statistics for logit model and multinomial model

Variable	**Mean (Std Dev) N=239**
CHOICEQ1 =1	75.66% (N=226)
CHOICEQ2 =1	23.45% (N=226)
CHOICEQ2 =2	19.03% (N=226)
CHOICEQ2 =3	4.87% (N=226)
CHOICEQ2 =4	41.15% (N=226)
CHOICEQ2 =5	11.50% (N=226)
Major	
AgEcon	22.98% (N=235)
Forestry	39.57% (N=235)
Wildlife	16.17% (N=235)
Architecture	6.81% (N=235)
Management	5.96% (N=235)
Engineering	3.83% (N=235)
History	4.68% (N=235)
Age (< 20 years old)	17% (N=233)
Family income (in thousand dollars)	72.41 (23.36)
Senior	57% (N=233)
Family size	2.59 (1.37)
Male	79.83% (N=233)
City of residence	
Rural area (population <2,000)	23.85% (N=239)
Small city (2,000-50,000)	50.21% (N=239)
Large city (> 50,000) (base)	25.94% (N=239)
Environment Group	24.03% (N=233)
Parents' education	3.97 (0.89)
Parent's occupation	
Professional	75% (N=232)
Technical	8.62% (N=232)
Skilled worker (base)	16.38% (N=232)

Method

First, since the response to the choice of wilderness or neatness landscape is binary in this study, the assumptions of OLS are violated when it is used with a non-interval outcome variable. Thus, a **logit model** (Cameron & Trivedi, 2005) using maximum likelihood estimation is used. Consider a random sample $Y_1,...Y_n$ from the Bernoulli distribution, define

$$Y_i = \begin{cases} 1 & \text{if landscape in wildness is chosen} \\ 0 & \text{if landscape in neatness is chosen} \end{cases} \quad \text{and}$$

$Pr[Y_i = 1] = p$

$Pr[Y_i = 0] = 1\text{-}p$

The logit model specifies

$$p = \wedge(x'\beta) = \frac{e^{x'\beta}}{1+e^{x'\beta}} \qquad (5)$$

where $\Lambda(\bullet)$ is the logistic cdf, with $\Lambda(z) = e^z/(1 + e^z) = 1/(1+e^{-z})$

The interpretation of the coefficients is in terms of marginal effects on the odds ratio. For the logit model,

$$p = \exp(x'\beta)/(1 + \exp(x'\beta)$$

$$\Rightarrow \frac{p}{1-p} = \exp(x'\beta)$$

$$\Rightarrow \ln\frac{p}{1-p} = x'\beta \qquad (6)$$

Thus, p / (1-p) measures the probability that $Y_i=1$ relative to the probability that $Y_i=0$ and is called the odds ratio or relative risk.

Second, a **multinomial logit model** is used to further compare the importance of five specific urban trees and landscaping factors. The multinomial probit model is not often used mainly due to the practical difficulty in estimation (Park, 2005). The five alternatives are functions of the characteristics of the individual making the choice. Since categories are unordered, multinomial logistic regression was used to answer the question: "what is people's preference compared to the other four alternatives?" In this study, "to keep more naturalized landscape" (coded as 4) is designated as the reference category. The probability of membership in other categories is compared to the probability of membership in the reference category. Generally, for m = 1,2,3,5

$$\mathrm{Ln}\frac{\mathrm{P(Y_i} = m)}{\mathrm{P(Y_i} = 4)} = \alpha_m + \sum_{k=1}^{K} \beta_{mk} X_{ik} = Z_{mi} \qquad (7)$$

the respective probability is

$$\mathrm{Pr(Y_i = m)} = \frac{\exp(Z_{mi})}{1 + \sum_{h=2}^{M} \exp(Z_{hi})} \qquad (8)$$

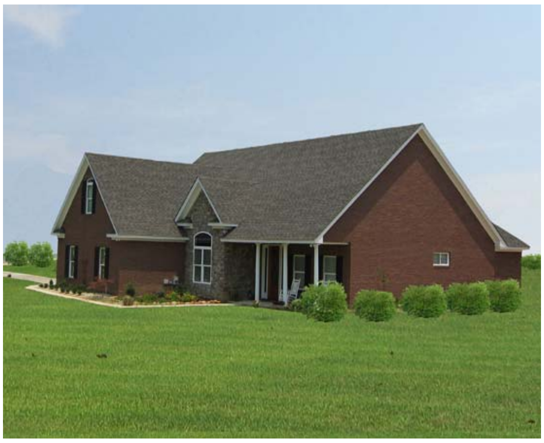
For the reference category,

$$\mathrm{Pr(Y_i = 4)} = \frac{1}{1 + \sum_{h=2}^{M} \exp(Z_{hi})} \qquad (9)$$

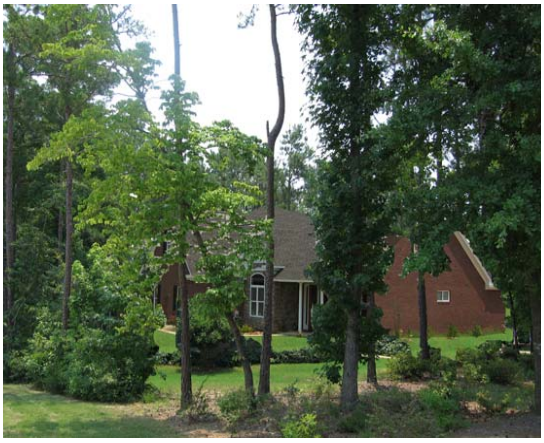
Results

Wilderness Landscape vs. Neatness Landscape

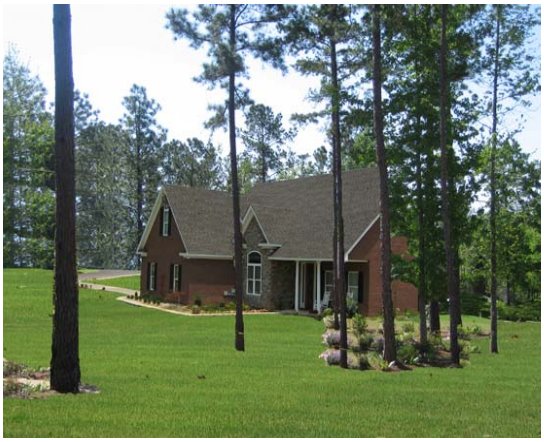
First of all, we compare the mean value of the likert scale for the four specific designs of wilderness/neatness landscape. The distributions of mean values for different disciplines are shown in Figure 12.



H1
Mean value=1.80
Std.dev=1.19 (N=239)



H2
Mean value=3.41
Std.dev=1.14 (N=239)



H7
Mean value=3.21
Std.dev=0.83 (N=239)

H13
Mean value=3.74
Std.dev=1.34 (N=239)

Figure 12 Mean value for H1, H2, H7 and H13

H1 is the base slide. There were no trees in H1, and the mean score is as low as 1.80. In the slide H2, 80% of the picture was covered by trees. The house was hidden behind some big trees, and it looked messy because of the defoliation, straggly stems, bushes and dead wood. However, H2 received the second highest score compared to other designs, and the mean score is 3.41. It was hypothesized that students having natural resource backgrounds were more inclined to rate it highly because it was good from an ecological perspective.

H7 is a well-maintained, neat design compared to H2. People also like this design and the mean score is 3.21.This is higher than the score for H1, but lower than the score of H2. In H13, more than 80% of the slide is covered by trees, and it also suggests some mess in these trees. However, the use of a white stone edging gives us a message that these trees have being maintained. And H13 received the highest score in these 4 designs. The result supported Nassauer's (1995) theory. Nassauer (1988, 1995) indicates 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. I believe that the white stone edging in H13 makes a good "Cue to care", and that is the reason why people prefer H13 to H2, while both of them have the understory dominated the forest.

Natural and Wild vs. Man-made Landscape: a Logit Model Analysis

Further, we will analyze the potential influential factors for neatness/wilderness preference. In question 1, people were asked to make a choice between wild status and well-managed landscapes. In total, 171 students choose a): wilderness status and 55 students choose b): neatness status. The logistic regression results are listed in Table 10.

Table 10 Logistic regression result

Logit Model for Question 1 N=226				
Variables	**Estimate**	**Std. error**	**Pr > ChiSq**	**Odds Ratio**
Intercept	1.6008	2.1908	0.4650	
Log(inc)	0.0303	0.4752	0.9491	1.031
Child<6	0.1716	0.2552	0.5014	1.187
forestry	-0.6781	0.5999	0.2583	0.508
Agecon	-1.1747**	0.6213	0.0587	0.309
Manage	0.3156	0.9203	0.7317	1.371
Engineer	-2.0701**	0.9069	0.0224	0.126
Architecture	-0.5408	0.8330	0.5162	0.582
History	-1.5153*	0.8662	0.0802	0.220
Senior	0.0102	0.9271	0.9912	1.010
Group	0.1543	0.4297	0.7196	1.167
Male	0.2853	0.4238	0.5008	1.330
Agel20	0.6181	0.7613	0.4169	1.855
Edu	-0.2133	0.2219	0.3364	0.808
Prof	0.6646	0.5020	0.1855	1.944
Tech	1.4649*	0.8540	0.0863	4.327

Note: **significant at 0.05 alpha level;*significant at 0.10 alpha level

Academic disciplines of Agricultural Economics, Engineering and History are significant predictors of choosing alternative a) — prefer wilderness, and the impacts are negative. Compared to wildlife science students (base category), the odds of preference on wilderness (vs. neatness) for students majoring in agricultural economics decrease by a factor of 0.309; and for engineering students, the odds decrease by a factor of 0.126; and for students majoring in history, the odds decrease by a factor of 0.22. The results suggest that wildlife students are more inclined to choose wilderness/natural environment surrounding their houses. Agriculture Economics, Engineering and History students are less likely to choose wild landscapes. We believe that this difference comes from the different educational backgrounds. Wildlife Sciences students are more knowledgeable about ecology systems, and usually they are more concerned about wild animals. That is to say, they have better informed about “messy is good”.

However, the academic disciplines of forestry, management and architecture have no significant impacts on prediction, and there is no significant difference between first year students and senior students. Also, there is no evidence to believe that participation in environmental group, gender or parents’ education might influence the preference. However, compared to students whose parents are skilled workers, the students whose parents are in technical occupations are more likely to choose a wild surrounding. The odds ratio is 4.327.

Various Kinds of Trees: Multinomial logit model Analysis

The multinomial logit model is significant at a 0.02 level (LR=78.41). The dependent variable is respondents’ choices for the five alternatives. The results respond to equation M1-M4 in Table 11.

Table 11 Results of multinomial logit regression (Analysis of Maximum Likelihood Estimates)

Parameter (std.error)	Multinomial Logit Model for Question 2			
	M1	M2	M3	M4
	$Ln\frac{P(Y_i=1)}{P(Y_i=4)}$	$Ln\frac{P(Y_i=2)}{P(Y_i=4)}$	$Ln\frac{P(Y_i=3)}{P(Y_i=4)}$	$Ln\frac{P(Y_i=5)}{P(Y_i=4)}$
Intercept	-3.4051	-3.4678	-10.4893	5.6885
	(2.3735)	(2.6233)	(158.6)	(203.9)
Log(inc)	0.4202	0.2836	-0.2340	0.8171
	(0.5281)	(0.5643)	(1.0289)	(0.6861)
Forestry	-0.2748	0.4954	11.4719	0.9028
	(0.5586)	(0.7456)	(158.6)	(0.7653)
AgEcon	0.0225	1.1445	10.5493	-0.3518
	(0.6322)	(0.7670)	(158.6)	(0.9486)
Manage	0.4119	0.3812	12.6867	0.6276
	(0.7989)	(1.0589)	(158.6)	(1.0826)
Engineer	1.0534	0.4531	13.0376	0.6293
	(1.0760)	(1.4314)	(158.6)	(1.4576)
Architecture	0.5307	1.2874	11.5329	0.0234
	(0.7823)	(0.9373)	(158.6)	(1.2876)
History	2.8213**	2.9557**	14.1648	-8.6753
	(1.2241)	(1.4030)	(158.6)	(252.3)
Senior	0.9835	2.3923**	0.8234	-9.7316
	(0.9770)	(1.1709)	(1.8443)	(203.9)
Group	0.1397	-1.1278*	-0.0308	-0.9446
	(0.4364)	(0.5916)	(0.8455)	(0.7125)
Male	1.0594**	0.4689	-0.4517	0.1860
	(0.5388)	(0.5376)	(0.8695)	(0.7435)
Agel20	1.1629	1.4259	0.3244	-10.5923
	(0.8497)	(0.8897)	(1.5156)	(203.9)
Edu	-0.4078*	-0.5434**	-0.6493	-0.0174
	(0.2520)	(0.2658)	(0.4658)	(0.3218)
Prof	0.6773	0.5271	-0.4330	-1.2747*
	(0.6334)	(0.6601)	(1.0150)	(0.7082)
Tech	0.7769	-0.6224	0.9823	-0.6525
	(0.8101)	(0.9919)	(1.1908)	(0.8855)

Note: “To keep more naturalized landscape” is the referenced category, coded as 4; “To keep trees pruned and well maintained”, coded as 1; “To plant flowering shrubs, perennials, annuals”, coded as 2; “To keep more naturalized landscape”, coded as 3; “To have a good mix of conifers and deciduous trees”, coded as 5.

In the multinomial logistic analysis, “History” is significant at a 0.05 level in equation M1 and M2. This suggests that for students majoring in history, the log of the ratio of the two probabilities, P(Choice =1)/P(Choice=4), will increase by 2.82, and the Odds=exp(2.82)=16.799; and the log of the ratio of P(Choice =2)/P(Choice=4), will increase by 2.96. That is to say, compared with Wildlife Science students, students majoring in history are less likely to choose “keep more naturalized landscape”, and they prefer “to increase tree canopy” and “keep trees pruned and well maintained”. This result is consistent with the previous finding.

Grade is expected to have some impact on students’ decision, because the senior students have learned more professional knowledge than the first year students. In this study, “Senior” is significant at a 0.05 level in equation M2. The log of the ratio for the two probabilities, P(Choice =2)/P(Choice=4), is increased by 2.39. Senior student prefer “to keep trees pruned and well maintained” as the top important factor.

Furthermore, the participation in an environmental group indicates a significant influence in equation M2 and the sign of the log of ratio is negative. That is to say, for those who are members of an environmental group, they are more likely to choose a natural landscape. However, among males, increasing tree canopy is more important. The odds of choosing to plant more trees over naturalized landscape decreased by exp (1.06) = 2.885 in equation M1. Thus, we can say that men consider “planting more trees” as the most important factor.

Parents’ background is expected to have some influence on students’ preferences. Parents’ education is statistically significant in equation M1 and M2. The log of ratio in these two equations is negative. It suggests that when students' parents have a higher education, they are more inclined to choose a natural landscape. Also, Prof is significant at a 0.10 level in equation M4. The log of the ratio of the probability P(Choice =5)/P(Choice=4), is decreased by 1.27 compared to those whose parents are skilled workers. This means that students whose parents are professional are more likely to choose a naturalized landscape.

Discussion

Our finding explored students' attitudes toward wild and neat landscape surrounding their houses. The results suggest that most of the time, people love a clean and well-maintained landscape. Students in agricultural economics, history and engineering are more inclined to choose a neat environment. The same result is also found for senior students.

It is not surprising that people like a neat landscape. Preference to neatness may not only reflect aesthetic appreciation; it may also be a product of public communication. Human are social animals with complicated social relations. Many socioeconomic factors can influence his perception. For example, as a traveler, we may enjoy wilderness. But for our residence, we cannot ignore the views from the neighborhood. In this sense, a mown lawn, clipped shrubs, and colorful flowers—a landscape that is neat leaves no doubt that someone is taking care of it. It shows pride in self and care for the community.

However, neatness may have ecological cost (Nassauer, 1988). Also, the pursuit of neatness has economic costs, (e.g. the time and maintenance fees). So how to make people accept the messy but healthy landscape is an important issue in landscape design.

This study revealed that the important factors of perceived attractiveness were factors related to care as neatness—white stone edging, pathway, and horticultural plants. It suggested a way to combine “wilderness” and “neatness”. This is a way to deceive the viewers’ eyes. The finding that individual prefer H13 to H2 supported this theory.

CHAPTER VI DISCUSSION AND CONCLUSION

The findings of this study suggest the amount, the shape, the location and the size of trees, and the perceived wilderness/neatness are very important attributes in residential landscape design. Usually residents prefer more trees with medium size and round shape of canopy with more shade. Most people showed a preference for a clean and well-maintained residential environment, although some differences were noticed between different educational backgrounds

The results of this study also indicate that there is a relationship between academic major and individual attitudes toward residential landscapes. The study also provides some evidence for the belief that age, gender, education level, parent's education level and the presence of young children in the family are influential factors for individual preferences. Students usually are representative for the public behavior. There is no significant preference difference between student group and resident group. Also, whether an individual perceives himself or herself as coming from a rural or urban location suggested no difference in how he or she rated the designs on the survey.

This study focused on the data from student survey. We target on college students for two reasons. First, college students behaved as adults, so they are representative in individual's behavior. In addition, current college students will be future buyer and producer. What they have learned today will influence their future decision. Thus, it is meaningful to study their preference and examining the role of education in shaping individual's perception.

The role of education and academic major

Information theory (Bandura, 2001; Watt et al., 1978; Klapper, 1960; Bandura, 1986) suggests that preferences can be influenced by media and education. The results in this study indicated that preferences differed by academic disciplines. Wildlife science students like naturalized landscapes. In their eyes, a little messy is still beautiful, because it is good for a healthy ecological system and biosystem. Also, for those who are members of an environmental group, and those whose parents have a better education and work as professionals, they are more likely to choose a natural landscape. Thus, the empirical study results support information theory.

To achieve an environment friendly preference in landscape appreciation, knowledge about environmental issues can be important factors. Individual with more recycling knowledge are more inclined to engage in recycling (Gamba & Oskamp, 1994). Chan (1996) found that school was one of the most important sources of environmental information. And thus this study suggested an effective education tool to shape residential landscape perception. Courses or lectures about environment and ecological biodiversity may be given intendedly in different disciplines. And city planner may take steps to help the information about environmental issues be more accessible in the community. We believe that education can help to transmit the individual's belief, and then change people's behavior.

The greening of landscape design

Urban planners have been trying to balance economic needs and environmental protection (Campbell, 1996). Unfortunately, the historic tendency has been to promote the development of cities at the cost of natural environment. With the development of urbanization, forests were cleared, mountains were leveled, and river and air were fouled. Houses are built after clearing all trees. And later trees are planted to the landscape. But is it necessary to clear trees before building a house?

Tree attributes such as the amount of trees and size of trees are critical in residential landscape design. The finding in this study suggested that people don’t like barren and boring environments. That is why most of newly built houses need to be landscaped with trees. Our results indicated that people prefer more trees, and don’t like newly planted small trees. If that is so, why not leave the trees in place while we build the house? It may save the cost of landscape. Housing developers may also need to consider constrains of building technology and cost of more specific construction, however, trees in landscape design cannot be ignored. Housing landscape and environmental quality are part of housing quality.

Trees play an important role in landscape design. A thoughtful landscape design is critical for a good-looking, functional, ecological and economical housing. The results of this study meet the pressing need of information among resource managers, land-use planners, developers, environmental policy makers, and private land owners on a variety of topics regarding residential land development. Including residential landscape design to urban planning may contribute to the sustainable development for a green city.

Future research

As for major differences found in this study, some researchers might argue that self-selection might be a critical problem. For example, students who chose forestry as a major may initially prefer natural environment. Thus, if an individual an academic major based on the initial perceptions he or she possesses, the effect of training or education might be less influential in this study, and more attention should be put on family background and past experience. Future research is needed to better understand the individual's level of concern and initial interests. The causality relation between academic major and individual belief should be examined more cautiously.

Moreover, the results also have to be interpreted cautiously. As the study is based on a survey in Alabama, the outcomes will be a general frame work on this region. An extensive study based on the similar approach may offer more site specific results and explanation. The cross-country comparison between China and USA is meaningful to analyze the differences in culture and geography space. Even within North America, cross- region research (e.g., Arizona, New England) may shed some light on the socioeconomic diversity and the relative importance of trees for shade and other values.

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APPENDIXES

APPENDIX I HUMAN SUBJECT PROTOCOL

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April 7, 2008

MEMORANDUM TO: Dr. Yaoqi Zhang
Forestry

TITLE: "Assessing Preferences for and Attitudes towards Urban Forests in Suburban Communities #1"

IRB FILE: 07-058 EX 0703

IRB APPROVAL DATE: March 20, 2007
RENEWAL DATE: April 3, 2008
IRB EXPIRATION DATE: March 19, 2009

The renewal for the above referenced protocol was approved by IRB Procedure on April 3, 2008. The protocol will continue the designation "Exempt" under 45 CFR 46.101 (b) (2).

> "Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
> (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and
> (ii) any disclosure of the human subjects' response outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation."

You should report to the IRB any proposed changes in the protocol or procedures and any unanticipated problems involving risk to subjects or others. Please reference the above authorization number in any future correspondence regarding this project.

If you will be unable to file a Final Report on your project before March 19, 2009, you must submit a request for an extension of approval to the IRB no later than March 5, 2009. If your IRB authorization expires and/or you have not received written notice that a request for an extension has been approved prior to March 19, 2009, you must suspend the project immediately and contact the Office of Human Subjects Research for assistance.

A Final Report will be required to close your IRB project file. Please only use the stamped, approved information letter with your participants.

If you have any questions concerning this Board action, please contact the Office of Human Subjects Research at 844-5966.

Sincerely,

Niki L. Johnson, JD, MBA, Director
Office of Human Subjects Research
Research Compliance Auburn University

cc: Dr. Richard Brinker

APPENDIX II
PREFERENCES SURVEY FOR STUDENTS

Preferences & Attitudes:
Trees & Greening in Single Home Communities

Part I Visual Preference Survey

Please assign a Likert scale from 1 to 5 (**1= least preferred**; **5= most preferred**) when we show the landscape slide by slide.

1) Single house landscape

Slide A Slide B Slide C Slide D Slide E

Slide F Slide G Slide H Slide I Slide J

2) Streetscape (within your subdivision)

Slide K

3) Woodlots (within and nearby your subdivision)

Slide L

4) When you have completed rating the scenes for visual quality, we would like to find out which factors in the scenes influenced your ratings. Please put a check ☑ beside each influential factor, check as many as apply:

	Which is preferred?	
☐ The size of the trees.............................	☐ Bigger trees	☐ Small trees
☐ The species of the trees......................	☐ Native species	☐ exotic species
☐ The presence of trees	☐ a lot of trees	☐ few trees
☐ The open space....................................	☐ More open space	☐ Less open space
☐ The configuration...........	☐ close to home	☐ away from home
☐ The wildness/nature.........	☐ More Nature	☐ More Artificial

☐ Others____

Part II: Verbal Questions

1. **Within same size of subdivision and same construction area and number of single house, which one you like?**
   a) Compact development (leave an integrated open green space or wood lot)
   b) Dispersed Development (evenly dispersed settings of the homes)

2. **Woodlot near or within your subdivision, which one you would like?**
   a) More natural and wild status (mixed species) with some dead wood and grass on the ground
   b) Clean ground and well managed with most of the trees are planted with similar size.

3) The following kinds of urban trees and landscaping (or activities) you would agree?

	Strongly Disagree	←----------		----------→	Strongly Agree
A) To increase tree canopy by planting more trees	1	2	3	4	5
B) To keep trees pruned and well maintained	1	2	3	4	5
C) To plant flowering shrubs, perennials, annuals	1	2	3	4	5
D) To keep more naturalized landscape	1	2	3	4	5
E) To use more created and artificial landscape	1	2	3	4	5
F) To have a good mix of conifers & deciduous trees	1	2	3	4	5

Ranking the Top 3 factor from A-F of the above items by order of the importance you think: (1st is most important, 3rd is less important):

1st.____________

2nd.____________

3rd.____________

4) The following characteristics of trees are important for me.

A) Seasonal color	1	2	3	4	5
B) Shape of trees	1	2	3	4	5
C) Growing rate	1	2	3	4	5

Part III: Demographic Information

1. Including yourself, how many brothers and sisters?

2. How many children under 18 years of age currently live in your household?

3. What is your major ?

4. What is your grade? ☐ freshmen ☐Junior ☐ Sophomore ☐ Senior ☐ graduate

5. What race do you identify with? ☐ African-American ☐White/Caucasian ☐ Hispanic ☐Other (e.g., Asian)

6. Gender ☐Male ☐Female

7. In which age group would you belong to? ☐less than 20 ☐ more than 20

8. In what areas you have most recently lived before you came to Auburn?

☐ Rural area (population less than 2000); ☐ small city (2000- 50,000); ☐ large city (lager than 50, 000)

9. Do you belong to any environmental groups ☐Yes ☐ No

10. Which category best describes your annual household income?

☐ Less than \$20,000 ☐ \$20,000-\$39,999 ☐ \$40,000-\$74,999 ☐ \$75,000-\$99,0999 ☐ \$100,000+

11. What is your parents' education (the higher one)

☐ Less than 12th grade ☐ High school completed ☐ Some College or technical degree ☐ Bachelor's degree ☐ Graduate degree

12. What is your parents' occupation (the higher one) ☐ Professional ☐ Technical ☐ Skilled worker

Thanks!

APPENDIX III
PREFERENCES SURVEY FOR RESIDENTS

Part III: Demographic Information

1. Including yourself and your children, how many people live in your household?
2. How many children under 18 years of age currently live in your household?
3. Current Employment Status: ☐ Full-time ☐ Part-time Homemaker ☐Retired ☐Unemployed ☐ Other (e.g. student, etc.)
4. What is your highest level of education? ☐ Less than high school ☐ High school diploma/GED ☐ Some college ☐Bachelor's or higher
5. Which category best describes your annual household income? ☐ Less than $20,000 ☐ $20,000-$39,999 ☐ $40,000-$74,999 ☐ $75,000-$99,0999 ☐ $100,000+
6. What race do you identify with? ☐ African-American ☐White/Caucasian ☐ Hispanic ☐Other (e.g., Asian)
7. Do you belong to any environmental groups ☐Yes ☐ No
8. Gender ☐Male ☐Female
9. How would you classify the house in which you live? ☐ Apartment ☐House (less than $100,000)* ☐ House ($100,000 –150,000) ☐House (150,000-200,000) ☐ House (more than $200,000) * Estimated current market value
Other Comments and Information (particularly on how to support community tree programs):

Thanks!