AESTHETIC RESPONSES TO URBAN GREENWAY TRAIL CORRIDORS: IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT IN TOURISM AND RECREATION SETTINGS

A Dissertation

by

JIN HYUNG CHON

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2004

Major Subject: Recreation, Park and Tourism Sciences

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Approved as to style and content by:

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ABSTRACT

Aesthetic Responses to Urban Greenway Trail Corridors: Implications for Sustainable Development in Tourism and Recreation Settings.

(May 2004)

Jin Hyung Chon, B.A., Chonbuk National University;

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Urban greenway trails are emerging as potential tourist attractions in cities and are well recognized for their recreation opportunities in general. The study presented an opportunity to expand the scope of aesthetic response research into the realm of urban greenway trails. The concept of likability (Nasar, 1998) was used as a guiding concept in the study.

In order to gather data for the study, a web-based virtual tour was developed and implemented. Treatments were assigned to 6 groups that viewed two urban greenway trail corridors. Each trail had three treatments including the existing trail condition, a manipulated trail condition, and a reverse in direction of the existing trail condition.

Analyses were conducted to 1) identify dimensions of aesthetic responses, 2) examine relationships between cognitive evaluation, affective response, trail characteristics, and likability, and 3) evaluate specific greenway trail characteristics and their relationships to the trail experience.

Results indicated five aesthetic dimensions of the greenway trail corridors. The cognitive dimensions were maintenance, distinctiveness, and naturalness and the affective dimensions were pleasantness and arousal. Pleasantness and distinctiveness were the strongest predictors of likability in urban greenway trails. In terms of greenway trail characteristics, six of eight specific characteristics had predictive value in relation to how inviting the virtual trail was to the viewer. Finally, several greenway trail characteristics had significant influences on human perception and the likability of trail environments.

This study proposed a new way of conceptualizing likability and a model of relationships leading to likability. One of the major implications of this study is to identify a way to improve physical conditions of greenway corridors in urban areas based on aesthetic responses. The study also implied that greenways can encompass natural or man-made features and can be managed and developed as a tourist attraction while providing local opportunities in cities. Aesthetic quality influences perceived quality of life and sense of well-being. Findings of the study can help enhance the aesthetic quality of the greenway trails that can contribute to sustainable development in various tourism and recreation settings.

I dedicate this work in loving memory of my grandmother, who taught me true love and patience

ACKNOWLEDGEMENTS

This dissertation is the fulfillment of my childhood ambition, as well as the realization of my parents' and grandmother's wish. As well, it is a representation of my career as a landscape architect and social scientist, which I have been pursuing in academic and professional settings in the United States for the past eight years. As a foreign student from the Far East with different views, personal values, and background experience, I found my Ph.D. coursework to be an overwhelming pleasure, and it was an exceptionally rewarding and privileged experience. As a guest to this society, I felt this experience provided me profound opportunities to participate in and become a part of this culture.

I am more than happy to express my appreciation for the support and assistance of some very important people. I extend immense gratitude to Dr. C. Scott Shafer. His constant guidance, support, and patience have made my stay in Aggieland worthwhile. He provided me with constant encouragement, motivation, critical evaluation, and support along with countless hours of stimulating and fruitful discussions. I thank my committee members, Dr. Carson Watt, Dr. James Petrick, and Dr. Christopher Ellis for their support, encouragement, and professionalism. My deep appreciation also goes to Dr. Turgut Var, Dr. Michael Schuett, and Dr. James Gramann for their guidance and words of encouragement which greatly eased my tension throughout my doctoral work. I wish to thank all the RPTS faculty, staff, and graduate colleagues for making it an experience worth remembering.

Sincere thanks to Dr. Dana Tomlin at the University of Pennsylvania for his insightful guidance and encouragement. I would like to extend my thanks to my former teachers at Penn with whom I was fortunate to study: Professors James Corner, Anu Marther, Lori Olin, Dr. John Dixon Hunt, and the late Professor Ian McHarg. I also thank Professor Anne Whiston Spirn at MIT who mentored my academic development in my first year at Penn.

Friendship, scholarly discussion, and support have come generously from my dear fellows and friends at RPTS: Minsun Doh, Hyunggon Kim, Sangkwon Lee, Marcos Borges, Jamie Rae Walker, Dr. Ginni Dilworth, Dr. Bumyong Ahn and Dr. Bongkoo Lee. Appreciation is also extended to my dear fellows in Aggieland: Dr. Gyuyoung Hwang, Dr. Hoyoung Lee, Dr. Seongmin Lim, Dr. Jae Hong Han, and Jungho Song for their numerous nights of "guy talk and beers." I would like to thank my fellow Penn GSFA alumni for their support and love: Yoonchul Cho, Bang Sohn, Chul Moon, Eunyoung Cho, Jaehoon Kim, Hyungseung Min, Chung Kim, and Gyuman Song. My old 43rd street family in Philadelphia, Dr. Yong-Un Ban, Eugene Park, and Gwangsuk Ha, has made me stand strong. Thanks for your prayers!

Oh boy! Very special thanks to my dear friends in Korea: Young Cho, Seung Hyun Park, Dr. Juphil Cho, Dr. Keunsang Kwon, Sanghyun Han, Jongsung Kim, and YoungHo Seo for making me sing and laugh anytime I needed to escape from the stresses of everyday life throughout my journey. They were always there with friendship and encouragement to help me in the difficult times and to share the good times. For giving me the spark, the trust in myself, and the courage to undertake this endeavor, I am grateful to my professors at Chonbuk National University.

My warmest gratitude goes to my parents for their endless love and patience. They always prayed for and supported their thirty-four year old kid. Nothing is enough to express my appreciation and love for them. They are the one in my life that I can always count on. I also want to give my deepest respect and appreciation to my parents-in-law, brothers, brother-in-law, and sisters-in-law for their support and encouragement.

Finally, to my lovely wife Eunmi Yang, thank you for your support and sacrifices. Without your enduring support and beautiful smile, I would have not completed this work. You are my sunshine! To my son Juwon, you changed my life and taught me love and patience. You are my hero. U~~vu~~ba~~ I was amazed when he made this sound one day in the morning. Oh golly, he talks!

I love y'all!!!

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CHAPTER I

INTRODUCTION

Outdoor recreation, natural, cultural, and historical resources are increasingly important attractions for travelers. Tourism that focuses on the natural, recreational, cultural, and historical has emerged as the world's largest industry (Goeldner, Ritchie, & McIntosh, 2000). Nature-based tourism including outdoor recreation is a one of the fastest growing areas in the leisure and travel industries. Nature-based tourism often operates utilizing natural resources in a relatively undeveloped state that includes interacting with scenery, topography, waterways, vegetation, wildlife, and cultural heritage (Deng, Bryan, & Bauer, 2002). Potentially, nature-based tourism generates expenditures and economic gains that assist with the sustainability of an area's natural resources through support for appropriate management (Dwyer & Edwards, 2000). This is becoming more critical in urban areas. Because cities have attracted much attention as important types of tourist destinations across the world, landscapes of urban nature can contribute as a critical tourism resource and play an important role in developing a city's image (Law, 1994).

Since any given destination is largely characterized by its physiography which includes the nature and appearance of its landscape, the most fundamental and the very basis of much tourism is the natural environment (Goeldner, Ritchie, & McIntosh, 2000). Another dimension of the destination is the built environment created by humans. This built environment encompasses culture, infrastructure, technology, and

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This dissertation follows the style of *Journal of Leisure Research*.

information. The infrastructure of urban tourism destinations that includes hotels, restaurants, conference centers and other built attractions such as urban parks and trails should be developed to create the best possible experience for visitors.

The development of green infrastructure, such as trails and greenways, is an important element in sustainable development and can help us grow in a more balanced way (Morris, 2002). Trails and greenways provide vast benefits to a community including economic, public health, education, transportation, and social capital (Morrison & Purves, 2002). There are two contexts from which benefits can be derived from trails and greenways. The primary benefit is from the corridor's existence and its ecological values such as improvement of air quality, wildlife habitat, and biodiversity. Research also suggests that the benefits extend from individual experience such as recreation and fitness, alternative transportation opportunities, and tourism at the community level and through visual quality enhancement, (e.g. Hay, 1991; Kent & Elliot, 1995; Little, 1990; Lynn & Brown, 2003; Moore & Shafer, 2001; Shafer, Lee, & Turner, 2000).

Greenways

Today cities and many organizations are seeking revitalization in urban areas by promoting trails and greenways that connect urban and rural areas and enhance recreation and alternative transportation opportunities (Moore & Shafer, 2001). The fastest growing recreational activities are associated with trail use (Cordell, Lewis, &

McDonald, 1995), and many natural and urban areas provide recreation opportunities along greenway trails. In addition, planners use greenways as a tourism attraction since they provide green infrastructure based on natural characteristics in the environment. By providing alternative transportation options, trails can also have beneficial impacts on environmental degradation by reducing auto traffic.

Greenways can range in form from narrow urban trail corridors to winding river corridors to very wide, wilderness-like landscape linkages. The term *greenway* refers to either open space connectors linking parks, nature reserves, cultural features, or historic sites, with each other and with populated areas or natural corridors such as riverfront, a canal, a scenic road, or other route (Little, 1990). In describing the different elements that can make up a greenway, many advocates and planners emphasize greenways as a major part of infrastructure that is shaping the urban landscape. In the late nineteenth and early twentieth centuries, Frederick Law Olmsted recognized the great potential of linear open spaces as parkways that linked parks to each other and to surrounding neighborhoods, and that enhanced the recreational and aesthetic experience of park visitors. In the 1960s, ecological planners and landscape architects recognized the need to protect corridors, mostly along waterways, that include a high concentration of important natural features (Lewis, 1964; McHarg, 1969). More recently, scientists have considered the significance of these corridors for wildlife management and biodiversity protection. From a social perspective, greenways are also recognized as places for recreation and to help maintain the scenic quality of landscape.

In recent years, greenways have captured attention due to their linear shape and internal characteristics, but research has rarely examined the human-experience through perceptions of trail based greenways layouts and designs. While many authors have focused on the physical characteristics and multiple criteria that must be applied in greenway planning and management, a few have examined human interaction with the environment through visual aspects of perception and preference. For example, an increasingly popular area of research has examined aesthetic responses to the landscape resources (Ahern, 1994; Burel & Baudry, 1995; Dawson, 1995; Tzolova, 1995). A poll conducted by the President's Commission on Americans Outdoors found that natural beauty was the single most important criterion for tourists in selecting outdoor recreation sites (Scenic America, 1987).

Visual Quality Enhancement and Aesthetic Response

Planners and designers have recognized that green spaces provide intrinsic values such as aesthetic quality that contribute to livability and quality of life. A study by Ulrich (1983) revealed that aesthetic and emotional/affective experiences are the most important benefits realized by many recreationists in the natural environment. Many studies have shown that affect stimulates meaningful thoughts, actions, or environmental encounters (Ittelson, 1973: Izard, 1977; Zajonc, 1980) and, thus, “an affective state is an important indicator of the nature and significance of a person’s ongoing interaction with an environment” (Lazarus, Kanner, & Folkman, 1980). Therefore in advancing our

understanding of human interaction with the natural environment, research concerning aesthetic and affective response plays a central role (Ulrich, 1983).

Research has also found that aesthetic factors had major influences on judgments of community satisfaction (Lanssing, Marans, & Zehner, 1970) and that aesthetic variables are rated in the highest among variables in the quality of residential environment (Carp, Zawadski & Shokron, 1976 in Nasar, 1997). Further, based on an evolutionary perspective (Ulrich, 1993; Nasar, 1997), since humans would have had to evaluate events that might benefit or threaten their well-being, the aesthetic character of our surroundings is not a trivial concern. When confronted with something that could threaten or enhance survival, we have to be able to recognize what it is, evaluate it, and act on that evaluation (Nasar, 1997). Thus, aesthetic response can be seen as having probabilistic relationships to physical attributes of the environment. The probabilities stem from the ongoing interactional individual's experience with their surroundings.

By examining the interaction between humans and environment for favorable aesthetic experience and well-being, an important question can be answered: what kind of physical features tend to make a place likable or unlikable?

In an early study by Lynch (1960), identity, structure, and meaning were the major components of an environmental image. Lynch suggested five elements such as paths, edges, districts, nodes, and landmarks which are related to the attributes of identity and structure in the mental image which is called imageability. Researchers using cognitive mapping studies also found that three affective elements added to the imageability (DeJonge, 1962; Gulick, 1963). Theses are distinctiveness of form,

visibility, and use/symbolic significance (Appleyard, 1976a; Evans, Smith, & Pezdek, 1982).

Later, Nasar (1998) extended Lynch's work by focusing on the importance of meaning and evaluation in association with five environmental attributes that people associate with their evaluative image (i.e. likability) of the city: naturalness, upkeep/civilities, openness, historical significance, and order. Nasar (1998) emphasized the importance of discovering how city design affects its citizens. There is also strong evidence that aesthetic issues are the most important evaluators of environmental quality for city residents and workers (Dornbusch & Gelb, 1977). Furthermore, many cities today are concerned about their "image" as a potential tourist destination (Heath, Smith & Lim, 2000a). Because places of high aesthetic quality will tend to become landmarks, significant paths or nodes of the pedestrian, or transportation network (Heath, 1988), the aesthetic quality of a city contributes greatly to this image.

Likability

The urban landscape can evoke a sense of delight and pleasure from people and can have a restorative value from the stresses of everyday life. Toward this end, the shaping and reshaping of the city "should be guided by a 'visual' plan: a set of recommendations and controls…… concerned with visual form on the urban scale" (Lynch, 1960, p. 116). From this point of view, Nasar (1998) emphasized that we can

measure preferences to determine the degree to which people like or dislike various areas of a city.

To know the meaning transmitted by landscape, we should investigate how people respond to the landscape's prominent features. The likability represents a psychological construct that involves subjective assessments of feelings about the environment (Nasar, 1998). This suggests that the likability contains two kinds of variables: the visual aspects of physical environment and human evaluative response. Professionals involved in environmental design, planning and management want to know what noticeable features of the visual environment are associated with favorable meaning in the evaluative image. Research has also found that evaluative images and meanings can provide valid, reliable, and useful information for the planning, design, and management of desirable surroundings (Kaplan & Kaplan, 1989; Nasar, 1988a; 1998, Purcell, 1986; and Zube 1980). Although research in environmental preference often takes a stimulus response form that suggests a certain kind of determinism, Moore (1989) argued that preferences conform to an interactional perspective. The affective and aesthetic response is a result of the person, the environment, and the interaction between the two.

Despite an increased interest in greenways as a potential tourism attraction, little empirical research has actually been conducted on the topic, especially from a likability perspective. Likability research in open space or greenway settings is especially scarce: very few studies have focused on examining perceptions of linear natural settings and their relationship to aesthetic response. As found in many studies, likability measures

and community appearance provide important implications for creating an objective basis for decision-making and policy development (Nasar, 1998). Recreation and tourism planning and design, including greenways, have a major role to play in the image that communities convey.

In addition, since greenway planning and design affects a variety of socio-cultural groups and environmental contexts, planners and designers should understand public opinion for decision-making. Further, current literature suggests that environmental simulation techniques are crucial for communication and collaboration in the environmental design decision-making process (Mahdjoubi & Wiltshire, 2001). Research has found that visual simulation encourages participation in planning and design processes (Howard, 1998). One line of environmental simulation studies is investigating the ability of simulation to predict real-life situations. This often involves presenting simulations to observers and comparing their responses to those obtained from viewing photo-realistic representations such as photographs and slides. Also by using these in conjunction with scientific research, they should more accurately predict eventual public meanings than would judgment by a jury of outsiders and design experts (Nasar, 1999).

Purpose of the Study

This study used environmental perception theories and empirical findings of environmental aesthetic research to guide questions in a specific type of recreation and

tourism setting. This study will provide empirical information useful in understanding how greenway trails in urban areas are perceived to develop designs that would improve the physical qualities of these trails. These places are emerging as potential tourist attractions in cities and are well recognized for their recreation opportunities in general. Two basic questions initiated this study: "How do the visual aspects of the physical environment affect people's aesthetic response along a trail based greenway?" and "What environmental variables are associated with greenway likability?" Analyzing how and in what way the environmental variables of greenway trails influence people's evaluative response can increase the understanding of public likability and guide future design.

The study has four objectives. The first is to investigate aesthetic dimensions of greenway trails. To develop aesthetic dimensions related to the perception of greenway trails, literature has been reviewed to determine variables which have been shown to be related to aesthetic responses. The intent here is to determine if the same dimension that have been developed for cities in general apply to more specific greenway trail environments.

The second objective of this study is to investigate the relationship between aesthetic responses and likability. This study will examine how aesthetic dimension of cognitive evaluation and affective response to greenway trail corridors may contribute to likability. To examine this, relationships between aesthetic responses and the level of invitingness conveyed by the greenway trail corridors will be established.

The third is to examine how more specific greenway trail characteristics influence likability in greenway trail corridors. These findings will help improve understanding of the role of greenway trail characteristics in relation to other variables which can be influenced through planning and design.

The final objective of this study is to examine how specific characteristics influence people's perception and experience within a greenway trail corridor environment. This objective is intended to help understand if and how a greenway trail corridor can be altered to enhance or detract from the experience. To achieve these objectives, the following questions will guide this research:

1) What are the aesthetic dimensions of likability in a greenway trail environment and do they differ from other environments?
2) How do cognitive and affective dimensions, based on responses to greenway trail corridors, predict a likable greenway?
3) How do visual characteristics of the environments in greenway trail corridors relate to likability?
4) How can specific characteristics in a greenway trail corridor be altered to enhance or detract from the experience?

Significance of the Study

This study investigates a neglected aspect of visual resource management in tourism and recreation research that of the methodological and analytical issues involved

in assessing human response to visual aspects of physical greenway trail environments, and of procedures using advanced communication technology. Although there are other studies examining urban likability including community appearance, few have examined greenways as one aspect of the evaluative image of these settings.

Few efforts have been made to develop methods assessing the aesthetic response to the virtual environment. In spite of the recognition that visual preference is often measured through 2-Dimensional static images, there has been little research measuring the aesthetic response of 3-Dimensional virtual environments. The need for a better method of visual analysis for recreation and tourism studies has been called for in the literature (Reed & Mroz 1997). Cole (1986) specifically pointed out the development of methods for "assessing and modeling the spatial distribution of recreation and the better integration" of geographic analytical capabilities into recreation planning. This study is an exploratory step towards understanding one aspect of human aesthetic response in the field of tourism and recreation and presents an opportunity to expand the scope of visual preference research into the realm of urban greenway trails. This research will also initiate the process of collecting and documenting data from participatory environmental simulation that will provide planners with information about the human-environmental interrelationship in tourism and recreation settings.

The contribution of this study also refers to building upon sophisticated planning and design strategies and technologies. This work will provide a feedback process to get user's perception of trail designs and get advanced means to assist visual data exploration and decision-making. Study findings will explore the design and

implementation of a platform for the delivery of environmental information. To make environmental information most readily available and useable by tailoring it to the public for information and style of use, planners, designers and managers will gain understanding for the selection of alternative design scenarios.

Limitations of the Study

There are limitations as to the amount of generalization that can be made from this study. First, since subjects will be composed of students at Texas A&M University, the study sample is not necessarily representative of the populations found using urban greenway trail corridors. The characteristics of this study sample are different from those of the general population. Second, the nature and contents of greenway trails in a virtual tour vary substantially from one trail to another. It is hard to expect that every trail can affect viewers' likability in the same manner because each trail has a different appearance. Thus, the findings of this study should not be generalized to all types of greenway trails. Third, the quasi-experimental portion only represents selected view points along trails. People may have a different response to the whole trail experienced without interruption. Fourth, because the subjects' responses will be measured shortly after they experience the web-based virtual tour, any estimation of the enduring effects of the tour cannot be made.

Definition of Terms

Affective response: an emotional way that people respond to and evaluate the environment.

Aesthetic response: refers to evaluative aesthetic experience in relation to the environments.

Cognitive evaluation: a psychological process through which people acquire, retain, and process information in the environment.

Greenway trail characteristics: specific visual properties of the physical environment in a greenway trail setting.

Greenway trail corridors: surrounding and background landscape of greenway trails

Invitingness: used as a surrogate measure for likability in this study it represents the level of invitation that a trail segment offered to respondents as they encountered it during a virtual tour.

Likability: is defined as the environmental aesthetic experience which causes evaluations related to potential behavior resulting from the interaction between cognitive evaluation of and affective human response to the physical characteristics.

Multiple objective greenways: greenways that have multiple benefits or objectives: ecological benefits (e.g. landscape integrity, water quality improvement) and social benefits (e.g. recreation and tourism, fitness, and alternative transportation)

Urban greenway: a green infrastructure in urban areas encompassing trails and linear open spaces and helping connectivity.

CHAPER II

LITERATURE REVIEW

Planning an urban environment is a complex task that involves balancing ecological values against the human needs and desires underlying social values (Grannis, 1999). The following literature review provides a background of ecological and social values as a basis for constructing a conceptual framework for greenways as a domain of sustainable urban environments. The literature also concerns understanding human aesthetic experiences and responses to the environment which deal with both ecological and social value to operationalize likability.

First, the literature addresses greenways as a domain of sustainable urban environments. This section covers the multiple objectives of greenways and their contributions to sustainable urban environments. Second, it establishes a conceptual framework of environmental aesthetics for sustainable design by reviewing human perceptions and affects of the environmental variables and their relationship to potential behavior. Several aesthetic models are also reviewed. At the end of this section, consideration is given to an interactional model that will help further environmental aesthetic research and focuses on "likability" as a useful measure for examining aesthetic response to urban greenway trails. Finally, based on the reviewed literature, a conceptual model, and a set of hypothesis will be presented.

Greenways as a Domain of Sustainable Urban Environment (Smart Growth)

Today new local environmental movements have emerged to address key urban development issues. Under the banner of "no growth", "slow growth" and "farmland preservation", a variety of interest groups intend to control the scale and scope of urban growth (Freilich, 1999). While these ideas are sometimes radical, environmental themes and languages are increasingly used to describe new "smart" projects that align economic, environmental, and quality-of-life interests (Gatrell & Jesen, 2002). One of the more prominent smart-growth movement components has been urban nature and related environmental concerns such as greenways and green space.

Greenways have been tested as having multiple benefits or meeting multiple objectives. Although many greenways have been created primarily for recreation, they suggest the potential of realigning human settlement patterns to promote a sustainable environment (Thorne & Huang, 1991). Greenways have been suggested as infrastructure that can contribute to sustainability in urban environments. They, indeed, have played a significant role in the development of urban areas (Taylor, Paine, & FizGibbon, 1995). Although the scope, planning methods, form, and administrative framework for each greenway differ, they have common characteristics of linearity, open space conservation, and connectivity of urban areas to natural and rural environments. Greenways represent an adaptation that helps mitigate and provide counterpoints to the losses of natural landscapes as a result of growing urbanization (Searns, 1995). Thus, the development of urban greenways can bring greater utilization of ecologically based

planning recognizing natural systems, incorporation of principles of sustainability, expansion of public participation (Taylor et al., 1995).

Urban development processes tend to use a network approach. (Vrijlandt & Kerkstra, 1994). One aspect popular in US greenways as urban network is the durability of nineteenth century parkways and park systems to stitch together fragmenting cities and urbanizing areas (Walmsley, 1995). Greenways as a formative device for stitching together fragmenting cities and their urbanizing hinterlands are attracting widespread attention. To achieve a comprehensive regional green network that joins inner cities to the countryside, cities' urbanizing hinterlands will need greenway corridors to interweave with development in more structured and articulated patterns (Walmsley, 1995).

In fast growing metropolitan areas, development is outpacing efforts to conserve open lands and cultural resources for public use. While urban parks and greenways alone cannot solve urban problems, they are critical to the human health in cities and growing metropolitan areas and to the quality of life in modern society. For the many urban dwellers who lack the leisure time and disposable income to reach remote wilderness areas, urban greenways offer respite from the rigors of city life and the only means to appreciate the beauty of a scenic landscape or learn about the natural world.

Greenways provide number of ecological, economic, and quality of life benefits to the communities that create them (Carr & Zwick, 2002). Although most corridors have certain basic characteristics in common, the diversity of greenways will function in different ways. Two distinctive features are often suggested to gain multi-objective

efforts in greenway planning in a sustainable manner: ecological features and social features. Greenways can protect environmentally sensitive lands and wildlife and can provide people with access to outdoor recreation close to home. Greenways can contribute numerous benefits that enhance the quality of life through the sustainable use of land for multiple purposes (Bueno, Tsihrintzis & Alvarez, 1995; Flink & Searns, 1993; Little, 1990; Mac Donald, 1991; Porter & Hastings, 1991; Shafer, Lee & Turner, 2000). Ecological, environmental, cultural, recreational, aesthetic, and economic benefits are derived from the preservation and development of greenways (Ahern, 1994; Bueno et al., 1995; Ndubisi et al., 1995). So, in addition to providing single purpose planning and design, greenways and greenway trails contribute comprehensive, multi-purpose, mulit-objective efforts to sustainable community development (Figure 1).

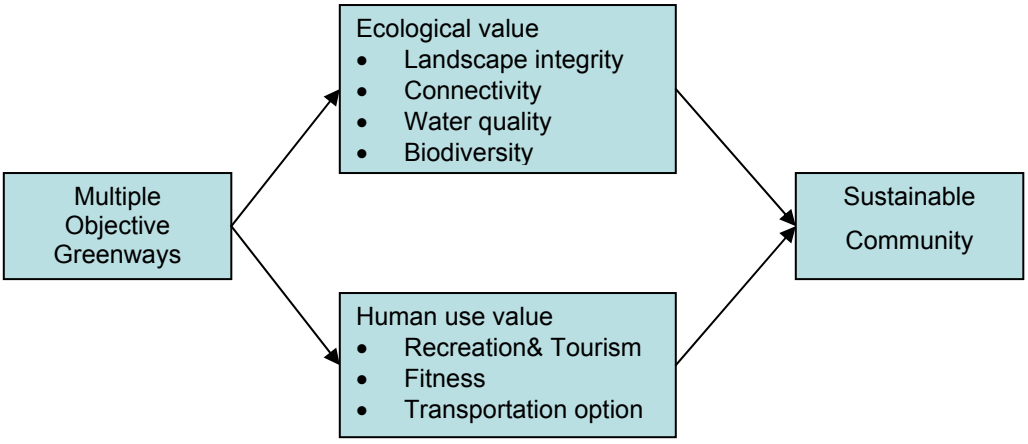

Figure 1. A Schematic Diagram for Contributions of Greenways to Sustainable Community Development

Sustainable Urban Environment and Human Experience

Ecological Benefits of Sustainable Urban Environments

Paralleling the rapid expansion of greenways, there has been an increased research interest in examining the ecological benefits for sustainable environment. One line of research has focused on greenways as ecologically significant corridors and natural systems which help maintain environmental quality (Ahern, 1994; Baschak & Brown, 1995; Bueno et al., 1995; Burley, 1995; Linehan et al., 1995; McGuckin & Brown, 1995; Ndubisi et al., 1995; Searns, 1995; Viles & Rosier, 2001; Yahner et al., 1995).

A greenway is, in simplest terms, a linear open space. It is a kind of corridor composed of natural vegetation or at least vegetation that is more natural than in surrounding areas (Smith & Hellmund, 1993). The common characteristic of greenways is that they all go somewhere simply because, by definition, they are linear and natural. Greenways often follow natural land or water features like ridges or rivers, and link nature reserves, parks, cultural features, and historic sites with each other and with populated areas.

Greenways intended primarily to protect natural values are, therefore, sometimes called environmental corridors or ecological corridors. Some greenways are publicly owned, some are privately owned, and some are the result of public/private partnerships. Some greenways are open to visitors; others are not. Some appeal to people, others attract wildlife. Therefore, the ecological structure and function of any given greenway

will depend on its location, its shape, the types of habitat it contains, and the nature of any human modification that has occurred within its boundaries.

There are other kinds of corridors that are partially synonymous with greenways (Smith & Hellmund, 1993). Wildlife corridors and riparian buffers are specific to wildlife movement and water resource protection. Greenways intended primarily to protect natural values are sometimes called environmental corridors or even ecology corridors. Very wide greenways (on the order of several miles wide) are often referred to as landscape linkages. Hence, greenways, which are sometimes called environmental corridors, landscape linkages, wildlife corridors, or riparian buffers, have come to be seen as an important means of protecting natural areas and providing recreation opportunities, especially in and around cities where open land is scarce.

Greenways can be used to create connected networks of open space that also include more traditional, nonlinear parks and natural areas. Thus they offer a powerful strategy for helping to maintain ecological integrity in human-dominated landscapes especially with regard to reducing habitat fragmentation, preserving biodiversity and maintaining high-quality water resources. In addition, they soften urban and suburban landscapes by contributing green connections that improve the quality of life and enhance property values.

Landscape Integrity

One important greenway attribute is to provide interconnectedness between ecological systems. This approach generally includes floodplains, wetlands, steep

slopes, and water resources, as well as agricultural, visual, and historical resources into an open space plan (Forman & Gordon, 1986). By linking ecological structures and functions, a regional greenway system may be able to help the biological diversity of plant and animal species by maintaining the connection between natural communities, provide present and future open space needs, and allow for economic growth and development (Ahern, 1994).

A regional greenway network is primarily proposed to ecologically reconnect the fragmented landscapes and to reduce the impacts of habitat fragmentation. Habitat fragmentation is considered one of the most serious threats to biological diversity and is a primary cause of the extinction crisis (Brown et al., 1991; Bueno et al., 1995; Harris, 1984; Linehan et al., 1995). Studies based on this idea recognized landscape fragmentation as a physical process with important negative spatial consequences in landscapes. In terms of ecological resources and nature protection, integration is often proposed as the appropriate conceptual solution to fragmentation. For example, Burley (1995) covered scales from the continental North American scale to the project scale focusing on locally-based habitat restoration and management for migrating bird species and suggested that both broad landscape planning visions and detailed site endeavors are necessary to understand and manage the greenway successfully.

Riparian corridors often serve as the backbone for local and regional greenway networks (Hay, 1991). This is partly the result of a deep-rooted affinity that people have for watercourses, but also because lands bordering creeks and rivers are usually among

the last available for conservation in settled landscapes. Floodplains are unsuitable for most other types of development.

Riparian areas are also important sources of biodiversity (Naiman et al., 1993). In the case of habitat networks, which form a part of the greenway network, habitat networks should not only provide suitable habitat and facilitate species movement between habitat patches but also provide water resource protection, forestry opportunities, and other ecological functions. Networks also provide opportunities for an efficient migratory route, as well as to alter the flow of nutrients, water, and energy across the landscape (Forman & Gordon, 1986).

Greenways also help protect the quantity and quality of water, a natural resource vital to people, plants, and wildlife. A study on South Florida Greenways (Bueno, Tsihrintzis, & Alvarez, 1995) proposed how a network of drainage canals which facilitated the over-development and exploitation of the South Florida region, has been reconceived as a potential network of ecological corridors. The original functions of flood control and water conservation have been combined with a broader vision in which the canals are managed at several scales in response to their landscape context. On the other hand, McGuckin and Brown (1995) studied the spatial distribution model of stormwater catchment facilities in developing urban areas demonstrated that important greenways benefits. To maximize the ecological potential of stormwater management facilities, they must be integrated into a regional landscape network of greenways based on Noss and Harris (1986) and Cook's (1991) scheme or interconnected nodes, patches, corridors and multiuse modules. In the study, simulations of various scenarios for

incorporating stormwater catchment facilities into greenways have been tested with the model and the resultant land use patterns compared with the status quo, through measures of landscape ecological integrity such as connectivity and porosity. The results demonstrated that landscape integrity could be increased, urban wildlife habitat enhanced, and opportunities for residential non-consumptive wildlife recreation improved through integration of the evolving 'blue-green' open space provided by urban stormwater management facilities into existing greenways.

Connectivity

One of the benefits of greenways can be that they direct development and growth away from important natural resource areas. According to Baschak and Brown (1995), as natural areas in urban environments become more fragmented and threatened, using approaches like the ecological framework in landscape planning, design, and management might begin to reverse the trends. They reviewed and compared to the development of an ecological framework for the planning, design and management of urban river greenways utilizing three approaches including naturalistic, ecosystem science, and landscape ecology approaches. Another study conducted by the state of Georgia pointed out greenway potential focusing on a statewide interconnected system (Dawson, 1995). The study process combined intrinsic values (natural resources, environmental quality, and aesthetics) with extrinsic values (human use, accessibility, market demand and land use and endangeredness) to provide priorities for greenway conservation. The study was published in 1976 and the state of Georgia updated the

corridor study in the Georgia Trails and Greenways Plan (Soriano, 1992), which provides technical assistance to local communities on issues and agency action plans. The corridor study was intended, from the broader state view, to identify the most important greenways, focus attention on their value, and suggest means for action which can be useful in protecting them. It is not intended to draw attention away from the importance of management responsibilities that government has to the land outside of the greenways. Instead it focuses on demonstrating the relationships of remaining potential greenway landscape to the whole (Dawson, 1995). The corridor study concept takes the area such as river flood plains, low-fertility soils, and steep slopes that are generally not attractive to development, yet they are also some of our most valuable resources for many kinds of recreation, conservation, and sites of cultural interest (Dawson, 1995).

A wildlife corridor system that protects regional diversity should be at the forefront of the greenway planning process and could serve as the skeletal framework of a regional greenway system. Such a system could then go on to provide recreational opportunities, help control community development patterns, guide overall growth management efforts, protect the character of a region, and protect the health, safety, and welfare of society (Linehan et al., 1995). To take concept further, recent research in the area of designing wildlife and wildland reserves has indicated that primary nodes or large reserves are necessary for proper management but that inter-connections between the primary areas are necessary for conservation strategies (Shafer, 1990). Through the system of nodes (park, wildlife management areas, reserves, state and national forests)

and interconnected corridors (river flood plains, ridges, non-developed greenbelts), the expenses of management are lower and the quality of management results are much improved (Crossen, 1979). This idea is originally derived from landscape ecology and often applied environmental planning.

The fundamental elements of environmental planning are represented by patch, edge, and corridor which also stand for ecological principles in landscape ecology. In human ecological background, for example, patch include neighborhood, park etc, edge can be shown as district, school area and urban forest area, and corridor is formed as road, trail or river and so forth. A greenway system could also be composed of three components: large hubs, links and smaller sites. The hubs anchor the system and provide an origin or destination for people and wildlife moving to or through it. Hubs come in many different sizes, from large protected reserves to smaller regional parks and preserves. For example, urban hub might be hotel, restaurant or recreation facilities. Ecological hub can be national park or wildlife refuge. Links are the connections that enable the system to work. They range in size and function from large landscape linkages to smaller conservation and recreational corridors and trails. Sites are smaller features that serve as points of origin or destination but are not always linked with hubs or with each other. They can be made up of natural, historical, cultural, and recreational features.

Within the landscape, greenways serve at least three major functions: they protect and/or enhance remaining natural, cultural and historical resources; they provide linear open space for compatible human use; and they maintain connectivity -- between

conservation lands, communities, parks and other recreational facilities, and cultural and historic sites. Connectivity is a critical landscape characteristic important to the health, well-being, and aesthetic values of human communities and vital to the maintenance of functional native ecosystems. While the ability of greenways to "link" other resources is important, not every greenway is a connector. Greenways are not a "connect-the-dots" concept applied without justifiable ecological or human need. Therefore, one of the most important benefits of greenways is that they provide alternative transportation routes like trails and bikeways that connect people, communities, and the countryside.

Dynamics of Human Experience with Greenway Trails

One of the most important goals of greenways is to directly enhance quality-of-life through human experience. Trails in greenways provide access and can help improve quality of life in various ways. They provide residents and visitors with additional recreation and transportation opportunities. Literature suggests that moderate forms of regular basis physical activity such as walking and bicycling can have important beneficial effects on public health (Frank & Engelke, 2001). Vegetation and green spaces provide significant advantages to enhance aesthetic quality which affect psychological and physical well-being (Gatrell & Jensen, 2002). In general, open spaces and greenways decrease stress, enable residents to cope with daily life, and in very real terms make cities more livable (Flores, Pickett, Zipperer, Pouyat, & Pirani, 1998).

Recreation, Tourism and Alternative Transportation Opportunities

Greenways with trails provide many valuable experiences to humans including tourism and recreational opportunities (Dodd, 2000; Flink & Searns, 1993; Little, 1990; National Park Service, 1995; Shafer et al, 2000; The Conservation Fund, 2000; Turner, 1995). Urban tourism attracts distinct visitor groups based on differences in the type of traveler and in their motivations to visit (Page, 1995). A greenway can be an important asset to the community as a major tourist attraction, which provides local opportunities including accommodation, food, and recreational opportunities that enhance the appeal to tourists. For example, greenways with historical heritage and cultural values can attract tourists, provide recreational, educational, scenic and economic benefits, and increase aesthetic values, livability and quality of life (Fabos, 1995, 2002). Recent trend analyses show that the traditional two-week summer vacation is on the decline for today's travelers, while on the other hand weekend trips to nearby areas are on the increase because of the "job complications of two-income families, limited time budgets, interest in more specialized recreation experiences, increased mixing of personal and business travel, and year round school" (NPS, 1995).

There has been a tremendous increase in recreational use of urban areas over the past decades. The fastest growing recreational activities in urban area are associated with trail use which many urban areas provide (Lynn & Brown, 2002). Greenways in urban regions are, of necessity, heavily oriented toward public access and recreational use (Hay, 1991). Indeed, many urban riverfronts and former docklands have been restored as greenways (Little, 1990). Much of the appeal of greenways for urban

planners stems from the notion that these areas can simultaneously provide numerous recreational opportunities—hiking, biking, jogging, wildlife viewing—as a means to enhance the urban experience (Little, 1990; Searns, 1995; Smith & Hellmund, 1993).

In areas of human settlement, greenway and open space not only are often intended to provide sustainable urban development strategy but also serve recreational and tourism opportunities. For many decades, national studies have documented the need for urban open space. The 1962 Outdoor Recreation Resources Commission's report, "Outdoor Recreation for Americans," found that most people do not have the means to derive any consistent benefit from large public open space holdings in rural and remote areas. The report recommended that parks and nature be brought closer to people. Sixteen years later, in 1978, the "National Urban Recreation Study" (Carr & Zwick, 2002) revealed that urban open space needs remained unmet and were getting worse. The report documented an increasing disparity between public funding for urban parks and recreation and assistance provided to suburbs and other outlying areas.

In 1987, the President's Commission on Americans Outdoors (PCAO) concluded that our nation's greatest open space needs are in urban communities. The report identified the special recreation and open space needs of the aged, the disabled, people of color, the poor, and other population groups that tend to be concentrated in cities. According to the report, walking and bicycling were two of the top five outdoor activities, with more than 80% of Americans walking for pleasure and nearly half bicycling at lest once during the previous year. Perhaps most importantly the President's Commission identified the tremendous potential for greenways to meet urban open space

needs and provide public recreation close to home. Gilbert M. Grosvenor, Vice Chairman of President of the Commission wrote that "We need to bring open space to people, instead of expecting them to journey to find it. That's where greenways are contributing. To truly benefit residents and visitors, the community systems of greenways must be accessible."

Urban greenways can also provide networks of trails that link land and water-based recreational sites and areas. These trails often have scenic qualities based on diverse urban landscapes (Fabos, 1995). The intent may be local, regional, national or international in scale. For instance, Tzolova (1995) sought to justify a greenway planning approach with recreation as a management object. The study showed that landscape resources are available in the study area that meets recreational conditions for the development of a greenway. To achieve this result, the study analyzed the natural and anthropogenic components of the riverine landscape based on three-phase process involving landscape analysis, diagnosis and synthesis.

The study assessed a forest landscape with three different aesthetic qualities for recreational suitability: high (3.3%), moderate (70.1%), and low (26.6%). The natural landscape with high aesthetic visual qualities included woodlands, water bodies and sites with little to no developed infrastructure. The landscapes with medium aesthetic quality had thick forests, agricultural lands, orchards and vineyards, shelter-belts, water canals and other light infrastructure that indicated more human presence. Zones with low aesthetic quality had a strong presence of human activity including existing settlements

and industrial zones with dense infrastructure (Tzolova, 1995). The analysis used in this study identified natural resources and recreation sites best suited for the leisure activities.

Another study by Kent and Elliot (1995) described that scenic roads may be the most important historical/cultural landscapes to the mostly natural and recreational greenways along rivers, streams and coastal areas. Because many cultural features are near rivers and along shorelines, historic heritage values could easily included in greenways. This would enhance that recreation and tourism benefits that result in greenways planning (Fabos, 1995).

Greenway trails can provide ecological benefits to society (Dawson et al., 1991) through linearity and connectivity. As an alternative recreational transportation corridor, they serve to link nodal areas of high environmental value, such as state parks, natural areas, and historic sites, resulting in a unique, interconnected system. An urban greenway trail can accommodate several modes of transportation, such as hiking, boating and bicycle trails, or scenic roads, thus lending great flexibility to the system. The examination of uses and potentials of alternative transportation and the protection of ecologically significant corridors suggest that the greenway movement plays an important role to provide a more comprehensive planning vision than those based on single purpose ideas about greenways.

Greenway trails also provide recreational opportunities for people to interact with the natural environment while sustaining qualities of the environment (Moore & Shafer, 2001). Trails and trail networks can connect origins with destinations linking cities, regional points of interest, different parts of the community, and various transportation

routes. They link people with natural and cultural environments and foster new enthusiasm for community natural, recreational, cultural and historic resources. Trails provide access to special places that help create a strong sense of place and community (Luymes & Tamminga, 1995; Gobster, 1995)

Paradox of Sustainable Greenways

Greenways are sometimes formed as systems or networks of connected land for human use. They are protected, managed or developed to provide ecological and social benefits (Burel & Baudry, 1995). So, the design of greenways that contribute to provide human benefits such as aesthetics is not a trivial task. Greenways can be seen not only as an approach to linking open spaces, but, more importantly, as a tool to realize the relationship between ecological structure and function in an economically viable and socially desirable way (Linehan et al., 1995). For example, Burel and Baudry (1995) presented an integration of the ecological role as well as the aesthetic and cultural role of hedgerows in a landscape planning process. The French and many European cultural landscapes combine the natural drainage areas and cultural features, the hedgerows, to produce a high quality scenic landscape. They described that the integration of the different points of view on the same landscape is the only way to connect visual values to productive or ecological processes. In addition, to sustain and connect landscapes of particular ecological, recreational and aesthetic value (Little, 1990; Hay, 1991; Soule, 1991), many states and towns in the U.S. have adopted legislation of scenic routes (Kent & Elliott 1995).

However, the increasing popularity of outdoor recreation and the need to meet user's diversity have inevitably resulted in positive sustainable environmental impacts on the urban environment. The increasing intensity of the development and use of trails including all physical, ecological, and aesthetic effects are considered to be one of the most prominent issues in sustainable greenways. Thus, the sustainability of open space and natural and cultural features which define the unique qualities of a region has become a major focus of environmental planning (Yaro et al., 1988; Iverson et al., 1993). This new movement advocates equal treatment of both ecological and social sustainability in the planning process (Akbar, Hale, & Headley, 2002).

While an area of greenways research has focused on sustainable development and quality of life, one of the problems to designers and managers of greenway trail is the paradox of sustaining the environment while providing for various human uses (Kuss & Grafe, 1985). Since greenways provide opportunities for integration of social functions which are more or less compatible with ecological functions (Ndubisi et al., 1995; van Langevelde, 1994), resolving conflicts among these needs often requires integrating information across diverse disciplines and fields of inquiry (Grannis, 1999). In order to enhance and manage physical quality of greenway trails in a sustainable way, planners and designers must understand people's experience and responses, for example "aesthetic response" to the environment which deals with both ecological and social value.

Aesthetic Responses for Sustainable Design

The need for sustainable approaches for planning, designing and managing landscapes is recognized worldwide. New tools are needed to effectively apply sustainable principles to planning, design, and management. The spatial dimension of sustainability engages processes and relations between different land use, ecosystems, and biodiversity at different scales and over time. Therefore, ecological knowledge is essential when planning for sustainability (Leitao & Ahern, 2002).

However, while several aspects of contributions to sustainable development have been well established by planners and landscape architects, the dynamics of human aesthetic experience have not enabled them to learn how to make more ecologically and socially sustainable places (Environmental Protection Agency, 1992). In the meantime, ecological issues in greenway trails were considered of highest importance while the aesthetic issues were relatively neglected in planning and design. However, due to increasing value of human use in greenway trails, aesthetic quality has become a major element of the trail environment which people experience (Akbar, Hale, & Headley, 2002). In addition, public concerns for environmental design and their associated aesthetic concerns have changed considerably.

Although aesthetic considerations are only one of many factors of concern in greenway design, they are important ones. Aesthetic quality influences perceived quality of life and sense of well-being (Nasar, 1988a). Aesthetic quality of places can also influence decision-making to where people live, work, shop, and travel. Further,

aesthetic improvements are often emphasized as a strategy for revitalization for areas in decline, enhancement for sense of community, and reduction for vulnerability of crime (Nasar, 1997; Nasar, 1998; Nasar & Jones, 1997).

Aesthetic quality may also be assumed to contribute to the character or identity of a place. Places of high aesthetic quality will tend to become landmarks, over and above their specific roles in the activity system of the individual (Eben Saleh, 2001). Heath (1988) hypothesized where places of high aesthetic quality are significant paths or nodes or pedestrian or transportation networks, their aesthetic affect will be reinforced (that is more people will attend to their aesthetic quality); but where they do not relate to way-finding activities (e.g. people feel oriented and confident that they can find their way around), their aesthetic effect will be altered to be detracted. Eventually, the aesthetic response of people to the environment will be either reinforced or inhibited by aesthetic quality of the environment.

Aesthetic Responses

Aesthetics is formally defined as the study of the principles that guide the formation and evaluation of art (Wallenmaier, 2002). Derived from the Greek word 'aisthanesthai', the word aesthetics literally refers to perception. This general sense is maintained in the current Oxford English Dictionary definition of aesthetics as 'knowledge derived from the senses.' Thus the 'aesthete' is generally thought of as some kind of expert, skilled and/or talented in the appraisal and evaluation of beautiful things. While the traditional way of defining aesthetics paid attention on extreme and

intense feelings, psychologists have attempted to broaden the definition to include less extreme and smaller changes that people experience within their everyday life.

Aesthetic response in this study corresponds to the broader definition. It refers to evaluative aesthetic experience in relation to the environment (Nasar, 1997). According to Sparshot (1972), an aesthetic response is one that is "valued otherwise than for its commercial, economic, vital or hygienic significance" (p. 18). The aesthetic response consists of three main components (Figure 2): affective appraisal, emotional reaction (Russell & Snodgrass, 1989), and changes in behavior (Izard, 1977). An affective appraisal represents an attribution to the environment such as an individual's judgments that they like a certain environment (Nasar, 1997). Affective appraisal is used here synonymously with *cognitive perception*; although in a strict sense the concepts are different. Affective *appraisal* is a psychological assessment of places whereas emotional *reaction* is physiological response to place. An emotional reaction refers to an internal state such as pleasure or arousal that relates to the environment (Russell & Snodgrass, 1989).

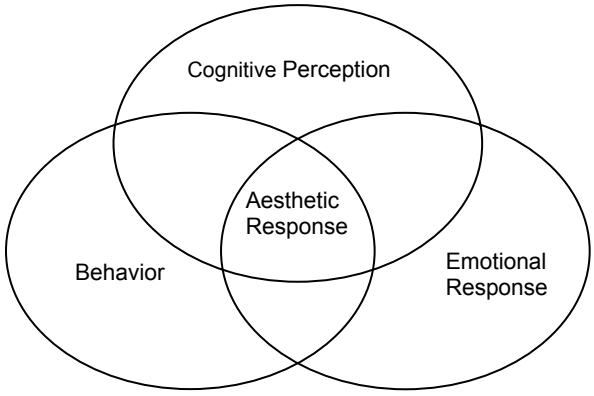

Figure 2. Components of Aesthetic Response (Nasar, 1997)

Affect was found as a broader term that encompasses emotions and feelings (e.g. Ulrich, 1983) and was consisted of three dimensions including evaluation, activity, and potency (c.f. Heise, 1970). Research explains that the two dimensions of affective quality (Russell, 1988) such as pleasantness and arousal represent evaluation and activity. Excitement and relaxation result from the mixtures of evaluation and activity. A potency dimension did not emerge as critical while possibly relevant to environmental responses (Nasar, 1997, p. 153). Nasar (1997) stated,

> Does the relaxing feeling of resting in a peaceful field or the excitement of a vista to Time Square represent an aesthetic response? In each case, the presence of an environmental referent and an evaluative feeling or appraisal makes them relevant. It would be useful to identify the factors contributing to the feelings of relaxation or excitement as well as pleasantness. (p. 153-154).

Aesthetic response can be seen as having probabilistic relationships to physical attributes in the environment. The probabilities stem from the ongoing interactional experience of persons with their surroundings (Nasar, 1997). Therefore, a greater understanding of the influence of the physical environment on human aesthetic response may facilitate more effective design policies that result in an enhanced quality of life. To accomplish effective sustainable greenway development, planners and designers must have an understanding of human aesthetic response to these environments. Then, we can better understand how people might perceive and use the near-by nature that greenways provide in urban areas.

Building upon existing empirical findings, this study develops a conceptual framework for sustainable greenway trail development applying environmental aesthetic

concepts and exploring the multiple potential roles of aesthetic quality of the environment as a resource for sustainable recreation and tourism.

Theoretical Framework for Sustainable Design Aesthetics

The aesthetic quality of both urban and natural environments has proven to be a field of active investigation over the decades (Zube, Simcox & Law, 1987). Like traditional aesthetic research, environmental aesthetics was being studied under the assumption that general or universal principles of aesthetic quality can be empirically discovered (Wohlwill, 1976). Since studies in environmental aesthetics involve people's reaction to the visual quality of the environment, central concerns focus the examination of a psychological phenomenon by investigating how aesthetic qualities and attributes of an environment effect people's response to the environment. People respond to an environment's aesthetic quality by assessing feelings and behaviors that result from previous experience with that environment; by deriving inferences from environmental cues; or by recalling similar places (Ataov, 1998). Research consistently shows the importance of the visual features of the environment and people's evaluative responses to those attributes (Appleyard, 1976a; Ataov, 1998; Berlyne, 1971; Hanyu, 1993; Nasar, 1997). For example, Lansing, Marans, and Zehner (1970) found aesthetic factors had major influences on judgments of community satisfaction. In factor analysis of ratings of the quality of the residential environment, Carp, Zawadski, and Shokron (1976) found the highest proportion of variance explained by aesthetic variables.

In environmental aesthetics, it is important to understand affective environmental features and to apply the understanding to environmental design in a way that is judged favorably by the public (Nasar, 1988c, p.xxi). The study focused on the effects of aesthetic quality on human response that the groups or the public may experience. The research found that human response arises from the observer and the environment and the ongoing interaction between the two (Kaplan & Kaplan, 1989; Nasar, 1988a, 1997).

The aesthetic quality of the surroundings may affect immediate experience, "sense of well-being", in those surroundings; it may influence subsequent reactions to both the setting and its inhabitants; and it may influence spatial behavior in that individuals are attracted to an appealing environment and are likely to avoid an unpleasant one. Professionals in planning, design, and management must understand the relationship between visual attributes of an environment and human response in order to contribute more to designs that fit the preferences and activities of the users (Nasar, 1988c, p.xxi).

Perceived aesthetic quality is a psychological construct which involves an assessment of either the environment or of people's feeling about the environment. Thus, research in environmental aesthetics can be classified into two categories: perceptual/cognitive aspects and emotional/affective responses (Moore, 1979; Nasar, 1988b; Russell, Ward & Pratt, 1981; Wohlwill, 1976). Perceptual/cognitive aspects refer to the identification and understanding of the factors that contribute to the perception and cognition of an environmental attribute. Studies in this topic deal with the acquisition, organization, and memory of environmental attributes such as level of

naturalness, coherence, and complexity. Perceptual/cognitive studies investigate the types of visual aspects while emotional/affective responses examine the way people feel about the environment. Emotional/affective responses are the understanding of the nature of the human reaction to the environment such as pleasantness, excitement, relaxation, and fear. Studies of emotional/affective responses investigate the process of the individuals' evaluation of environments, and the individuals' emotion (Ataov, 1998). Researchers also found that emotional and affective responses are significantly related to perceptive and cognitive aspects. They treat visual properties such as man-made complexity, coherence, and historical significance, as perceptual and cognitive aspects and they study the effects of visual properties on affective and emotional responses (Ataov, 1998; p.23).

The following section investigates the conceptual framework of perceptual/ cognitive aspects and emotional/affective responses. It also highlights research on the relationship between evaluative responses and significant visual attributes. In addition the conceptual models, as methods that explain relationships between evaluative responses and the visual attributes, will be reviewed. This framework helps clarify salient visual attributes and emotional variables in human-environment interaction and the ones that may be relevant to the peoples' experience of recreation-based tourism attraction settings.

Perceptual/Cognitive Aspects

Since perception and cognition for environments process the visual properties as main inputs, major environmental studies treated visual properties as perceptual/ cognitive contents. According to Lynch (1960), community consensus on the elements can enhance the identity and structure of a city, in other words, its *imageability*.

> Imageability is that quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, color, or arrangement that facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment (Lynch, 1960, p.9).

It helps people orient and find their way around, thus enhancing people's enjoyment of a city. In his seminal book, *the Image of the City*, Lynch pointed out three components of environmental image including identity, structure, and meaning. The structure which involves the relationships among the imageable elements contributes to the vividness, clarity, or legibility, of the image. Despite the images and prominence of various elements vary for different populations and places (DeJong, 1962, Francescato & Mebane, 1973; Gulick, 1963; Milgram & Jodelet, 1976; Rapoport, 1977), the imageable elements can affect perceptual and cognitive process hence the imageability of a city (Figure 3).

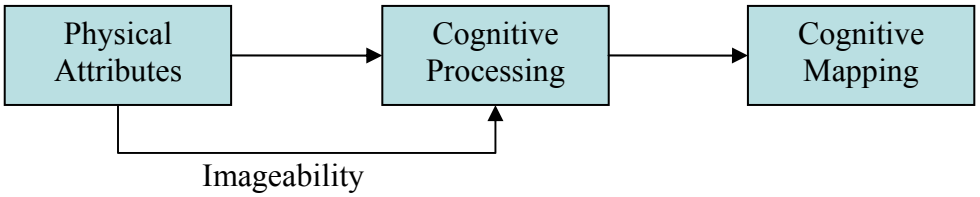

Figure 3. A Conceptual Model of Imageability and Cognitive Mapping

In the perceptual and cognitive category, studies have examined people's cognitive representations of the environment produced by these processes called cognitive or mental maps (Appleyard, 1970; de Jonge, 1962; Francescato and Mebane, 1973; Golledge, 1987; Lynch, 1960; Orleans, 1973). The term "cognitive map" was based on a method by Tolman (1948) who used it to describe the internally held spatial representations of knowledge upon which actual spatial behavior was based (Kimble, Wertheimer, & White, 1991). This method was originally used to observe rats' behavior of searching for foods in a maze. As applied to people, a cognitive map is derived from mental representation or knowledge of peoples' everyday socio-physical environment (Figure 3) at a variety of scales ranging from the local urban environment to regions, individual countries, and even the entire globe (Downs & Stea, 1973; Golledge, 1987; Lynch, 1960). In theory people acquire knowledge of physical settings through direct and indirect experience. Constructing cognitive maps requires two types of information: locational information and attribute information (Downs & Stea, 1973). Locational information refers to both actual location of the physical elements and the relative location of the physical elements such as orientation and distance from one to another. Attribute information involves the meaning of places such as design features, function,

importance, and role. So cognitive mapping refers to the ability to collect, organize, store, recall, and manipulate information about the environment (Downs & Stea, 1977).

Studies about cognitive mapping consistently confirm Lynch's (1960) five types of physical elements in the map including paths, edges, districts, nodes, and landmarks. Paths represent channels along which the observer customarily or occasionally moves such as trails and roads. Edges represent linear elements that are considered to be the boundaries between two areas, for example, shorelines and rivers. Districts illustrates medium to large parts of the city that are recognizable as having some common perceived character or identity such as an industrial area or a historic neighborhood. Focal points of activity where people can gather and perform activities such as a park or public square are represented by nodes whereas physical objects that are considered to be only visual point-of-reference are represented by landmarks (Lynch, 1960; Moore, 1979).

Although Lynch recognized the importance of meaning and evaluation, his research emphasizes identity and structure. Later, various cognitive mapping studies limit this approach to the visual quality of these five physical elements. The cognitive mapping studies have overlooked the importance of the emotional and affective quality of these physical elements. Lynch (1960) asserts that imageability may be necessary but is not sufficient for a likable environment. Because people have feelings and associations, both positive and negative, about their surroundings and the imageable elements. These feelings and meanings are also crucial to people's perception of and reaction to the environment (Nasar, 1988a). Lynch assumed that it would be impractical

to measure and control individual differences, but later studies have shown that affective meaning is measurable and also has a certain common structure across individuals (Appleyard, 1976a; Nasar, 1997).

Emotional/Affective Responses

Affective appraisal is one aspect of how people perceive the environment. An affective appraisal occurs when a person judges something as having an affective quality, such as pleasant, exciting and so forth. It is a judgment that distinguishes affective appraisal from the physiological and behavioral components of emotion. Studies in this category deal with the assumption that individuals make affective judgments on environmental quality in terms of a common set of dimensions. To find a place pleasant, interesting, stressful, or the like is to assign to that place an affective quality. When we consider or confront an environment, we make a judgment whether it is interesting, relaxing, gloomy, etc. Whether we choose to go there, what we do there, and whether we return may rely on such judgments.

The affective/emotional quality of an environment has been measured by people's response to the environment in terms of likability (Al-Kodmany, 2001; Nasar, 1998; 1999), preference (e.g. Herzog & Smith, 1988; Herzog & Miller, 1998; Nasar & Hong, 1999; Nasar & Kang, 1999), interest (Wohlwill, 1976), or safety and fear (Herzog & Smith, 1988; Ulrich, 1983, 1993). On the other hand, the studies of emotional and affective responses attempt to examine the fundamental dimensions that underlie people's affective quality judgments. To uncover the fundamental dimensions, it is

assumed that multiple dimensions play significant roles in the affective judgment for environmental quality.

A factor analysis of verbal descriptions of the environment derived from Osgood, Suci, and Tannenbaum's (1957) semantic-differential approach, was applied to examine the fundamental dimensions of affective quality judgment. The semantic-differential approach operates a set of scales where each scale is composed of a pair of adjective words with opposite meanings (good-bad, like-dislike). This approach has been confirmed in many studies (e.g. Kasmar, 1988). Osgood et al. (1957) and many others conducted studies and identified three semantic dimensions-evaluation (subjective assessment of feelings), potency (capabilities), and activity (functions or usage) as fundamental dimensions of the meanings across a wide range of stimuli and respondents.

Research has yet to identify a single set of dimensions that depict the meaning of all environments (Oostendorp & Berlyne, 1978a). For example, two different kinds of dimensions emerged in two different studies. Canter (1969) revealed eight environmental meanings in building interiors. They were friendliness (good understanding and harmony), coherence (togetherness), activity (function), formality (regularity), uniqueness (originality), cowardliness (fear), potency (capabilities), and sanctity (beliefs). On the other hand, three other factors of environmental meaning such as evaluation, urbanization, and organization were found in Horayangkura's (1978) building exterior study. Since these earlier studies did not measure perceptual/cognitive scales and affective/emotional scales separately, pure affective/emotional dimensions are not identified (Nasar, 1998).

Research focused on the natural environment has revealed four aspects of affective responses of emotional reaction to places: pleasure, arousal, excitement, and relaxation (Nasar, 1997). Such research has attempted to examine affective/emotional variables and has revealed relatively stable dimensions in the affective judgment of natural environments. For example, by using verbal rating scale with factor analysis (a semantic-differential approach) Ward and Russell (1981) found four dimensions in terms of arousal, excitement, pleasure, and relaxation as the primary dimensions of emotional/affective responses of place. Later, several studies consistently confirmed this hypothesis using a verbal approach (Russell, 1988; Russell, Ward and Pratt, 1981).

However, the factors may not represent the respondents' own dimensions of stimuli because they only transfer respondents' mental processes through prepared words (e.g. the semantic differential method). Non-verbal approaches (e.g. such as categorizing photographs by similarity) were introduced as alternative research techniques to overcome this problem in a variety of studies that suggest similarity, multidimensional scaling, and cluster analysis. Hanyu (1993) used a non-verbal approach and employed multidimensional scaling to extract the dimensions (i.e. factors) of people's affective meanings and the results supported Russell's hypothesis.

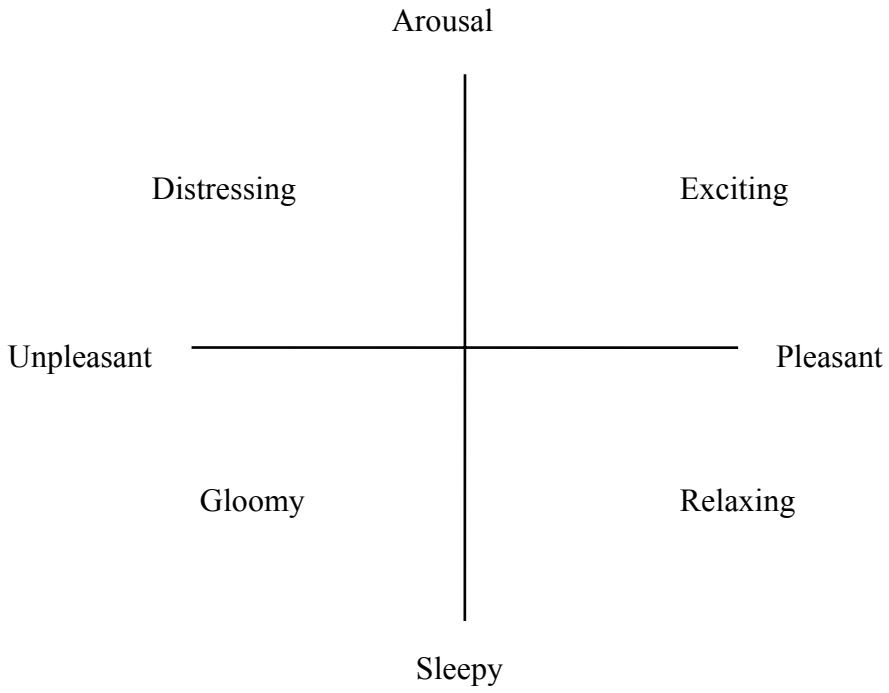

Figure 4. A Spatial Representation of Description of the Affective Quality of Environments (Russell, 1998)

Furthermore, the studies showed that the dimensions of affective meanings are structured in a circular order (Russell, 1988; Russell, Ward, & Pratt, 1981; & Hanyu, 1993). Figure 4 depicts a spatial representation of description of the affective quality of environment. This structure is also known as Guttman's "circumplex" that showed the configuration of entities on a two-dimensional scale space which are related in a systematic manner even though they are independent from each other. It is also implied that the four dimensions in Russell's model provide eight different affective responses. The eight responses are arranged in an order from arousal, exciting, pleasant, relaxing, sleepy, gloomy, unpleasant, and distressing.

In summary, two categories of environmental aesthetics research have been discussed: perceptual/cognitive process and affective/emotional responses. Research in perceptual/cognitive process found that the presence and character of physical attributes and its relation affect the perceptual and cognitive process (i.e. imageability) and representation produced by these processes (i.e. mental map). Research in affective/emotional responses revealed that arousal and pleasantness may be the fundamental dimensions. Also various studies consistently confirm that perceptual/cognitive process and affective/emotional responses are related (Appleyard, 1976a; Berlyne, 1960, 1971; Horayangkura, 1978; Nasar, 1988a, 1998; Rapoport, 1990). The next section reviews research on relationships between perceptual/cognitive aspects and affective/emotional responses on human response to the natural environment.

Relationship between Perceptual/Cognitive Aspects and Emotional/Affective Responses

Research in this category is exemplified by studies by Berlyne (1960, 1971) and Berlyne and Madsen (1973). Empirical research supports the theory that emotional and affective responses are significantly related to perception and cognition (Appleyard, 1976a; Berlyne, 1960, 1971; Horayangkura, 1978; Nasar, 1988a, 1998; Rapoport, 1990). For example, Nasar (1998) examined likability of city appearance in two U.S. cities. The study revealed that respondents' likable places have two components: affect and imageability (cognitive property). In an earlier study, Appleyard (1976a) found that most imageable buildings in a city elicited the strongest evaluative responses. These studies deal with the visual attributes of an environment (e.g., complexity, coherence,

legibility, and historical significance) as perceptual/cognitive factors and then study how these factors influence affective/emotional responses. Thus, a major concern of this field of study is the relationship between perception/ cognition and emotional/affective appraisal.

Since the relationship has theoretical importance, the nature of this relationship has yielded considerable debate among researchers over time. For example, Lazarus (1984) claims that emotion (affect) can be evoked only after a cognition process. The major theme of this argument is that emotion always requires internal processing of the information. In contrast, Zajonc (1980, 1984) presented that affect can occur independent of and prior to cognition. He demonstrates that affect is an initial emotional reaction to general environmental character without internal processing such as cognition. The major theme of this argument is that preference judgments usually occurred promptly and that they precede rather than follow conscious thought or rational calculation. And, he suggests that the first stage in the response to stimuli consists of global, generalized affects that are related to preferences. The affect can occur rapidly with little information for certain stimulus characteristics such as shape, proportion, rhythm, scale, complexity, color, illumination, shadowing, order, hierarchy, spatial relations, incongruity, arid ambiguity (Nasar, 1994).

A later study combined these two models and proposed another interpretation of the relationship of affect and cognition. Kaplan (1988b) asserts that cognition is more than conscious thought. Information processing, such as categorization, assumption, and inference, often occur without conscious thought (awareness). Consciousness is not

required for information processing. He criticized the conclusion that affect is independent of cognition as misleading and suggested that cognition plays a role in affect. He suggests two types of elements to conceptualize the relationship of affect and cognition: content and process. The contents of cognition are occasionally associated with affective reactions; cognitive processes themselves carry affective implications at other times. Certain cognitive contents can evoke affective reactions through either learning or genetics. For instance, a cognitive map can refer both positive and negative feelings. For example, places to be avoided can create negative feelings in one's mind. The process of cognition can also occur in affective implications. A failure of recognition can result in feelings of confusion and pain. In contrast, the difficulty and uncertainty in recognition can be a source of pleasure (Kaplan, 1988b).

Measures of Aesthetic Responses

A number of studies have attempted to examine perceptual cognitive scales in relation to affective/emotional scales using environmental stimuli that require such measures.

Cognitive Evaluation Scales

Naturalness. Naturalness has been mostly employed to measure aesthetic response along with preference (Hands & Brown, 2002; Purcell & Lamb, 1998). Hands and Brown (2002) asserted that although people have a visual preference for natural over built environments, what people perceive as "natural" is often quite different in

appearance from naturalized areas that are high in ecological function. They found that the amount and diversity of color in a natural area and the use of "vernacular cues to care" such as the addition of cultural elements like bird boxes and large rocks had a substantial effect in increasing visual preference.

The natural-built dimension has consistently emerged as the most prominent dimension of human response to the environment (Herzog, Kaplan, & Kaplan, 1976, 1982; Nasar, 1988b, 1994). Studies define naturalness as either the degree of human influence on an environment (Purcell, Lamb, Person & Falchero, 1994; Ulrich, 1979, 1981) or, the presence or amount of natural elements (Herzog, 1989; Nasar, 1987; Young & Brown, 1992). Several types of natural elements were examined in environmental aesthetic research including water (Herzog, 1985; Herzog & Bosley, 1992, Purcell et al., 1994; Yang & Brown, 1992) and vegetation (Herzog, 1989; Nasar, 1987; Ulrich, 1979, 1981). These researchers have consistently found that naturalness is a powerful predictor of preference.

Beyond that, a line of research has begun to suggest a calming and restorative value of nature (Kaplan, 1995). Findings indicate that natural scenes possess physiological and psychological restorative powers. Contact with nature has been found to promote restoration from psychophysical stress (Ulrich, 1979, 1981; Ulrich et al., 1991) and mental fatigue (Kaplan & Talbot, 1983). Following the literature, this study considers naturalness as either the degree of human influence on an environment or the presence or amount of natural elements.

Openness. According to Appleton's Prospect-Refuge theory, openness of a scene refers the sense of prospect and the potential of surveillance (1975). Thus, openness is considered as an attribute that affords certain information in the scene. Subsequent studies have confirmed the prominence of spaciousness and related variables such as openness in human perception of the environment (Kaplan & Kaplan, 1989; Nasar, 1988a, 1988b, 1997). Ecological models also confirm that openness of a scene is positively related to people's preference (Appleton, 1975; Kaplan & Kaplan, 1982; Ulrich, 1983).

Distinctiveness. Distinctiveness refers to places perceived as having unique characteristics including historical significance (Nasar, 1998), familiarity (Herzog, 1984; Purcell & Nasar, 1992), typicality (Purcell, 1986; Purcell & Nasar, 1992), and identifiability (Purcell & Nasar, 1992). Places with authentic historical significance may look unique to the observers which can evoke favorable response. Distinctiveness can correspond to the extent to which a scene or the environment can be identifiable according to its typicality. Identifiability is a sense of familiarity (Purcell & Nasar, 1992). They assert that more typical scenes would be more identifiable.

Upkeep/Maintenance. Research has consistently shown upkeep as prominent in human perception of the environment (Herzog, Kaplan, & Kaplan, 1976, 1982; Nasar, 1983, 1987, 1988a, 1988b, 1990). It has been found that upkeep is a primary predictor of evaluative response (i.e. preference, interest, and safety) to physical elements of a residential area (Nasar, 1988a). Such environmental factors, for example dilapidation and poor upkeep, are found to increase fear of crime (Taylor, 1989).

Mystery. Mystery is defined as the degree to which a scene promises more to be seen. According to the Kaplans (1982, 1989), mystery promises one can gather new information in the context of an involvement and an inferred space. Thus mysterious scenes promise information if one travels deeper into the scene. In Kaplans' environmental preference model, mystery in a place is positively related to people's preference. However, according to Kaplan (1995), mystery has to do with its compatibility to use. For example, if a mysterious scene is compatible with one's purpose, it evokes an exploratory action but if it is incompatible, it evokes fear.

Legibility (upkeep). Lynch (1960) argues legibility exists in a city when the five perceived elements are present and when they are organized into an overall image of the city. According to Kaplan and Kaplan (1982, 1989), legibility means that one can explore a place extensively without being lost. Thus, legibility is the possibility of making sense of space and is high in well-structured and imageable environment. The environmental preference model (Kaplan, 1982) also confirms that legibility is positively related to preference.

Complexity. Complexity has consistently appeared as a prominent aspect of people's response to surroundings (Nasar, 1988a, 1988b, 1994). Complexity involves the number of different noticeable features and the distinctiveness between those features. For example, Wohlwill (1976) divided complexity into two parts: diversity and structure. Diversity (visual richness) indicates the number of different elements present in a particular scene. Ulrich (1983) defined complexity that refers generally to the number of independently perceived elements in a scene. On the other hand, structural

aspects of complexity refer to structure and order of complexity elements in a scene that could be related to legibility. In Berlyne's collative-arousal model (1971), complexity is explained that relates to arousal responses linearly and an inverted U-shaped curve with preference.

Kaplans' informational approach also considered complexity as a visual attribute and defined an involvement component which includes diversity and richness (Kaplan & Kaplan, 1989). Research has consistently confirmed that complexity evokes interest, and people prefer moderate complexity that also has a positive linear relationship with preference (Kaplan & Kaplan, 1989; Nasar, 1988; Wohlwill, 1976). This study defines complexity as the number of different elements that are contained in a scene and how much is going on in the scene.

Coherence (order). Coherence has also emerged as a prominent dimension of human response to the environment. Several studies have found organizing variables including legibility and coherence as important predictors of preference (Kaplan & Kaplan, 1989). Research has consistently found preference associated with coherence (order) that may relate to its perceptual character or social meaning regarding as orderly environment (Nasar, 1997). Coherence is defined as a physical pattern variable that indicates the degree of order or structure of a scene and makes sense to the observers. This is a key concept of the environmental preference model (Kaplan & Kaplan, 1982, 1989), and the collative-arousal model (Berlyne, 1971; Nasar, 1988; Wohlwill, 1976) as well. The models assume that the degree of coherence in a scene is positively related to

people's evaluative response (Berlyne, 1971; Kaplan & Kaplan, 1982, 1989; Nasar, 1988b; Wohlwill, 1976).

Affective/Emotional Response Scales

Pleasantness. In theory, pleasantness is a hedonic response that can have a positive or negative nature. Evaluation is defined as how much the individuals like a place. Pleasure is a purely evaluative dimension (Nasar, 1998)

Arousal. Arousal is independent of the evaluative dimension and orthogonal to the pleasantness factor (Russell & Snodgrass, 1989; Russell, 1988).

Excitement. Excitement consists of positive evaluation and high arousal. The counterpart, boring, consists of negative evaluation and low arousal (Russell & Snodgrass, 1987; Russell, 1988).

Relaxation. A relaxing response has positive evaluation and low arousal while its counterparts, distressing, consists of negative evaluation and high arousal (Russell, 1988). A group of researchers have studied relaxation with respect to the restorative value of nature and stress recovery (Kaplan, 1995; Kaplan & Kaplan, 1989; Ulrich, 1983; Ulrich et al., 1991). For example, Parsons et al. (1998) examined the efficacy of vernacular environments to influence both aesthetic experience and general well-being. They found that people who viewed nature-dominated drives would show greater autonomic activity indicative of stress (e.g. elevated blood pressure and electrodermal activity) than people who viewed artifact-dominated drives. Ulrich et al. (1991) compared the psychophysiological recovery time of people who viewed videotapes of

nature with people who viewed videotapes of urban scenes. They found that people viewing videotapes of nature recovered more rapidly than the others. Emerging evidence from this research area is presented indicating potential stress-reduction, health, cognitive and psychosocial effects of human interaction with outdoor environment (Parsons, 1995).

Fear of Crime & Safety. Some studies have also examined fear or safety (Kaplan & Kaplan, 1989; Nasar, Fisher, & Grannis, 1993; Nasar et al., 1983; Ulrich, 1983). Like distress, fear consists of negative evaluation and high arousal. Fear often represents a central concern of urban experience in relation to crime (Nasar, Fisher, & Grannis, 1993; Nasar, et al., 1983). For example, ironically, research has found that many of the same features found to be positive predictors of preference in natural settings are also positive predictors of fear of crime in urban setting (Fisher & Nasar, 1992). Although studies reveal the positive influence of natural features such as trees, vegetation, and water, research indicates that people may feel fear towards a natural environment, especially in an urban nature setting (Nasar, Fisher, & Grannis, 1993). Nasar and Jones (1997) found college women walked a campus route after dark and reported their feelings that environmental features affording concealment such as shrubs and bushes were a major contributor to fear. Ulrich (1983) asserted that natural settings where one can experience threat or risk contribute to dislike and often create fear.

Preference. Preference was often adopted as a measurement (Herzog, 1985, 1989, 1992; Herzog, Kaplan, & Kaplan, 1976, 1982; Herzog & Smith, 1988; Kaplan & Kaplan, 1989; Nasar, 1983, 1990; Yang and Brown, 1992). For instance, Misgav (2000)

investigated the degree of visual preference of selected native and planted forests and other vegetation groups by selected groups of users. In another study, Green (1999) gathered preference ratings for positive town characters by natural landscape features, by certain built features, and by popular social settings.

Likability. A prominent theme in the field of environmental aesthetic research is the development of likability. What kind of physical features do people remember as likable. Nasar (1998) classified five environmental attributes that people associate to their likability of the city which are naturalness, upkeep/civilities, openness, historical significance, and order. This concept stresses connotative meanings affect their behavior, influencing decisions about whether to go somewhere and how to get there (Nasar, 1998, p. 7). Likability may influence the choice of neighborhood, place to shop, places for recreation, and travel route. Various reviews of this research show how feelings and meanings play an important role in people's perception of and reaction to the environment. For instance, Nasar (1990) found that respondents judged parts as liked and other parts as disliked places in two American cities, Knoxville and Chattanooga, Tennessee. He found that likeable places in the cities have two components, visual aspects of city form (imageability) and human evaluative response (affect).

Models of Aesthetic Responses

The main concerns of these models involve the subjective meaning of the environment to individuals (i.e. aesthetic response). The theories and models relating to

the analysis of subjective meanings can be classified into four categories: collative-arousal, ecological, schema, and symbolic property models. The first two models consider formal aesthetics. Formal aesthetics is defined as human aesthetic experience in relation to the formal or structural parts of the work "for their own sake". It is concerned with the effects of the structural aspects or patterns of built and natural environments on people's feeling rather than for any instrumental purpose they serve or associational meaning they provide (Lang, 1987: 187; Nasar, 1994). Lang (1987) considers shapes, proportions, rhythms, scale, degree of complexity, color, illuminations, and shadowing as the structural aspects of environments. In the contrary, symbolic aesthetics consider the associative meanings of places and components of places, and the influences of those meanings on emotional responses. It is defined as pleasurable connotative meanings associated with the content of the formal organization. These meanings relate to individual's "recognition or formal categorization" of types, a group of objects characterized by the same formal structure (Groat & Despres, 1991). Schema models examine the effects of information, such as knowledge and experience, concerned with places on affective evaluation of places. The next section will describe the models in more detail.

Collative-Arousal Models. Collative-arousal models focus on the effect of patterns or structure of appearance of places on emotional responses to them. Berlyn (1971) proposed this model which explains the relationship between perceptual/cognitive judgments and emotional/affective appraisal. He argued that aesthetic experience relates to the degree of arousal that environmental patterns initiate.

He proposed three arousal-increasing devices: 1) psychological variables; 2) ecological variables; and 3) collative variables. The psychological variables include physical features such as intensity and color. The ecological variables represent properties involving association, whether inherent or learned, with conditions having advantages for survival and well-being; and collative variables involve response to the degree and nature of similarity and difference stimuli (Berlyne, 1971).

Of the three types of arousal-increasing devices Berlyne and his followers (Berlyne, 1971; Wohlwill, 1976; Oostendorp & Berlyne, 1978a, 1978b, 1978c; Nasar, 1994) have focused on collative variables as most relevant to human aesthetic response. These variables include *incongruity, novelty, surprisingness,* and *complexity.* Incongruity is a simultaneous combination of elements that are unlikely to occur (Berlyne, 1971). Novelty involves a discrepancy between the range of stimuli experienced previously by an individual and the particular characteristic of the current encounter (Wohlwill, 1976). A conflict between some expectation and what one actually encounters represents surprisingness. Complexity involves "uncertainty." A pattern becomes more complex as the number of independently perceived elements increases. A stimulus has more uncertainty as it conveys more information and accordingly more complexity (Wohlwill, 1976). In theory all of those collative variables relate to the uncertainty contained within stimuli or the conflict produced by it. Stimuli that contain uncertainty or produce conflict elicit exploratory responses (Wohlwill, 1976).

Berlyne (1971) presumed that the collative properties influence individuals' aesthetic judgments or hedonic tone (pleasure or beauty). He argued that aesthetic

judgments or hedonic tone relates to arousal. According to him, arousal relates monotonously to the degree of collative properties of stimuli and the relationships between hedonic tone and the degree of collative properties of stimuli have an inverted-U shape (Figure 5). Accordingly, individuals prefer environments, which elicit some intermediate level of arousal best, because after reaching a certain level of arousal they start to get overload. They should prefer environments having moderate complexity, incongruity, novelty, and surprisingness.

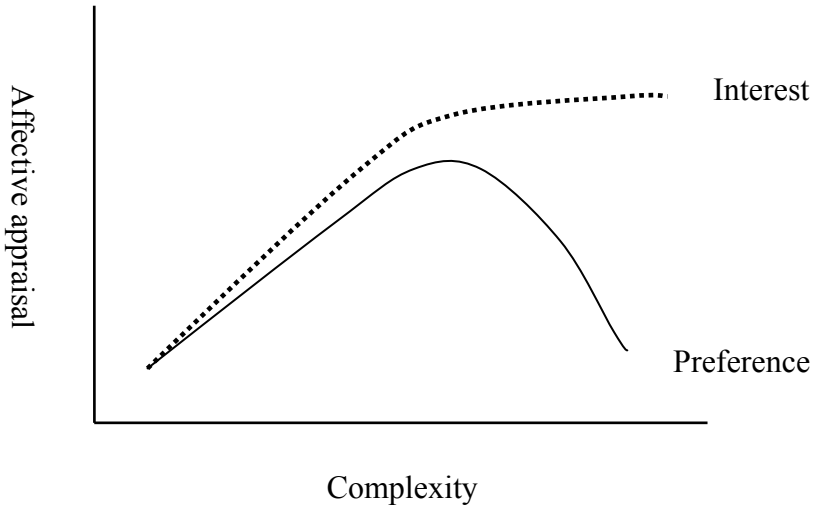

Figure 5. The Effect of Complexity on Interest and Preference (Nasar, 1998)

This theory has been tested by many researchers (Wohlwill, 1976; Oostendorp & Berlyne, 1978a; Nasar, 1988b). However, the empirical evidence does not always support Berlyne's argument. Although the research shows the importance of collative variables in environmental aesthetics, the relationship between these variables and hedonic tone do not always conform to Berlyne's idea. For example, Nasar (1988b)

showed in the study of preference for signscape in a commercial street that people preferred the moderately complex signscape but also preferred the most coherent signscape rather than a moderately coherent signscape.

Wohlwill (1976) proposed one possible explanation that the most complex natural scenes because did not achieve a high enough level of complexity. He adopted some of Berlyne's ideas to make it more suitable for environmental studies. Wohlwill (1976) differentiated the variable "complexity" of Berlyne into two aspects: diversity and structural or organizational complexity, and he added ambiguity and fitness to Berlyne's variable set. To emphasize the number of types of elements in a scene, Wohlwill substituted the term diversity for Berlyne's complexity. He defined structural or organization complexity if these elements to give structure or organization to the complexity. It is noted that the two variables have different functions and should be treated separately in research. For example, Oku (1990) found that both diversity (the number of types of elements) and structural complexity (degree of characteristics of fractal structure) of geometric elements of urban skylines accounted for visual complexity but they are independent properties. This result supported Wohlwill's differentiation of complexity.

Ecological Models. There are two distinctive ecological view points on environmental aesthetics: objective analysis and subject meaning. With respect to objective analysis, the models of ecological perspective assume that the value of the environment is a part of its stimulus property, separate or apart from the individual, and it can be perceived without cognitive evaluation (Zube, Sell & Taylor, 1982). The main

concern of these models is the identification of subjective aesthetic qualities or elements of the environment that can be stated objectively for use in decision making (Zube, Sell, & Taylor, 1982). In an affordance model of perception, Gibson (1979) gave an explanation for the mechanisms in an ecological perspective. Gibson considered senses as a perceptual system and proposed that the human perceptual system has been adapted through evolution. The surface properties of environment determine the pattern of light reflected from, and certain patterns of reflected light afford visual perception. For example, some kinds of patterns promise the benefit for living; others for sitting and eating.

With respect to subjective meaning, the ecological models suggest that the pattern of humans' affective responses to visual features of environments has been influenced through evolution. Accordingly, humans would have preference for such environments that would provide some advantages to survival. The subjective meaning of ecological models differs from Gibson's (1979) ecological theory. Gibson views the environment as external to the individual and only considers human's perceptual system. On the other hand, the ecological models of subjective meaning consider cognitive evaluation. Various ecological models have been proposed including "Appleton's prospect-refuge model" (Appleton, 1975), "Kaplan's environmental preference model" (Kaplan & Kaplan, 1982), and "Ulrich's adaptive behavior model" (Ulrich, 1983).

Appleton (1975) proposed the prospect-refuge theory. It is defined as the ability to see without being seen and is thought to be conducive to the exploitation of environmental conditions favorable to biological survival. He argued that humans

acquire and store information from the environment in a way that it can be efficiently and quickly retrieved when needed to ensure survival. Humans have *innate* preferences for places where informational opportunities allow them to improve their chances of prospect (an open view) and refuge (protection from outside potential dangers without being seen). Appleton's theory uses an experiential and strategic approach that is sensitive to perceptions of personal safety (Luymes & Tamminga, 1995) to explain human environmental preferences (Appleton, 1975, 1984). Prospect-refuge theory postulates that, because the ability to see without being seen is an intermediate step in the satisfaction of many of those needs, the capacity of an environment to ensure the achievement of this becomes a more immediate source of aesthetic satisfaction (Appleton, 1988). A landscape which affords both a good opportunity to see and a good opportunity to hide is aesthetically more satisfying than one which affords neither, but again weakness in prospect or in refuge may be compensated for by strength in the other (Appleton, 1988).

A growing body of literature is concerned with safety issues in urban parks. Mozingo (1989) has documented distinct differences in the ways men and women perceive and use urban open space. Studies found that women tend to avoid less used and perceived them as unsafe, especially at night and even during the daytime. Men are predominant user of urban parks (Luymes, 1992; Mozingo, 1989). The city of Toronto conducted an empirically derived safety assessment of urban parks that indicated the spatial design of park, levels of use, communication, lighting and surveillance contributed to the feelings of safety (Egan, 1991). Chapin (1991) pointed to primitive

human needs for openness, peace, comfort, freedom and refuge indicating the strong connection of this research to the basic premise of prospect and refuge theory. A recurring theme in the literature on safety is that increased levels of use contribute to enhanced perceptions of safety in parks and urban greenways.

Kaplan and Kaplan (1989) also proposed an ecological theory about human environmental preference. Like Appleton, this model points out the evolutionary perspective. They consider preference as an outcome of a complex process that includes perceiving things and spaces and reacting to them in terms of their potential usefulness and supportiveness (Kaplan, 1988a, 1988b). The Kaplans argue that two types of information needs in the environment (making sense of and involvement in) play a significant role in preference for the environment.

	Understanding	Exploration
2-D	Coherence	Complexity
3-D	Legibility	Mystery

Figure 6. Environmental Preference Matrix (Kaplan, Kaplan & Ryan, 1998)

The preference matrix (Kaplan, Kaplan & Ryan, 1998) is divided into two domains representing two critical facets of people's relationship to information (Figure 6). The first domain involves two major categories of human needs: understanding and

exploration. The need to understand, to make sense of what is going on, is far reaching in its expression. Even reasonable, kindly people can become hostile and angry when they cannot comprehend material that seems to be necessary to functioning. The second category of human need is the need to explore, to find out more about what is going on in one's surroundings. Exploration is an important element in accumulating experience.

The second domain of the preference matrix involves the degree of inference that is required in extracting the needed information. It may be easiest to think of this factor in terms of the two-dimensional and three-dimensional aspects of the visual environment. The two-dimensional aspects involve information that is immediately available. It is perhaps easiest to think of this in terms of a photograph of any given landscape. The three-dimensional pattern of the actual or depicted space requires greater inference. For example, a setting with partially obscured elements, or with features that mark the distance available to the viewer, provides information that requires more interpretation.

The combination of these two domains yields four distinct combinations, or patterns including complexity, mystery, coherence, and legibility. *Complexity* is defined in terms of the number of different visual elements in a scene; how intricate the scene is; and the scene's richness. Complexity, which is the object of considerable study in built environment contexts, may not be powerful in explaining preference for the natural environment (Day, 1967). *Coherence* helps in providing a sense of order and in directing attention. A coherent scene is orderly; it hangs together. Coherence is enhanced by anything that helps organize the patterns of brightness, size, and texture in

the scene into a few major units (Kaplan, 1988a; Kaplan, Kaplan, & Ryan, 1998). As is true with complexity, coherence involves relatively little inference, relying on t he two-dimensional aspect of the setting.

The most important issue in considering *legibility* is distinctiveness. To increase legibility, a scene has to have some memorable components that help with orientation. A legible space is one that is easy to understand and to remember. It is a well-structured space with distinctive elements, so that it is easy both to find one's way within the scene and to find one's way back to the starting point (Herzog, 1984, 1985, 1989). Legibility entails a promise, or prediction, of the capacity both to comprehend and to function effectively. *Mystery* also involves promise, but it is the promise that one could learn more. For example, mystery to be present, there must be a promise of further information if one could walk deeper into the scene. This implies that it would be possible to enter the scene, that there would be somewhere to go. It is important to contrast mystery with surprise. The most preferred scenes in many studies are those that would be categorized as mysterious.

The preference matrix evolved from extensive examination of the scenes that are most and least liked across numerous studies. Through the studies, complexity is not powerful in explaining preference for the natural environment. The most preferred scenes in many studies are mystery. A lack of coherence makes it difficult to understand what is before one; a lack of complexity diminishes one's likelihood of becoming engaged in viewing. With more legibility, confidence is enhanced that the setting will continue to be understandable. More mystery entices one to further exploration (Kaplan,

Kaplan & Ryan, 1998). In theory, humans prefer environments which make sense and afford an involvement either immediately or in the future. Empirical research support their ideas (Herzog, Kaplan, & Kaplan, 1976, 1982; Herzog, 1985, 1989, 1992; Kaplan & Kaplan, 1989).

Ulrich (1983) is also developed an ecological based theory to explain environmental preference. In his theory of aesthetic and affective response to the environment, Ulrich (1983) implies that both individual and correlated aspects of affect and cognition exist. He discusses how separate areas within the brain process feeling (the limbic system) and cognition (in the neocortex) (Ulrich, 1983). Thus the physical aspects influence affective response and not information processing. Such response can entail "approach" or "avoidance". Ulrich theorizes that "biophilia" responses that entail exploring the natural environment that brains developed within account for approach behavior-exploratory behaviors motivated by preference and interest.

In turn, he relates humans' current day preferred features with similar aspects that were useful or necessary for prehistoric survival (e.g. shade, water, the savanna provided, and food). In contrast, negative appraisals based on emotions such as fear or anxiety underlies avoidance behavior. Elements that usually stimulate such appraisals account for many factors (e.g. complexity, surface texture, and water).

According to Ulrich (1983) "individuals are biologically prepared to respond with a greater liking to settings having moderate to high complexity, structural properties establishing a focal point and other order of patterning moderate to high depth, homogeneous ground surface texture conducive to movement, a deflected vista, the

presence of a water feature, and the absence of threat. In theory, these features should elicit quick liking with very little cognition and motivate adaptive approach behavior."

In sum, models of ecological perspectives seem to consider similar attributes of environments as salient in environmental responses and they all emphasize the importance of avoiding danger and obtaining information (Hanyu, 1995). Gibson's affordance model provides theoretical background for ecological models. It may be possible to consider some features of ecological models as affordance features. In Appleton's prospect-refuge theory, prospect affords information while refuge affords safety. The Kaplan's mystery and legibility can be considered as kinds of affordance features. Mystery promises information and legibility affords wayfinding and orientation. Wilson and Ulrich's biophilia and biophobia can be also affordance features. Since certain natural stimuli and configurations afford positive or negative information, people approach (biophilia) or avoid them (biophobia). Appleton's ideas focus more on safety while the Kaplans' and Ulrich's ideas attach approximately equal weight to keeping safe and obtaining new information. Although Appleton's model focus more on safety issues, his position with respect to how he explains the relationship is close to Kaplans' view.

Although these models assume that avoiding danger and obtaining information are dominant factors for human to act in environments, these models differ from each other with respect to the mechanisms that they use to explain the obtaining information phenomenon. The Kaplans put the emphasis on information processing for

understanding the relationship between affective responses and environmental aspects whereas Ulrich suggests that affective responses do not require any cognitive process.

The Kaplan's model highlights the importance of the information processing itself as well as the contents of information. They do not see the connections between certain contents and corresponding responses as only innately determined. They suggest that the relationship between affective responses and environmental content is established innately and is learned. On the other hand, Ulrich asserted affective responses occur much more rapidly than the cognitive process does when people see certain information. Ulrich suggests that the relationship between affective responses and environmental features is established purely innately. He sees this process as unconscious function which is never learned.

Schema Models. Another approach that links environmental experience to affective responses to the environment is based around schema models. Some researchers (Whitfield, 1983; Purcell, 1986; Purcell & Nasar, 1992) have adopted this concept to environmental aesthetics and proposed models for the relationship between schema and preference. The concept of "schema" was developed in cognitive science field which is defined as any cognitive structure that specifies the general properties of a category of objects or event and leaves out any specification of details that are irrelevant to the category (Stillings, Feinstein, Garfield, Rissland, Weisler, & Baker-Wark, 1989).

Research suggested humans have a full set of schema for every category of object (schema, prototype), event (script), concept (frame), and environment. Mandler (1984) suggested that people prefer an object best when it differs moderately from the

schema because it creates interest. On the other hand, Whitfield (1983) and Purcell (1986) suggested that real world object is fudged primarily by stimulus prototipicality. Prototypicality is established as a result of the stored representation of prior experience with similar environmental situations based upon a schema, and the aesthetic evaluation depends on the relationship between incoming information from the environment and its prototypicality. Whitfield (1983) pointed out that the more the object has prototipicality, the more people prefer it. The schema discrepancy model by Purcell (1986) suggests that the prototypicality of objects or structures determines the aesthetic evaluation. Both Whitfield and Purcell pay more attention to aesthetic response while Mandler stressed more on interest. Kaplan (1988b) asserted that both aesthetic response and interest can evoke preference.

What elicits affective response is the mismatch or discrepancy between the incoming information and the attributes of the prototype. Different types and degrees of affective response are systematically related to varying degrees of discrepancy from the basic schema organization. For example, if what you see fits the existing knowledge it is associated with familiarity. In existing knowledge structures of humans, small differences enhance liking and preference while larger differences produce interest which is accompanied by experiences. Preference decreases when differences become larger, but interest from the cognitive activity remains. The affective experience becomes strongly negative with very large differences. These models stand on the hypothesis that responses are established after a learning process rather than through any innate ecological pre-dispositions.

In general, although individual differences might exist in the way a person reacts to or experiences a certain environment or features in the environment, research indicates that common cultural, physical, and physiological characteristics produce overlaps in people's evaluative responses and the kinds of environments or features in the environment affecting those responses (Nasar, 1997). Although people might have unique individual experiences with the environment, research shows that common cultural, physical, and psychological characteristics produce common responses to certain kinds of environments or features of the environment. In addition, research has also confirmed that groups of individuals with similar cultural, educational, physiological, or socio-cultural experiences have similar responses to the environment. For example, studies found that design professionals and lay people evaluate environments and environmental attributes differently (Nasar, 1997; Rapoport, 1970; Stamps, 1991; Stamps & Nasar, 1997). Since people notice and draw meanings from their environment and respond accordingly (Nasar, 1997), these findings support the importance of environmental aesthetic research to planning and design.

Symbolic Models. Some researchers divided the environmental aesthetic studies into two types: formal and symbolic aesthetics (Lang, 1987; Nasar, 1994). Places can present two meanings to people who experience them: denotative and connotative meanings (Nasar, 1997). According to Lang (1987), formal aesthetics focus on the visual properties of environment (denotative meaning). Denotative meanings refer to a place's characteristics. In other words, the subject matter of formal aesthetics deals with denotative meanings of environment such as shapes, proportions, rhythms, scales, and

degree of complexity. Thus, the various types of models including collative-arousal and ecological models can be classified into formal aesthetic models.

On the other hand, symbolic aesthetics is defined as pleasurable connotative meanings associated with the content of the formal organization (Groat & Despres, 1991). Connotative meanings refer to the evaluation of the place. Experiences, values, lifestyles, cultures, and subcultures of individuals may influence affective responses. Through experience people may learn meaning associate with environments. Aesthetic responses to symbolic properties involve the interaction of denotative and connotative meanings. The recognition of denotative meaning of a place by the individual and the inference to connotative meaning elicit aesthetic response to the symbolic (Nasar, 1997). Research suggested that symbolic properties in places affect emotional/affective responses (Bruriswik, 1956; Moore, 1979, 1989; Lang, 1987; Nasar, 1994, 1997; Rapoport, 1982; Ulrich, 1983).

Symbolic properties may include naturalness, types of landuse, presence of certain elements in places, safety, and style. Several studies have issued symbolic variables related natural and built environment (Herzog, Kaplan, & Kaplan, 1976, 1982; Herzog & Smith, 1988; Horayangkura, 1978; Kaplan & Kaplan, 1989; Nasar, 1988a; Oostendorp & Berlyne, 1978a, 1978b, 1978c; Ulrich, 1983; Wohlwill, 1976). They involve inferences about the place. For example, Russell and Snodgrass (1989), and Nasar (1994) provided a list of those variables including the naturalness of places, the presence of certain natural features, environmental nuisances, intensity of use, and stylistic components.

For *naturalness* of places, Kaplan, Kaplan, and Wendt (1972) found constant higher preference for natural scenes over urban scenes despite the high complexity level in a study of preference and complexity for natural and urban visual material. Herzog (1985) found that most people preferred mountain waterscapes and large bodies of waters to swampy areas. In a crosscultural comparison study of visual preference for urban scenery between Japan and the United States, Nasar (1988a) found a relationship between naturalness and environmental preference of the subjects of both cultures. Naturalness of place also affects behavior. Research found vegetation along a road affects route choice (Kaplan & Kaplan, 1989).

A group of studies also found that the type of *land use* affects affective/emotional responses of street scenes and neighborhoods (Herzog, Kaplan, & Kaplan, 1976, 1982; Nasar, 1983). Some of these studies examined preference in association with another variables like complexity across various content categories (Herzog et al., 1976, 1982; Kaplan & Kaplan, 1989; Wohlwill, 1976) and found variation in preference due to the content associated with complexity rather than complexity itself. For example, Herzog, Kaplan, and Kaplan (1982) found that most people prefer older buildings and unusual buildings to alleys/factories and contemporary buildings.

Research has also found that *presence of certain elements* in places affect affective/emotional responses. Many studies have indicated that the presence of two natural features in the environment influences affective responses. Specifically, these features are trees and water (Zube, Pitt, & Anderson, 1974; Kaplan, 1995). Zube, Pitt, and Anderson (1974) found that water is a dominant visual attribute that always

increased scenic quality. Kaplan (l995) found that the sight of trees improved residents' satisfaction with their neighborhood. On the other hand, research found that man-made nuisance objects such as wires, polls, and cars can evoke negative response (Kaplan & Kaplan, 1989; Nasar, 1997).

Studies have revealed that specific physical incivilities, such as litter, graffiti, and vandalism are linked to *fear* of crime (Nasar, Fisher, & Grannis, 1993; Nasar, et al., 1983). Like distress, fear consists of negative evaluation and high arousal. Lastly, Nasar (1994) examined the relevant studies of evaluative and connotative responses to style and found differences in response as a function of *style*. His research indicates that several studies of house styles found the desirability of vernacular over modern styles; moreover, these studies showed that most people preferred Farm style and Tudor style houses over other styles. With regard to stylistic meaning, Nasar (1994) provided convincing evidence that people infer connotative meanings from stylistic contents.

Brunswik (1956*)* introduced the concept of probabilistic functionalism to explain the relationships between aesthetic judgments on symbolic variables and emotional reactions. He combined two forms of research on environmental perception and environmental assessment in his Lens Model. The Lens Model offers a conceptual framework to examine the relation between physical features and inferences about socio-environmental conditions instead of retrieving the cognitive sets as influences upon the subjective experience of environmental scenes. This approach assumes that individuals interpret environmental attributes as cues to other conditions through inferential processes, and, thus, such environmental cues are associated with environmental

attributes or conditions in a probabilistic manner. For example, in a residential neighborhood, the conditions of cars on the street can represent the economic level of that neighborhood leading individuals to preference. This probabilistic relation between environmental attributes as cues and socio-environmental conditions provides a basis for identifying the "ecological validity" of cues for each condition because the occurrence of certain events in certain conditions has a natural order.

Empirical research has supported the probabilistic functionalism in environmental studies (Cherulnik, 1991; Craik & Appleyard, 1980). For example, in a comprehensive study of inference Craik and Appleyard (1980) examined expert judgments of residential streets in San Francisco regarding three important socio-environmental conditions: traffic volume, average income, and the residents' degree of concern about crime in their neighborhood. The most affective condition appeared to be the last condition. The ecologically valid cues for residents' concern about crime included manifestations of the concern and number of grilles on windows and doors, signs of instances of asocial behavior, hints of an excessively public and difficult to defend residential setting, poor maintenance of public and private areas, and, lastly, lack of attributes indicative of relative affluence (Craik & Appleyard, 1980). Another study of environmental inference has been conducted by Cherulnik (1991). This study is based on the assessment of cognitive schema that underlies and encompasses aesthetic judgments for a particular category of places: restaurant facades in central Pennsylvania. The study shows that there are four conditions within the restaurants that allow the

subjects to differentiate restaurants from their facades: quality of food and service, cost, ambiance, and characteristics of fellow diners.

Interactional/Cotextual/Transactional Models. Interactional, contextual, and transactional models explain environmental cognition taking into consideration both internal organismic factors and external environmental factors and assume that individuals adopt to the environment in response to these factors (Moore, 1988). Interactional research describes dimensions of separate entities such as cultural background, social class, demographic factors experience in certain types of environments, personal predispositions, expectation, and goals as well as visual factors, examines their relationships, and attempts to reveal the cause-affect relationships between variables (Altman & Rogoff, 1987). Interactional views emphasize the person and environment separately. On the other hand, the transactional approach considers the person and environment as defined mutually in terms of each other

Figure 7 shows an example of interactional model that aesthetic response has probabilistic relationships to physical environments. This model, an extension of Brunswik's lens model, offers a conceptual framework to examine relationships between physical elements and perceptions. The arrows in the figure illustrate probabilities in relation to responses. Boxes represent lenses altering what is seen influencing the probabilities.

Although research in environmental preference often takes a stimulus response form that suggests a certain kind of determinism, the preference conforms to an interactional perspective (Moore, 1989). The evaluative response arises from the person,

the environment, and the interaction between the two (Nasar, 1998). Cognitive responses represent important mediating variables in human evaluative response. Humans may have various evaluative responses to any environment. Given a set of circumstances, an evaluative response has a probabilistic relationship to environmental perception and cognition. The interactional models suggest that the probabilisties result from the ongoing interaction between individual and the environment.

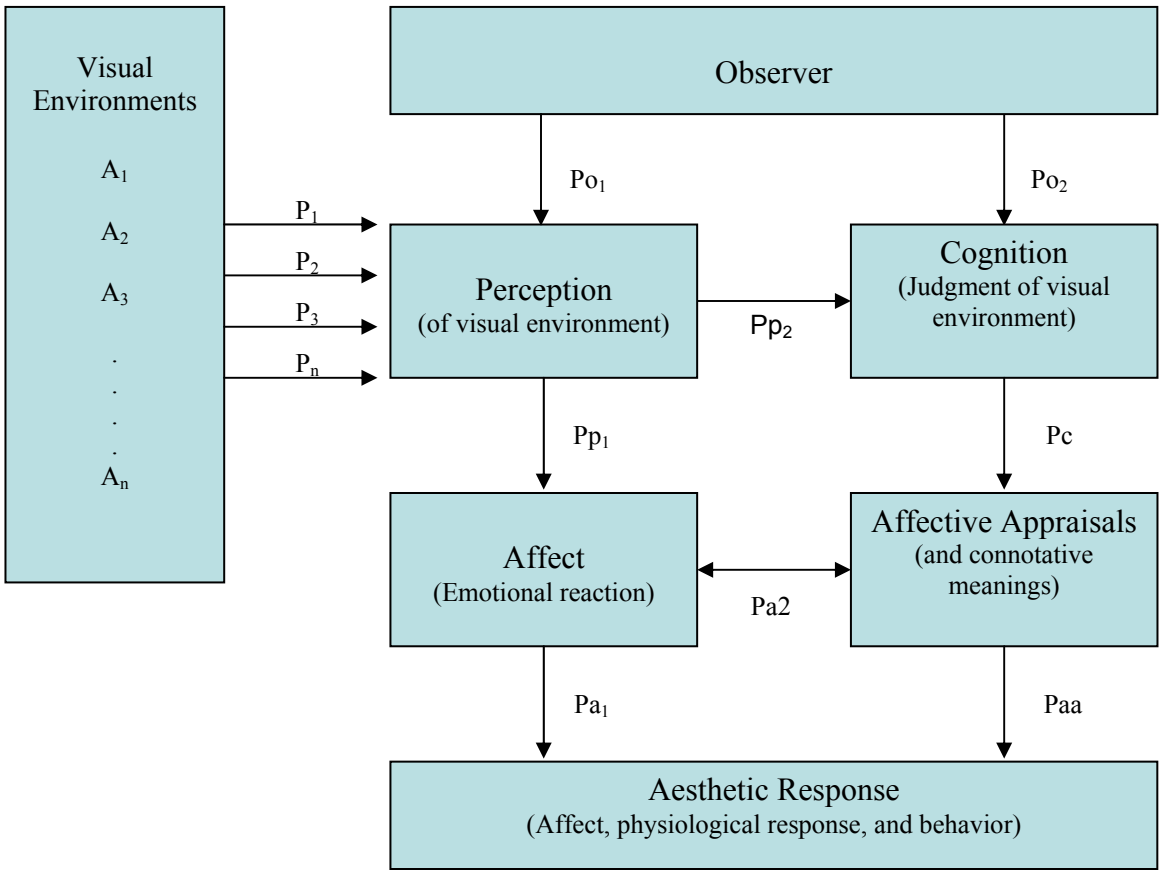

Figure 7. A Model of Aesthetic Response to the Environment (Nasar, 1997)

Likability

Nasar (1998) examined the visual quality of the American cities by considering the shared public image of the city and its parts. He focused on the evaluative image or likability of the cityscape. As discussed earlier Lynch (1960) classified the contents of city images into five elements such as paths, edges, districts, nodes, and landmarks which are referable to physical forms of the city. He suggested those five elements are related to the attributes of identity and structure in the mental image which is called imageability: "that quality in a physical object which gives it a high probability of evoking a strong image in any given observer." As with cognitive maps (deJongg, 1962; Gulick, 1963), researchers found that three affective elements to the imageability including distinctiveness of form, visibility, and use/symbolic significance (Appleyard, 1976a; Evans, Smith, & Pezdek, 1982). A highly imageable city would seem well formed, distinct, and remarkable. An imageable city helps residents and visitors to better spatially orient themselves, to navigate through the city and to find their way (Al-Kodmany, 2001), thus enhancing our enjoyment of a city (Lynch, 1960, p.10). Lynch (1960) suggested that people should have a reliable knowledge about the things present in their environment, and he assumed that people will more likely know, and so use, an environment that is easy to read, or is legible. He suggested that the environmental image has three parts: identity, structure, and meaning. He described those three components of environmental image in his book, *The image of the city* as

> An environmental image may be analyzed into three components: identity, structure, and meaning. It is useful to abstract these for analysis, if it is remembered that in reality they always appear together. A

> workable image requires first the identification of an object, which implies its distinction from other things, its recognition as a separable entity. This is called identity, not in the sense of equality with something else, but with the meaning of individuality or oneness. Second, the image must have some meaning for the observer, whether practical or emotional. Meaning is also a relation, but is quite different from spatial or pattern relation. Thus an image useful for making an exit requires the recognition of a door as a distinct entity, of its spatial relation to the observer, and its meaning as a hole for getting out (p. 8).

We identify objects, we recognize patterns and we draw emotional value in relation to them. Object recognition which depends on distinction or a noticeable difference, represents identity. Recognizing the pattern of relationships organizing the objects illustrated structure. Meaning has three levels: lower, middle, and higher level (Rapoport, 1990). A lower level coincides with object recognition, denotative meaning. A middle level meaning represents the emotional values associated with the object, connotative meaning. A higher level meaning refers less to the object than to broader values, abstract meaning. Rapoport noted that, for example, when people recognize an area as a commercial strip, they experience a denotative meaning (lower level meaning) which also include other everyday manifest meanings identifying intended uses of settings. When people make inferences such as guessing the likely quality of goods or the friendliness of the merchants in a commercial strip, or evaluative judgments such as how much you like the appearance of the area, people experience connotative meaning. When you look at the place through "cosmologies, cultural schemata, worldviews, philosophical systems and the sacred," you experience abstract meanings (Rapoport, 1990, p. 221).

In *The Evaluative Image of the City*, Nasar (1998) extended Lynch's work. However, he argued that knowledge about imageability is not enough. Although Lynch recognized the importance of meaning and evaluation, his research emphasizes identity and structure. The cognitive mapping studies have also overlooked the importance of the emotional and affective quality of these physical elements. Imageability is not sufficient for shaping city appearance in conjunction with a likable environment. Because people have feelings and associations, both positive and negative, about their surroundings and the imageable elements, these feelings and meanings are also crucial to people's perception of and reaction to the environment (Nasar, 1988a).

Nasar, therefore, focused on meanings which represent inferences about the quality and character of the place and its users. He stressed that the connotative meaning is relevant to shaping urban form and its importance to human behavior. Where people have the capacity to act, connotative meanings affect their behavior, influencing decisions about whether to go somewhere and how to get there (Nasar, 1998, p. 7).

Research has found that the most imageable buildings in a city elicit the strongest evaluations both positive and negative (Appleyard, 1976a). If most people like the imageable elements, the city will probably convey a positive evaluative image. If they dislike them, the city will convey a negative evaluative image. This brings an attention to the cities for changes their appearance (Al-Kodmany, 2001). The underlying concept of city image is what Nasar calls the *likability* of the cityscape.

A study revealed that respondents judged parts as liked and other parts as disliked places in two American cities, Knoxville and Chattanooga, Tennessee (Nasar,

1990). He found that likeable places in the cities have two component: city form (imageability) and human evaluative response (affect). As imageability helps people orient and find their way around within a city (Lynch, 1960), evaluative response may affect people's movement in a city. People would be well oriented, and they could move easily. Evaluative response may influence the choice of neighborhood, place to shop, places for recreation, and travel routes. Given a real choice, people would rather go to attractive places and avoid unattractive ones. Good appearance should also relate to the delight people take in a place, how well they remember it, and whether they come back to it for the qualities it embodies (Nasar, 1990).

The environmental attributes of naturalness, upkeep/civilities, openness, historical significance, and order were classified as those people associate with likability of the city. Because of shared biology, sociocultural factors, and environment, humans will show some agreement in their evaluative response (Nasar, 1998, p. 30). He describes that

> Many factors other than the evaluative image make for a successful city. By stressing the evaluative image……. however, the evaluative image or likability have a fundamental value……..Research showed widespread agreement on preferred environmental features, and it confirms the centrality of environmental evaluation and appearance to humans. Appearance and meaning are not separate from function but central to it. The disagreeable appearance of our cities goes beyond an absence of emotional satisfaction and abstract notions of good aesthetic form. In their incompatibility with human activity, appearance and meaning may heighten sensory overload, fear, and stress. Disorder in the form of physical incivilities such as dilapidation, graffiti and abandoned building can evoke a sense of anxiety and fear suggesting a threat to survival……and may affect rates of crime. With careful attention to improving the evaluative image, we can resolve these problems and enhancing well-being (p. 3-4).

The study suggested that respondents liked such areas in each city for certain features including vegetation, landscaping, openness, views, design, and historical buildings. Disliked areas were selected because of such features as pole, wires, poor upkeep, and lack of coherent styles (Nasar, 1998). It is noted that each city could enhance its likability by increasing the visibility of vegetation, landscaping, mountains, rivers, and historical elements and by decreasing the visibility of outdoor advertising, poles, parking lots and dilapidation. A city's high visibility (imageability) which seems well formed, distinct, and remarkable could increase visitors' attention and participation (Lynch, 1960, p.10). Community appearance affects our experience of the city, evoking emotions and inferences that influence spatial behavior, and that it also remains a paramount concern to the public. Although subculture aggregates may differ from one another, visual preferences are highly stable (Nasar, 1990).

Studies of the evaluative image and meanings can provide valid, reliable, and useful information for the planning, design, and management of desirable environment. As landscape architect Ervin Zube (1980) notes,

> Modification in the environment will occur sometimes under the aegis of federal, state or local policies. Evaluation studies provide a means for assessing the efficacy of those policies as evidenced by the success or failure of the development that result based on empirical data rather than on guesses and intuition. (p. 1)

By studying what kind of evaluative image residents have of their community, planners, researchers and community leaders can derive valuable information about how to improve the physical form of their communities (Al-Kodmany, 2001).

Summary

In summary, the two types of research on environmental aesthetics including the perceptual/cognitive research and the affective/emotional research, and the models of the relationship between the two are reviewed. The perceptual/cognitive research reveals that the presence and the location of physical elements such as paths, edges, nodes, districts, and landmarks, affect our mental representations of the environment. The affective/emotional research reveals four fundamental affective/emotional responses including arousal, excitement, pleasantness, and relaxation. Several studies employed independently defined measures and examined the affects of those measures on certain affective/emotional responses, such as likability (Al-Kodmany, 2001; Nasar, 1990, 1998), preference (Herzog, 1985, 1989, 1992; Herzog, Kaplan, & Kaplan, 1976, 1982; Herzog & Smith, 1988; Kaplan & Kaplan, 1989; Nasar, 1983, 1990; Yang and Brown, 1992), safety or fear (Kaplan & Kaplan, 1989; Nasar et al., 1983; Nasar, Fisher, & Grannis, 1993; Ulrich, 1983), and relaxation (Kaplan, 1995; Kaplan & Kaplan, 1989; Ulrich, 1983; Ulrich et al., 1991).

Also some studies developed models which focused on the relationship between the visual attributes and emotional responses. Two types of models suggested that each concerns different factors: external factors and internal factors. External factors determine human responses to the environment which include physical, social, and cultural factors. Internal factors may include biological and generic factors. These models argue that humans prefer openness, enclosure, legibility, and familiarity in the

environment. Both models focus on the formal aesthetics of environment in explaining the relationship between the environment and human response.

Models concerning the symbolic or associative meanings of the environment reveal such symbolic variables such as naturalness, environmental nuisance, intended land use, and stylistic features as determining human responses to the environment. Schema models deal with the ongoing experience of humans with the environment and their knowledge about the environment. Prototypicality is the main determining factor of human response in this type of models. Lastly, interactionalists have argued that aesthetic response arise from the person, the environment, and the interaction between them. This perspective focused on both external and internal factors.

Greenway Trail Characteristics

Tread and Trail Facilities

While corridor length and linkages have often been considered as top selection criteria in greenway development efforts, other factors are also critical to accomplish a successful network of greenways (Gobster, 1995). Studies of trail preference and perceptions have consistently found that scenic beauty including nature, trees, and water bodies were the attributes that respondents liked most about landscape elements of the trails (Allton & Lieber, 1983, Gobster, 1988, 1990, 1995, Schroeder & Anderson, 1984). In addition, it has been revealed that a smooth trail surface was ranked high in relation to the trail itself (Gobster, 1995). The other issues of Gobster (1995) findings are maintenance, safety, being away from car and traffic, quiet, and close to home. Gobster

also demonstrated that a rough trail surface was the most frequently mentioned dislike on the trail, followed by street crossings, shortage of trail, narrow tread, lack of drinking water and restrooms and poor signage. The study showed that the trail surface preference varied by user types and activities. Trail width can relate to safety problems. Allton and Lieber (1984) found that the most highly ranked attributes were trail surface, physiographic, length of trail, scenic view, and distance from home.

Several studies have confirmed that landscape elements can influence people's affective response. For example, the presence of water in the landscape is a powerful means to establish a sense of place, and a high degree of landscape preference (Green, 1999; Herzog, 1985). Research in landscape preference has been seeking to understand relationships between human values and different types of landscape (Daniel & Vining, 1983; Hartig & Evans, 1993; Herzog, 1985; Kaplan, 1995).

Background Buildings and Built Structures on Trail

In the scope of environmental aesthetic research, there has been very little evidence related to how the urban skyline might influence aesthetic quality. Studies have focused on street level, small cities and cities with few or no tall buildings (Heath, Smith, & Lim, 2000a, b). However, tall buildings have a significant impact on shaping urban infrastructure and effect the aesthetic quality of a city appearance. The form of the urban skyline has a major effect on the appearance of the city. In addition, postcards for tourists and television shots often contain the urban skylines as an extremely

important component of the city image and tall buildings as the most striking components of the urban skylines.

Most studies regarding perceived complexity and tall building and urban skylines have been conducted in a limited context, that of the tall buildings at a distance. For example, Lim and Heath (1993) and Smith, Heath and Lim (1995) investigated the effect of silhouette and façade complexity of tall buildings on preference for urban skylines. They found that increasing the quantifiable complexity of the silhouette and façade of buildings should increase the perception of complexity and preference. Stamps (1991) also revealed the influence of height, complexity, and style on preference for individual buildings that complexity is a predictor of preference for tall buildings. It also confirmed Berlyne's (1960, 1971) work on the aesthetic effects of complexity. Others have found that higher levels of silhouette complexity influenced the most on preference, arousal, and pleasure (Heath, Smith, & Lim, 2000a). On the other hand, the prominence of nuisance elements represents the intensity of visual nuisance elements such as wire, polls, boarded up buildings and litter in a scene.

Aesthetic Response to Urban Greenway Trail Corridors

Two basic questions initiated this study: "How do the visual aspects of physical environments affect people's aesthetic responses in a greenway?" and "What environmental variables are associated with greenway likability?" This study is intended to examine theories and empirical findings of environmental aesthetic research in a specific type of tourism and recreation setting. This study will provide empirical

information useful understanding how greenway trail corridors in urban areas are perceived in order to develop designs that would improve the physical qualities of these trails. Theses places are emerging as potential tourist attractions in cities and are well recognized for their recreation opportunities in general.

Several research questions and hypotheses will guide this research. Research questions are developed to help 1) understand what the aesthetic dimensions of a greenway trail corridor are and why they may differ from other environments; 2) understand how the aesthetic dimensions of greenway trail corridors may predict a likability in a greenway environment; 3) understand if and how specific characteristics in a greenway trail corridor relate its likability; and 4) examine if and how a greenway trail corridor can be changed to alter the experience.

Figure 8 illustrates conceptual model of the study and Figures 9 shows likability of virtual visitors in a greenway trail corridors.

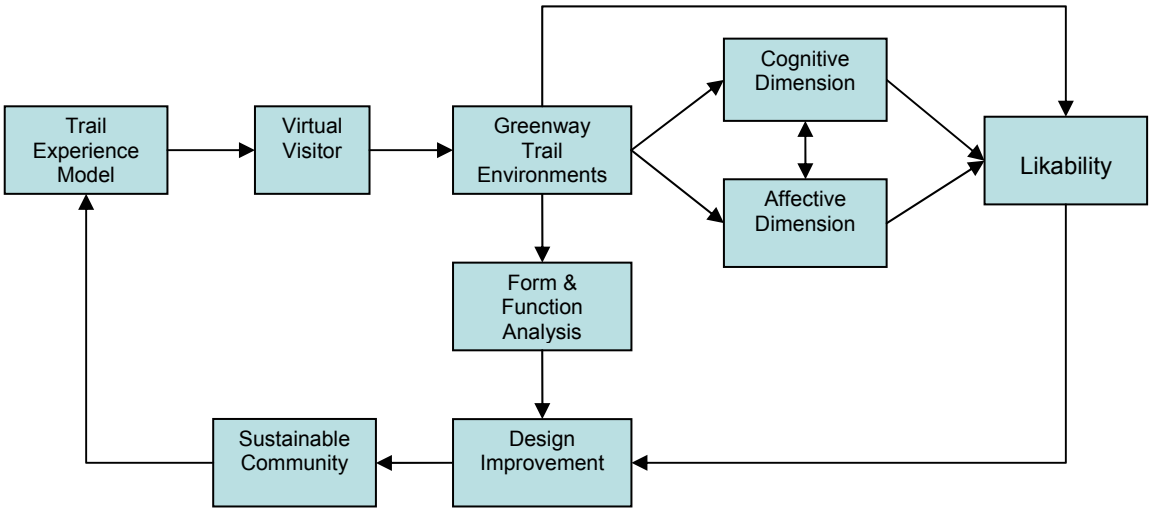

Figure 8. Conceptual Model of the Study

Hypotheses

H1: There will be a significant positive relationship between cognitive evaluations and affective response, and the likability of greenway trails during a web-based virtual tour.

H2: There will be significant relationships between specific greenway trail characteristics and the likability of greenway trails during a web-based virtual tour.

H3: There will be significant differences between respondents' perceptions of manipulated and non-manipulated greenway trail characteristics.

H4: There will be significant differences between respondents' perceptions of trail characteristics depending on the direction from which they view the trail.

H5: There will be significant differences in the level of invitingness perceived in different greenway trail scenes depending on specific trail characteristics manipulated.

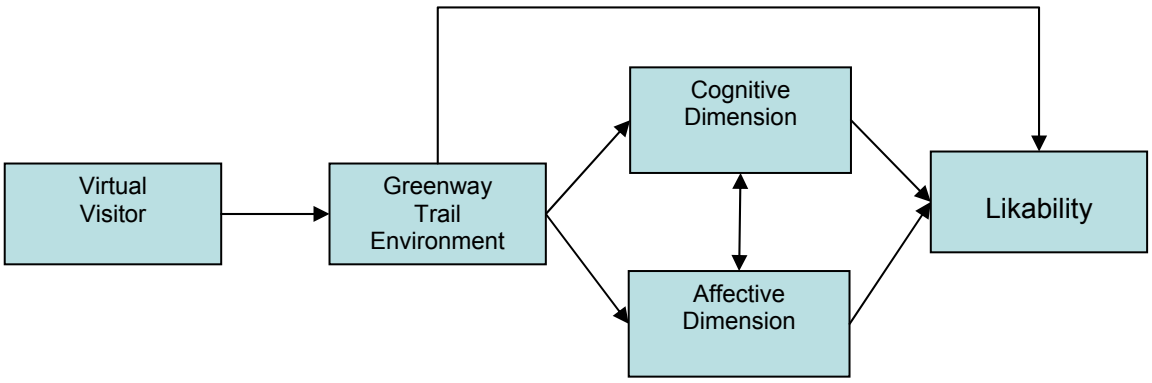

Figure 9. Likability of a Greenway Trail Corridor by Virtual Visitors

CHAPER III

RESEARCH DESIGN AND METHODOLOGY

This chapter describes the research methods used to investigate the research questions proposed in the previous chapter. The chapter is organized into four sections. The major constructs used in the study are presented in the first section. The second section presents study locations. In the third section, the pilot study and validity of treatment are discussed. Section four outlines survey procedures and analysis.

Questionnaire Development and Validity of Measurement

A questionnaire was developed through the review of literature. The questionnaire for a pilot test consisted of measurement of six concepts. Items that intended to measure various concepts including aesthetic dimensions (cognitive evaluation, affective response), greenway trail characteristics, appropriate types of use, evaluation of a virtual tour, and an assessment of the instrument were selected based on a literature review. This section describes the manner in which these concepts were operationalized in the study. Discussion follows on the validity and reliability of the scales used.

Aesthetic Response Dimensions

Cognitive Evaluation

The cognitive evaluation variables used in this study were selected from the existing theories and empirical findings on: naturalness, openness, upkeep/maintenance, distinctiveness, mystery, legibility, complexity, coherence. Items were selected for this study based on past research that measured perceptual/cognitive constructs. (e.g. Appleton, 1975; Fisher & Nasar, 1992; Herzog, 1982, 1984, 1989, 1992; Kaplan & Kaplan, 1982; Kasmar, 1988; Ulrich, 1993). A set of adjective pair scales was employed to measure these components (Appendix A). After respondents rated their cognitive evaluation on eight view points along the trail, validity and reliability checks were made for the trail experience as a whole. In other words, each rating for the cognitive evaluation in each view point was cumulated and submitted for the validity and reliability checks.

Participants were asked to rate each item on all the cognitive and affective items each of which had five response categories ranging from one extreme to the other, with the middle category representing neutral. For example, respondents were given a list of five-point adjective pair scales and asked to "Mark one space for each pair to indicate how you feel it describes the scene." For example,

maintained: ---:---:---:---:---: neglected

good for wildlife: ---:---:---:---:---: bad for wildlife

were both items used to measure the cognitive dimension.

Responses were converted into numbers from left to right, 1,2,3,4, and 5. The presentation of the adjective pairs and the orientation of each scale (i.e. right to left) were randomly ordered to prevent response sets. These measures were used to evaluate each view point along the virtual trail. The reliability and validity of the scales were tested in a pilot study as described below.

Initially, Measure of Sampling Adequacy (MSA) value was analyzed in order to ensure all the items were appropriate for factor analysis (Stevens, 1996). To assess the construct validity of the cognitive evaluation scale, a principal components factor analysis with Varimax rotation was performed to identify underlying constructs (Gall, Gall, & Borg, 1999). A Varimax rotation with Kaiser Normalization was the extraction method recommended by Stevens (1996). According to statistical criteria, an eigenvalue of 1.0 was employed for factor extraction and factor loadings of .50 were used for item inclusion (Carmine and Zeller, 1979; Stevens, 1996).

Sixteen items (exposed-protected, tidy-messy, clean-dirty, drafty-stuffy, inviting-repelling, understandable-confusing, ordinary-distinct, plain-ornate, typical-unusual, soft-hard, common-unique, natural-artificial, good for wildlife-bad for wildlife, rural-urban, wrinkled-pressed, casual-formal) were chosen from related literature to measure cognitive evaluation of the trail and four item scales including ordered-chaotic, mysterious-obvious, complex-simple, and maintenance-neglected were included to test the composition of landscape based on landscape preference concepts developed by the Kaplans (Kaplan et al., 1998).

The factor analysis resulted in four factors. The initial analysis showed that an item pair (drafty-stuffy) was measuring more than one underlying construct and two pairs (soft-hard, and exposed-protected) had factor loadings less than .50, thus they were dropped. Two items (order-chaotic, understandable-confusing) which were intended to represent "coherence" and "legibility" respectively, from the landscape preference concept developed by the Kaplans were included into Factor I. Kaplan et al. (1998) revealed that coherence (order) and legibility (upkeep) provide information that help with making sense (understanding) of the environment. A well-maintained and distinctive environment is easier to understand (Kaplan, Kaplan, & Ryan, 1998). Factor I was reported with eigen-value of 5.42 and Cronbach's alpha of .88.

Mystery and complexity in the context of being involved in the environment suggest the potential "exploration", either because of the number of different noticeable features or the distinctiveness between those features (Kaplan, 1998). Two items (obvious-mysterious, simple-complex) which represent "mystery" and "complexity" respectively, are included in Factor II. Cronbach's alpha was .80 and the eigen-value was 4.12. The three scale items loading on Factor III (good for wildlife-bad for wildlife, rural-urban, and natural-artificial) had an eigen-value of 1.49 and Cronbach's alpha of .73.

After removing the three items (drafty-stuffy, soft-hard, and exposed-protected) that were found to be inappropriate for measuring the cognitive evaluation of urban greenway trails, seventeen items remained in four factors and accounted for 64.92% of the total variance. Since the fourth factor had only one item, two items (wrinkled-

pressed, disarray-harmony) were added for the main study through discussion with committee members.

Affective Response

Eight items (calm-stressful, friendly-hostile, pleasing-annoying, pleasant-unpleasant, relaxed-tense, safe-dangerous, active-passive, exciting-boring) were selected to assess affective response from work on emotions by Russell and his colleagues (e.g. Russell & Snodgrass, 1989, Russell, 1989) and empirical studies regarding fear and safety related to landscape perception (Nasar, 1997a, Nasar & Fisher, 1993; Nasar & Jones, 1997; Hanyu, 1995, 1997, 2000).

As performed for the cognitive evaluation variables, validity and reliability checks were made for affective response using the same criteria. To assess the construct validity of the affective response scale, a principal components factor analysis with Varimax rotation was performed to identify underlying constructs of the eight items. To measure affective response of the trail six items were chosen from related literature and two item scales including safe-dangerous, friendly-hostile were included to test emotions on safety which is often cited as a central concern during urban experiences in regard to crime.

Six items were represented one underlying dimension Factor I. The eigenvalue was 4.76; percent of variance was 59.42%; the Chronbach's alpha coefficient was .88. The results also showed that two items (active-passive, exciting-boring) representing Factor II had a somewhat low alpha score of .57. while the .57 is lower than preferred,

Carmine and Zeller (1979) have suggested that as low as .50 may be acceptable when as few as 2 items are involved.

Greenway Trail Characteristics

Greenway trail characteristics included those related to trail width, trail surface, amount of vegetation, presence of water, trail facilities, background buildings, built structure on trail, and auto traffic. Items for the study were developed from the literature (Allton & Lieber, 1983; Gobster, 1995; Schroeder & Anderson, 1984). Analysis and results of greenway trail characteristics are explained in detail in chapter IV. Each of these characteristics was evaluated in each scene respondents viewed. Each was also added to or subtracted from select scenes to test for its influence on perception.

Likability

Items that asked participants to provide feelings about each part of the trail for the level of invitingness and certain activities were asked for each view point along the trail. The level of invitingness was considered surrogate for likability in the study. Because likability of greenway trails in the study refers to feelings of potential trail use resulting from the aesthetic response to greenway trail characteristics, perceived level of invitingness could represent potential trail use during a web-based virtual tour. At the end of the virtual tour, questions for overall experience of the trail, for example, like to visit the trail and potential enjoyment related to the trail were asked.

Study Sites

Geographical Locations

The study sites were two major multiple objective urban greenway trails in Texas cities. The Town Lake Trail (hereafter TLT) in Austin and the Buffalo Bayou Trail (hereafter BBT) in Houston were chosen for the study as both are located in the center of an urban area. Hiking and biking were the most popular activities on both trails. The trails are mostly flat and have excellent accessibility to and views of downtown.

The BBT extends from downtown Houston west to Shepherd (Figure 9). This trail runs along both sides of the bayou. At all seasons, but especially during migration, the trees, shrubs and weedy edges along the bayou attract songbirds. Even though this trail is often noisy because it runs adjacent to roadways, the scenery has many natural qualities. There is an art show that is displayed along the trail and poems are painted on the tread.

The TLT stretches from Longhorn Dam at Riverside to Lake Austin Boulevard (Figure 10). It passes by Zilker Park and the Mopac Bridge. The hike and bike trail is a loop of 10.1 miles around Town Lake much of which is easily accessible from downtown Austin. The trail offers several bridge crossings to make shorter loops of 2.5, 4.5 and 6.5 miles.

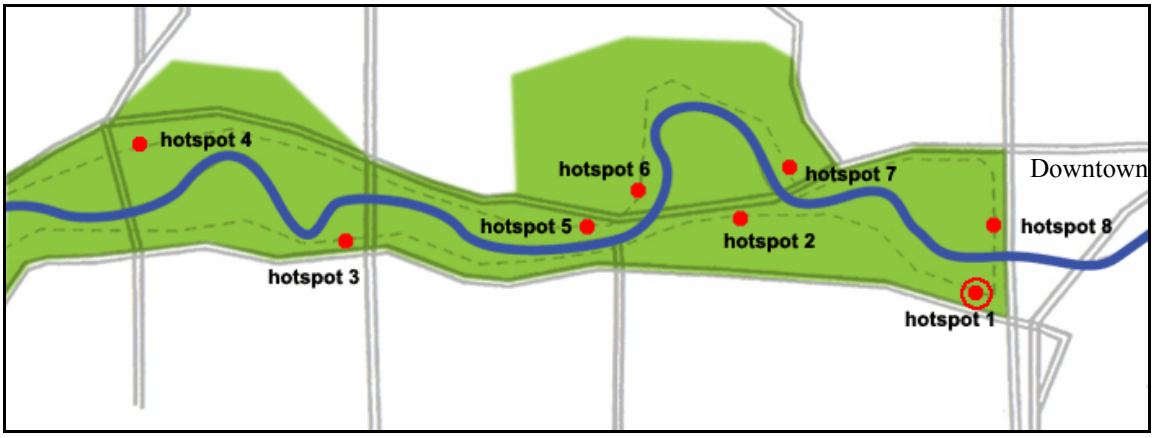

Figure 10. Map of Buffalo Bayou Trail

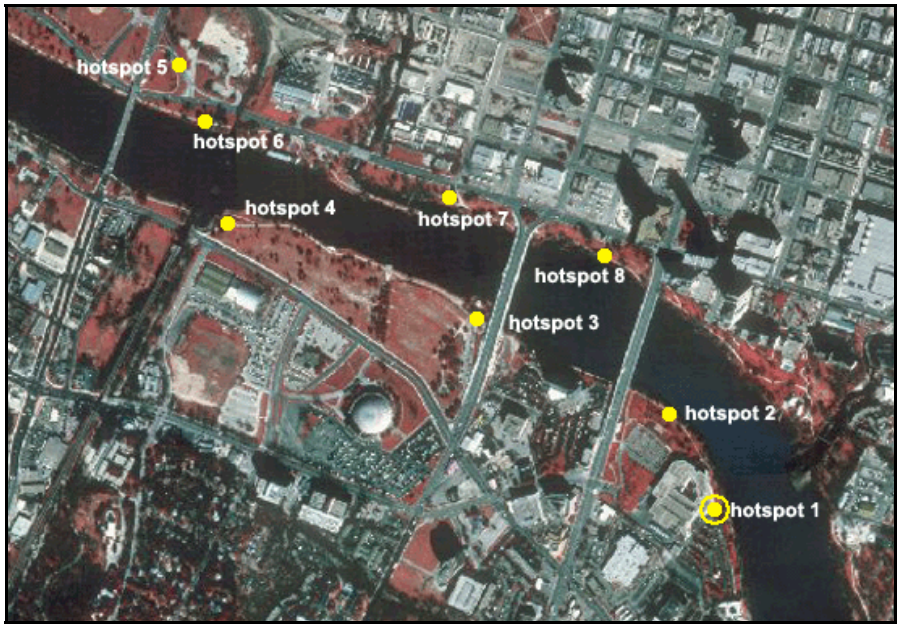

Figure 11. Map of Town Lake Trail

Virtual Environment

This study measured responses to visual environmental variables along urban greenway trails. Rather than bringing subjects to the greenway trail, this study examined human responses through a web-based virtual tour of the trails.

A scientific paradigm, according to Kuhn (1962), is characterized by a high degree of professional consensus regarding terminology, theory, methodology, and research priorities. Craik (1977) described research on environment and behavior as an array of multiple scientific paradigms, each organized around a set of exemplary achievements and an agreed upon agenda of topics for future research. Within the environmental assessment research paradigm, for example, substantial progress has been made in developing sophisticated techniques for modeling urban and natural environments (e.g. Appleyard, 1977; Bosselmann, 1993; Orland, 2001). Further, there is widespread agreement among researchers in this field regarding the potential of environmental simulation as a community decision-making and public participation tool (Al-Kodmany, 1999, 2000; Bosselmann, 1993; Kaplan, 1993) and the importance of evaluating the validity of simulations as a basis for predicting people's response to the environment (Smardon et al., 1986; Weinstein, 1976; Zube & Simcox, 1993).

Research has consistently found that responses to this form of simulation generalize well to the on-site experience (Muhar, 2001; Shappard, 2001; Shuttleworth, 1980; Stamps, 1994). In the meantime, assessing perceived environmental quality has become a major concern for planners, designers and managers. Researchers and designers have obtained research findings related to assessing visual quality of the

environment and evaluating visual impact of environmental change using on-site surveys, and more commonly, a representation of the site such as color slides or photographs to the stakeholder groups or to experimental subjects (Bishop, 2001; Orland, 1993).

Researchers have used color slides as simulations of natural and built environments (Bell, 2001; Hagerhall, 2000; Heath et al. 2000a). Meta-analysis of this research shows a strong relationship between preference ratings using slides and ratings of actual natural environments (Stamps, 1990). Besides using images for preference ratings, other researchers have shown that viewing nature pictures has other physiological effects (e.g., relaxation), which are similar to the experience of natural environments (Ulrich et al., 1991). Although color slides and photographs can play an important role as a representation of the environment for evaluation, the uses are limited to the presentation of the existing environment. Because those static representations only allow current conditions of the environment to be displayed, these images cannot represent future images if the environment has not changed yet.

To overcome these shortcomings, computer-based environmental simulations are suggested as an appropriate method by many landscape researchers (Orland, 1993). Advances in computer and video graphics are of major interest to landscape researchers. Some of the major developments of recent years have involved augmentation of site video with computer graphics (Nakamae et al., 2001), visualization of spatial information on the World Wide Web (Honjo & Lim, 2001; Morrison & Purves, 2002) and human response to virtual environment (Appleton et al., 2002; Belingard & Peruch,

2000; Bishop et al. 2001; Germs et al., 1999; Golob & Regan, 2001; Jansen-Osmann & Berendt, 2002; Levi & Kocher, 1999; Orland et al., 2001).

Another advantage of the virtual experience of this study was to discover how potential visitors evaluated the appearance (Al-Kodmany, 2001) of an urban greenway trail by asking respondents to evaluate particular elements. The survey instructions emphasized the issue of greenway appearance and encouraged respondents to think of which features they found to be pleasant and which features they found to be blighted and unattractive.

Environmental Stimuli

Creating a Virtual Environment

Each trail used in this study included three broad attribute types: natural features (hereafter NF), human-made features (hereafter HF), and visual connection to background infrastructure (hereafter VC). Several points were considered for each characteristic type along a trail to select view points that would capture specific characteristics to represent these broad attributes. View points were decided through discussion with committee members and landscape architects.

View points chosen to represents NF were views dominated by natural features such as vegetation and water. HF was represented by places where human-made trail support features in close proximity to the trail were in the view. Human-made features included, for example, benches, light poles, water fountains, and restrooms. VC included background buildings (urban skylines) and adjacent auto traffic such as roads

and vehicles, and built structures close to trail such as roadway intersections. The two or three representative scenes (view points) from each category were selected through reviewer judgments to select representative scenes that included each type of characteristic.

Panoramic photographs were taken using a digital camera (Sony DCP-50), a Manfrotto QTVR panoramic head, and a tripod at each selected view point along the primary travel direction on both trails. To represent a single view point, six photographs were taken at the resolution of 1600*1200 pixels and stitched to create a 180 degree panoramic view using VR Worx 2.0 version software. Image processing was conducted using Adobe Photoshop 7.0. Another set of panoramic photographs were taken in the opposite direction of the primary travel route at the same spot on both trails.

Construction of Treatments

A treatment in the primary travel direction (Table 1) was created for each trail. Treatment in NF1 was amount of vegetation. With this treatment, subjects would have experienced a different amount of vegetation in the scene compared to the control scene. Treatment in NF 2 was presence of water.

Treatment in HF1 and HF2 provided a manipulated trail tread such as trail width (e.g. narrow vs. wide) or trail surface (e.g. soft vs. hard) in the scene. Treatment in HF 3 was presence of trail related facilities. This scene was manipulated with trail facilities along trail such as benches, light poles, and water fountains. VC also has treatments for each viewpoint. VC 1 had background buildings i.e. urban skylines as a treatment. A

manipulated silhouette of an urban skyline was provided in this scene. Since a number of high-rise buildings are located around both trails, the treatment was elimination of the buildings. Adjacent auto traffic such as roads and/or vehicles in the scene was the treatment for VC 2 (Figure 12). Lastly, since both trails have several built structures on the trail, such as bridges or utility structures, these were eliminated to create treatment for VC 3 (Figure 13).

Finally, treatments were administered. Group 1 and 2 each experienced their respective trails along the primary travel route in the present condition. Group 3 and 4 viewed their respective trail in the same direction but experienced conditions along their trails as described above. Treatment for Group 5 (Figure 14) and 6 (Figure 15) was to have their respective trails in the opposite direction from Group 1 and 2 with no modification (Table 2).

TABLE 1
Treatments for Each Trail

	BBT	Category	TLT	Category
View point 1	Background buildings	VC1	Trail surface	HF2
View point 2	Presence of water	NF2	Presence of water	NF2
View point 3	Trail facilities	HF3	Background buildings	VC1
View point 4	Trail width	HF1	Trail facilities	HF
View point 5	Auto traffic	VC2	Auto traffic	VC2
View point 6	Built structure on trail	VC3	Amount of vegetation	NF1
View point 7	Amount of vegetation	NF1	Built structure on trail	VC3
View point 8	Trail surface	HF2	Trail width	HF1

TABLE 2
Travel Routes and Trails for Each Group

	Town Lake Trail	Buffalo Bayou Trail
Primary travel direction	↑ Group 1	↑ Group 2
Treatment of primary travel direction	⇑ Group 3	⇑ Group 4
Alternative travel direction	↓ Group 5	↓ Group 6

↑ *represents the primary travel route*
⇑ *represents the travel with treatment*
↓*represents the alternative travel in the same trail*

a. existing condition of adjacent auto traffic

b. manipulated condition of adjacent auto traffic

Figure 12 An Example of Viewpoint #*5* on the Town Lake Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition of built structure on trail

b. manipulated condition of built structure on trail

Figure 13. An Example of Viewpoint #*6* on the Buffalo Bayou Greenway Trail with Existing (a) and Manipulated (b) Views

a. primary travel direction

b. reverse travel direction

Figure 14. An Example of Viewpoint #*3* on the Buffalo Bayou Greenway Trail with Primary Travel Direction (a) and Reversed Travel Direction (b) Views

a. primary travel direction

b. reverse travel direction

Figure 15. An Example of Viewpoint #7 on the Town Lake Greenway Trail with Primary Travel Direction (a) and Reversed Travel Direction (b) Views

Sample Selection

The two hundred ten subjects who participated in the study were selected from students at Texas A&M University. Most students were involved in undergraduate level courses in the department of Health & Kinesiology; Recreation, Park & Tourism Sciences; Renewable Resource Management; and some graduate students in those departments. The subjects chosen were not expected to be representative of any specific population. Research has suggested that a representative sample is not mandatory in experimental studies (Henshel, 1980; Martin and Sell, 1979). A relatively homogeneous group is often preferred in experiments so that any differences found can be attributed to the various treatments, rather than to differences in the subjects (Havitz, 1987).

Quasi-experimental Design

Trail Experience Treatments

A portion of this study used treatments in a quasi-experimental way to help determine how trails may be perceived when certain independent variables are manipulated. Experimental research allows researchers to better identify variables causing the effects/response they observe for a given treatment. Researchers seek to measure the effect of a predictor (independent variable) on a criterion (dependent variable). Experimental research has two characteristics. First, the researcher actively manipulates the predictor variable to see its impact on the criterion variable. Second, the researcher randomly assigns subjects to experimental treatments.

Quasi-experimental research does not manipulate the aspects of the situation or randomly assign subjects to various conditions. This method assesses the relationship between "naturally occurring" situational variations. It describes the degree of the relationship between two or more quantitative variables.

Researchers can do experimental research in the laboratory or in natural settings. Natural settings make it more difficult to manipulate variables with the necessary controls. Though this may reduce the internal validity of the research, field research can increase realism and generalizability. In a laboratory the degree of control required may create an artificial situation, which can make the findings less generalizable.

However, many researchers may find field experiements difficult for a variety of reasons. The appropriate settings may not be available; the size of the project may make

it uneconomical; and sufficient control may not be attainable (Bell et al., 1990). Some researchers respond to these difficulties by using "simulation" methods, in which components of a real environment are introduced into an artificial setting (Craik & McKechnie, 1978; Herzog & Smith, 1998; Wohlwill, 1976).

Data Collection Procedure

All the following processes were conducted separately for the six groups. The experiment was conducted at a designated place using designated computers to control external factors influencing the level of virtual experience. The 210 subjects who participated in the main study were randomly assigned to one of six experimental groups. Subjects were scheduled to take part in the experiment in groups of between twenty and forty people. These groups were deliberately kept in a designated computer lab with high quality computers (Pentium 4 processor) and color monitors (17 inches) under the supervision of the investigator in order to maximize the opportunity for each subject to get a clear and close-up view of the Internet-based virtual tour, and to minimize talking and other distractions which are difficult to control when each individual is involved in different places and different time frames.

Each group was asked to come to a designated room and was seated in front of the display monitor with appropriate lighting to let them take a web-based virtual tour. The study was introduced to participants and they were told they were about to enter an urban greenway trail.

Table 3 illustrates phases of the survey. The first section of questionnaire asked participants about their pre-trail experience. The second section including cognitive evaluation, affective response, trail characteristics, and potential activity questions were measured by several items for each part. The third section of the questionnaire was overall questions about the likability and potential activity one might engage in on each segment of the trail. The last two sections asked several questions to evaluate effectiveness of virtual tour and to assess the instrument for the study. Lastly, brief demographic information was obtained.

TABLE 3
Phases of Survey Process

Phase	Type of questions	Items	About what
I	Pre-experience	On-site trail experience	Individual
II	Virtual trail	Cognitive evaluation Affective response Greenway trail characteristics Potential trail use & activity	Each view point along the trail
		Overall experience	Virtual Trail experience
III	Virtual experience	Evaluation of virtual tour	Virtual tour
IV	Assessment	Assessment of the instrument	Virtual tour
V	Demographic Information	Demographic information	Individual

CHAPTER IV

SAMPLE CHARACTERISTICS, AND IDENTIFYING AND MEASURING DIMENSIONS OF AESTHETIC RESPONSES

The intent of this chapter is to review the results from the primary study. This chapter presents two major sections. The first section presents descriptive statistics regarding subjects and their past trail experience. The second section discusses dimensions of likability in an urban greenway trail environment. This section also reports and discusses results of the exploratory factor analyses and validity and reliability issues related to the measurement used in the study.

Sample Characteristics

Characteristics of Respondents

The two hundred and eleven students that made up the sample were mostly selected from students in undergraduate level courses in the department of Health & Kinesiology; Recreation, Park & Tourism Sciences; Renewable Resource Management; and some graduate students in those departments. The subjects were generally homogeneous with respect to age. The majority of the subjects were enrolled as either a junior or senior and the mean age was just over 22. However, in order to test whether there were any differences among groups, ANOVA was used. ANOVA is used when the relationships among one or more categorical independent variables and one

continuous dependent variable are in question. Although subjects consisted of college students which are usually a fairly homogeneous group, a significant difference ($p<.000$) was found in age among groups (Table 4). Post-hoc tests revealed that a group who viewed Town Lake Trail with existing condition (TLTF) was significantly different from other groups because this group was older. A significant difference was also found in photo skills ($p<.05$) among groups even though over 70 percent of them rated their photo skills as above average. Post-hoc tests revealed that BBTF, BBTB, BBTM, and TLTB were significantly different ($p<.05$) from each other. This question was asked to know if there is relationship between photo skills and evaluation of the virtual tour and assessment of the web-based survey instrument.

TABLE 4
Results of One-Way ANOVA Seeking Differences in Subjects' Age and Photo Skills among Groups

	Category	BBTF[1] (n=37)	BBTB[1] (n=38)	BBTM[1] n=36)	TLTF[1] (n=31)	TLTB[1] (n=36)	TLTM[1] (n=33)	F-value	p-value
Age	Mean (S.D.)	21.05[a] (2.84)	21.13[a] (2.08)	21.78[a] (1.91)	25.13[b] (6.73)	21.39[a] (1.55)	22.24[a] (3.47)	6.512	.000
Photo skills	Mean[1] (S.D.)	2.97[b] (.687)	3.45[b] (.795)	3.39[b] (.871)	3.10[a] (978)	2.89[b] (.820)	3.27[a] (.876)	2.688	.022

[1]BBTF represents a group who experienced a forward direction of Buffalo Bayou Trail
BBTB represents a group who experienced a backward direction of Buffalo Bayou Trail
BBTM represents a group who experienced a forward direction of Buffalo Bayou Trail with modified greenway trail characteristics
TLTF represents a group who experienced a forward direction of Town Lake Trail
TLTB represents a group who experienced a backward direction of Town Lake Trail
TLTM represents a group who experienced a forward direction of Town Lake Trail with modified greenway trail characteristics
[2]Mean scores based on scale of 1-6 with 1 equal poor and 6 equal excellent
[a] no group differences
[b] outlier groups

As shown in Table 5, one hundred and one respondents were male and one hundred ten were female. Only four of the 211 subjects (1.9 percent) were color blind. A Chi-square test was performed that revealed there is no significant difference ($p>.05$) in gender or color blindness among the groups of respondents.

TABLE 5
Results of Chi-Square for Differences in Subjects' Gender and Color Blindness among Groups

Variables	Category	BBTF (n=37)	BBTB (n=38)	BBTM (n=36)	TLTF (n=31)	TLTB (n=36)	TLTM (n=33)	Pearson $\chi 2$
Gender n (%)	Male	17 (45.9)	17 (44.7)	18 (50.0)	16 (51.6)	14 (38.9)	19 (57.6)	2.85
	Female	20 (54.1)	21 (55.3)	18 (50.0)	15 (48.4)	22 (61.1)	14 (42.4)	
Color blind n (%)	Positive	0 (0.0)	2 (5.3)	2 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	7.557
	Negative	37 (100)	36 (94.7)	34 (94.4)	31 (100)	36 (100)	33 (100)	

Past Trail Experience of the Subjects

Five items measured respondents' past experience regarding trail activities. Table 6 indicates that walking was the most frequent activity among trail activities. Over forty six percent of respondents participated in walking on a trail daily. Running was the second most popular trail activity which 31.3% of respondents participated in on a weekly basis. Post-hoc tests showed TLTF significantly differed from others on both walking and running experiences.

TABLE 6
Results of One-way ANOVA Seeking Differences in Past Trail Activity Experience by Each Group

	Total Mean[1] (n=211)	BBTF Mean[1] (n=37)	BBTB Mean[1] (n=38)	BBTM Mean[1] (n=36)	TLTF Mean[1] (n=31)	TLTB Mean[1] (n=36)	TLTM Mean[1] (n=33)	F-value	p-value
Walking	4.63	4.92	4.58	4.83	4.10	4.69	4.58	1.00	.417
Running	4.04	4.38	4.18	3.97	3.16	4.03	4.42	2.74	.020
Bicycling	2.96	3.16	2.79	2.78	2.97	2.72	3.39	1.09	.370
In-line skating	1.55	1.54	1.53	1.56	1.32	1.92	1.36	1.40	.225
Motorcycling	1.90	1.43	2.03	2.44	1.71	1.83	1.91	2.59	.027

[1]Mean scores based on scale of 1-6 with 1 equal never and 6 equal daily

Results showed that over 30 percent of respondents participated in bicycling on a trail more than once in a month. Another 30 percent reported that they took a bicycle on the trail only few times a year. Activities related to in-line skating and motorcycling were indicated as very low percentage of participation among respondents' past experience on trails.

Identifying Dimensions of Aesthetic Responses in an Urban Trail Environment

Cognitive Evaluation

Descriptive statistics for the cognitive evaluation items are presented in Table 7. Grand mean scores by variable on the five-point semantic differential type scales used in the questionnaires ranged from a low of 2.53 to a high of 3.91. Standard deviation

scores on each variable ranged from a low of 1.03 to a high of 1.37, with the majority being clustered around 1.20. Items associated with maintenance and naturalness were recoded to help with interpretation of the analysis. The higher mean scores represent one extreme of the adjective pair of cognitive process of the trail; the lower mean scores, on the other hand, explain the other extreme of the adjective pair of cognitive process.

These items were measure using 5 point scales that represent the lower score tended to mean the left side word on the semantic differential scales while the higher score meant to be the right side word of the scale. This result, based on relative agreement, was the same for both trails. While most items presented similar mean values, respondents rated the highest mean score of 3.91 for "neglected-maintained" which means more maintained. The lowest mean score of 2.72 for "urban-rural" item revealed that respondents perceived the trails more urban than rural.

Affective Response

Descriptive statistics for affective response items are presented in Table 8. The items measured for both trails indicated that respondents' affective responses were all moderately positive in the virtual trail environments. Each scale were converted into numbers from 1 to 5 where 1 equals description on the left (e.g. hostile) and 5 equals description on the right (e.g. friendly). Grand mean scores ranged between 3.11 and 3.71 with standard deviation being clustered around 1.14. TLT are evaluated that the trail corridor provided more pleasantness to the respondents than that of BBT. In terms of active scale, both trail were measured they have very similar value on active scale.

TABLE 7
Descriptive Statistics of Cognitive Evaluation Items

	Total (n=211)		BBT(n=111)		TLT(n=100)	
	Mean[1]	S.D	Mean	S.D	Mean	S.D
neglected-maintained	3.91	1.09	3.76	1.18	4.08	.95
dirty-clean	3.86	1.06	3.79	1.11	3.93	1.01
confusing-understandable	3.84	1.03	3.83	1.08	3.85	.98
chaotic-ordered	3.82	1.04	3.76	1.10	3.90	.97
messy-tidy	3.59	1.09	3.51	1.15	3.68	1.03
repelling-inviting	3.58	1.18	3.52	1.19	3.66	1.17
artificial-natural	3.32	1.30	3.57	1.24	3.05	1.32
bad for wildlife-good for wildlife	2.91	1.37	3.10	1.40	2.70	1.31
ordinary-distinct	2.85	1.19	2.74	1.21	2.97	1.16
plain-ornate	2.83	1.16	2.69	1.17	2.98	1.13
urban-rural	2.72	1.33	2.96	1.32	2.46	1.29
simple-complex	2.68	1.19	2.58	1.17	2.80	1.19
typical-unusual	2.66	1.16	2.63	1.20	2.70	1.11
common-unique	2.53	1.11	2.50	1.13	2.57	1.09

[1] each scale has five response categories ranging from one extreme to the other, with the middle category representing neutral that were converted into numbers from left to right, 1,2,3,4, and 5. 1=description on the left, 5= description on the right.

TABLE 8
Descriptive Statistics of Affective Response Items

items	Total (n=211)		BBT[a] (n=111)		TLT[b] (n=100)	
	Mean[1]	S.D	Mean	S.D.	Mean	S.D.
hostile-friendly	3.71	1.09	3.64	1.10	3.79	1.07
tense-relaxed	3.62	1.20	3.59	1.22	3.65	1.17
annoying-pleasing	3.61	1.17	3.57	1.18	3.66	1.15
unpleasant-pleasant	3.60	1.17	3.51	1.18	3.69	1.15
stressful-calm	3.55	1.14	3.47	1.17	3.64	1.10
dangerous-safe	3.41	1.20	3.32	1.24	3.51	1.15
passive-active	3.30	1.09	3.32	1.14	3.27	1.04
boring-exciting	3.11	1.08	3.19	1.11	3.03	1.04

[a] BBT represents Buffalo Bayou Trail
[b] TLT represents Town Lake Trail
[1] each scale has five response categories ranging from one extreme to the other, with the middle category representing neutral that were converted into numbers from left to right, 1,2,3,4, and 5. 1=description on the left, 5= description on the right.

TABLE 9

Descriptive Statistics of Greenway Trail Characteristics

Items	Overall n=211		BBTF[a] n= 37		BBTB[a] n=38		BBTM[a] n=36		TLTF[a] n=31		TLTB[a] n=36		TLTM[a] n=33	
	Mean[1]	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Adjacent auto traffic	3.44	.94	3.23	.88	3.28	1.03	3.46	.98	3.64	.86	3.59	.89	3.44	.91
Background buildings	3.36	1.01	2.91	.81	3.09	.97	3.36	.98	3.70	.94	3.71	.97	3.47	1.10
Built structures on trail	3.20	1.09	2.79	.96	2.81	1.11	3.05	1.07	3.68	.94	3.58	.97	3.39	1.13
Trail surface	3.12	.84	3.27	.81	3.22	1.04	3.14	.99	3.01	.54	2.95	.57	3.08	.89
Trail width	2.61	.96	2.36	.88	2.38	1.02	2.59	1.03	2.73	.85	2.69	.88	2.95	.94
Amount of vegetation	2.59	.96	2.77	.79	2.66	.97	2.70	1.04	2.42	.88	2.42	.94	2.58	1.05
Presence of water	2.06	1.00	1.57	.71	1.72	.86	1.68	.86	2.52	.91	2.43	1.04	2.59	1.02
Trail facilities	1.97	.96	1.51	.71	1.75	.85	2.01	1.02	2.31	.90	2.12	.91	2.23	1.12

[a]BBTF represents a group who experienced a forward direction of Buffalo Bayou Trail
BBTB represents a group who experienced a backward direction of Buffalo Bayou Trail
BBTM represents a group who experienced a forward direction of Buffalo Bayou Trail with modified greenway trail characteristics
TLTF represents a group who experienced a forward direction of Town Lake Trail
TLTB represents a group who experienced a backward direction of Town Lake Trail
TLTM represents a group who experienced a forward direction of Town Lake Trail with modified greenway trail characteristics

[1] each scale has five response categories ranging from one extreme to the other (e.g. too little to too much), with the middle category representing about right that were converted into numbers from left to right, 1,2,3,4, and 5.

Greenway Trail Characteristics

Eight items were designed to measure greenway trail characteristics perceived by the respondents. Descriptive statistics shown in Table 9 revealed that grand mean values for greenway trail characteristics ranged from 1.97 to 3.44. Each scale had five response categories ranging from one extreme to the other (e.g. too little to too much), with the middle category representing about right that were converted into numbers from left to right, 1, 2, 3, 4, and 5. For example, perception about "background buildings" was measured on five point scale: 1 equals too little, 3 equals about right, and 5 equals too much.

Results showed that the respondents perceived much built structures on trail (x=3.20), background buildings (x=3.36), and auto traffic around trails (x=3.44). All groups indicated amount of natural features including vegetation and water on the greenway trail corridors as a little below "about right" or more toward the "too little" end of scale.

Measuring Cognition and Affect toward Urban Trail Environment

Cognitive Evaluation

To assess the construct validity of the cognitive evaluation scale, a principal components factor analysis with Varimax rotation was performed to identify underlying dimensions present in the nineteen items. An eigenvalue of 1.0 was the minimum required for factor extraction and minimum factor loadings of .50 were used for item

inclusion (Carmine and Zeller, 1979; Stevens, 1996). Thirteen of the cognitive evaluation items loaded into three factors and accounted for 69.88% of the total variance. The result showed that four item pairs (open-close, wrinkled-pressed, casual-formal, disarray-harmony) were measuring more than one underlying dimension and/or were too low to be included in the final solution. Inviting-repelling was also dropped because it was redundant to the invitingness measure used elsewhere. Those five items were excluded from further analysis. Cognitive dimensions were interpreted based on the common characteristics of items loading on each factor as shown in Table 10: maintenance (Dimension I), distinctiveness (Dimension II), and naturalness (Dimension III).

The maintenance dimension is represented by five items: maintained-neglected, tidy-messy, clean-dirty, ordered-chaotic, and understandable-confusing. Furthermore, a linear combination of these items found using a principal component analysis accounts for 33.80% of variance. The Cronbach's alpha, a measure of the degree of reliability, was .90 which is relatively high.

Five items (distinct-ordinary, ornate-plain, unusual-typical, complex-simple, unique-common) were apparently measuring another underlying dimension. The dimension was labeled as distinctiveness because the items representing it were interpreted as holding meanings related to a distinctive or unusual character. Factor loadings ranged from .87 to .77; Chronbach's alpha coefficient was .89 and the percent of variance explained was 23.29. As shown in Table 10, three items were apparently measuring an underlying dimension related to naturalness. The eigenvalue was 1.78;

percent of variance was 12.79%; Chronbach's alpha coefficient was .78 which was satisfactory.

TABLE 10
Principal Component Analysis for Cognitive Evaluation Items

	Factor loading	Eigen-Value	Variance explained	Cronhach's α
Maintenance		4.73	33.80	.90
maintained-neglected	.87			
tidy-messy	.86			
clean-dirty	.85			
ordered-chaotic	.83			
understandable-confusing	.69			
Distinctiveness		3.26	23.29	.89
distinct-ordinary	.87			
ornate-plain	.85			
unusual-typical	.82			
complex-simple	.81			
unique-common	.77			
Naturalness		1.79	12.79	.78
natural-artificial	.83			
good for wildlife-bad for wildlife	.81			
rural-urban	.80			
Total variance explained			**69.88%**	

Affective Response

Eight items were used to measure affective response from theory on emotions by Russell and his colleagues (e.g. Russell & Snodgrass, 1989, Russell, 1988) and empirical studies regarding fear and safety (Nasar, 1997, Nasar & Fisher, 1993; Nasar & Jones, 1997; Hanyu, 1997, 2000).

As performed for cognitive evaluation variables, validity and reliability checks were made for affective response using the same criteria. To assess the construct validity of the affective response scale, a factor analysis (principal components) with varimax rotation was performed to identify underlying dimensions represented in these eight items. To measure affective response of the trail, six items were chosen from related literature and two item scales including safe-dangerous, friendly-hostile were included to test emotions on safety which is often cited as a central concern during urban experiences in regard to crime.

Affective dimensions were also interpreted based on the common characteristics of items loading on each factor: pleasantness (Dimension I) and arousal (Dimension II). As shown in Table 11, six items were apparently measuring a dimension labeled pleasantness. The eigenvalue was 5.16; percent of variance explained was 64.55%; Chronbach's alpha coefficient was .96 which is satisfactory. The results also indicated that two items (active-passive, exciting-boring) measured another dimension labeled as arousal because arousal is the earlier dimension of activity and excitement results from arousal (Nasar, 1997). The eigenvalue was 1.34 and the alpha score was .71.

TABLE 11
Principal Component Analysis for Affective Response Items

	Factor loading	Eigenvalue	Variance explained	Cronhach's α
Pleasantness		5.16	64.55	.96
calm-stressful	.91			
friendly-hostile	.90			
pleasing-annoying	.90			
pleasant-unpleasant	.90			
relaxed-tense	.90			
safe-dangerous	.85			
Arousal		1.34	16.81	.71
active-passive	.90			
exciting-boring	.83			
Total percent of variance explained		**81.35**		

Discussion of the Findings

The Cognitive Dimensions of Aesthetic Responses

Lynch concentrated on considering the need for imageability (identity and structure) in human perception, and presented the special relevance of this quality to a specific urban environment in terms of a city image (Lynch, 1960, p. 10). He suggested a method to deal with the visual form of three American cities at the urban scale and offered principles of urban design from a professional perspective.

Maintenance

A number of studies have confirmed the importance of spaciousness and related variables such as openness, defined space, and upkeep in human perception of the environment (Kaplan & Kaplan, 1989; Nasar, 1988a, 1994). Research indicated that people prefer spaces in association with defined openness (Kaplan & Kaplan, 1989; Nasar, Fisher, & Grannis, 1993) and "well-managed panoramas" (Lynch, 1960). Upkeep refers to the maintenance of areas (Nasar, 1998). Nasar found that respondents liked places for their cleanliness, maintenance, and presence of open space and scenery. Items in Dimension I in this study labeled as maintenance were consistent with concepts of upkeep and openness in Nasar's study and appeared to relate referred to maintenance issues in Lynch's concept (Table 12).

Distinctiveness

Research has also confirmed preference in conjunction with order in the landscape and related variables such as legibility, identifiability, distinctiveness, and complexity (Kaplan & Kaplan, 1989; Lynch, 1960; Nasar, 1988a, 1994; Ulrich, 1983; Wohlwill, 1979). Nasar suggested that likability of an environment could be enhanced by increasing visual order and by increasing design features that help improve perceived order (Nasar, 1998, p. 73). Order can be enhanced by moderate complexity. Complexity refers to the number of different elements and the distinctiveness between those elements (Day, 1967; Heath, Smith, & Lim, 2000a; Nasar, 1988b; Oku, 1990; Synek, 2001). In addition, a legible and distinctive landscape provides sense of secure

and stimulates human experiences in the environment. Thus, distinctiveness, unique, and complexity items were interpreted as representing a dimension of distinctiveness in this study.

Naturalness

Naturalness is one of the most significant dimension of human perception of the environment (e.g. Herzog, 1989; Herzog, Kaplan, & Kaplan, 1976; Nasar, 1997). The importance of this dimension is believed to be due to the restorative and stress recovery value of nature (e.g. Kaplan, 1995; Ulrich et al., 1991). Both use and symbolic significance of natural contents are prominent dimensions of human response to the environment.

TABLE 12
Comparison of Major Components of Likability

Dimension	Lynch	Nasar	Chon
Cognitive	Well-managed landscape	Upkeep Openness	Maintenance
	Uniqueness	Order Complexity	Distinctiveness
	Use/symbolic significance	Naturalness Historic significance	Naturalness
Affective	Meaning	Evaluative image	Pleasantness Arousal

Table 12 compares various perceptual concepts identified by different researchers. This study found three components that make up cognitive evaluation: maintenance, distinctiveness, and level of naturalness. However, it should be noted that there are premises directing the comparison of those concepts. Even though concepts found in this study are classified into the same categories with concepts from other research, some differences exist because of the location being studied. Previous studies have been conducted in more urban areas with more built infrastructure as a part of the visual landscape. This study examined an urban trail environment. The characteristics of the trails include many nature-based components by design and present the viewers with a somewhat different composition of the landscape.

The Affective Dimension of Aesthetic Responses

Nasar (1998) paid attention to community appearance that dealt with residents' and visitors' visual perception and evaluation of cities. Nasar examined city appearance for two American cities and introduced the concept of the evaluative image which was overlooked in Lynch's work. In the study, likability was measured by evaluative emotions to the physical elements in the cities. He identified likability as favorable emotions and meanings experienced in relation to the environment and argued that pleasure represents an important component of emotional meaning (Nasar, 1998, p.27). Emotional meaning dimensions including pleasantness, arousal, exciting, and relaxing has been used to measure human response to physical environment in urban scenes (Hanyu, 1993; Russell & Snodgrass, 1989; Ward & Russell, 1981). Further, Nasar

speculated connotative meanings such as safety (Nasar & Jones, 1997) and friendliness (Nasar, 1989), that may influence emotional response and behavior.

This study found that pleasantness and arousal as affective dimension of aesthetic responses to greenway trail corridors. Some items including calm-stressful and friendly-hostile loaded higher than items which measured pleasant, but pleasantness was often considered as a fundamental dimension of emotion (Nasar, 1998) that can influence other emotional reaction such as calm, friendly, relaxation, and safe.

Likability

Nasar recognized two components of aesthetic responses. The first was imageability or cognitive evaluation. The second component he represented as emotional meaning or likability. However, it may not be sufficient to explain likability as emotion which results from an interactional model of aesthetic response as suggested in Chapter II. Likability could be more than an interrelationship between imageability and meaning. It is proposed here that likability is a variable which can be the result of cognitive process and emotion which drive a person's desire to use that place or be in the place.

This study has conceptualized likability as a variable at work between cognitive, emotion, and behavior. It may represent intent to behave. In this case, intent to visit as the trail invites the respondents in. Therefore, it would be of interest to see how greenway trail characteristics, cognitive evaluation, and affective response influence

comprehensive evaluative meaning (likability) of the environment. The next chapter will explore these relationships.

CHAPTER V

WHAT MAKES A TRAIL LIKABLE? EXAMINING THE RELATIONSHIPS BETWEEN COGNITION, EMOTION, TRAIL CHARACTERISTICS AND LIKABILITY

The intent of this chapter is to examine relationships between several independent variables (cognitive evaluation, affective response, and greenway trail characteristics), and likability of the urban trail environment. This was accomplished using multiple regressions to determine which variables best predicted how inviting the trail was to those taking the virtual tour. Two primary analyses were conducted in regard to the relative impact of independent variables on likability. First, a multiple regression was performed to determine significant predictors of cognitive evaluation and affective response predicting likability. In the second analysis, results of multiple regression showed that several greenway trail characteristics were related to likability.

The standard multiple regressions were performed to determine which variables were the strongest predictors of likability. Several variables were utilized as predictor variables in the regression analysis. Variables including maintenance, distinctiveness, and naturalness were three of the independent variables. They were found to be the potential cognitive dimensions of greenway trail likability. Factors were interpreted based on highly loaded items and the common characteristics of items grouped together: maintenance, distinctiveness, and naturalness. Two dimensions, pleasantness and

arousal, were determined to be affective dimensions and were also employed as independent variables.

Eight items were designed to measure specific greenway trail characteristics perceived by the respondents. Trail width, trail surface, amount of vegetation, presence of water, trail facilities, background buildings, built structures on trail, and adjacent auto traffic were also used as independent variables.

Likability as the dependent variable was measured using an item that asked respondents about "how inviting this portion of the trail is." Because this study used a virtual tour, the question of "how inviting the trail is" was judged to be a good surrogate for likability. That is, respondents were not really in a place but rather were reacting to how it might feel to be there and whether the landscape was a place they would like to be.

H1: There will be positive relationships between cognitive evaluation, affective response, and the likability of greenway trails during an Internet-based virtual tour.

The standard multiple regression results were reported in Table 13. The five independent variables in relation to aesthetic responses explained 21% of the variance in the inviting variable. Results indicated that there were positive relationships between level of invitation and each cognitive and affective dimension. The model produced an adjusted R-square of .207. Variables including pleasantness and distinctiveness were significant at the .001 level. Naturalness and arousal were significant at the .01 level. Maintenance was significant at the .05 level. Pleasantness was the most significant

predictor among human response variables followed by distinctiveness, naturalness, arousal, and maintenance. Pleasantness was measured utilizing six adjective pairs including calm-stressful, friendly-hostile, pleasing-annoying, pleasant-unpleasant, relaxed-tense, and safe-dangerous. This suggests that the more the trail elicits positive emotional responses, the more people feel the trail is an inviting environment. Cognitive evaluations and affective response were both shown to have positive significant relationships with likability. Thus H1 was confirmed.

TABLE 13

Multiple Regression Analysis of Aesthetic Response Dimensions on Likability for All Respondents

Group	Dependent Variables	Independent Variables	Beta (β)	t-value	p-value	Adj. R^2
All Respondents	Inviting	Maintenance	.070	2.021	.043	.207
		Distinctiveness	.130	5.444	.000	
		Naturalness	.077	2.830	.005	
		Pleasantness	.338	9.017	.000	
		Arousal	.085	3.326	.001	

H2: There will be a positive relationship between specific greenway trail characteristics and the likability of greenway trails during a web-based virtual tour.

This regression equation also produced six significant greenway trail characteristics as displayed in Table 14. Six of eight greenway trail characteristics

including trail width, trail surface, amount of vegetation, background buildings, built structures, and adjacent auto traffic on trail were significant at the .05 level.

TABLE 14

Multiple Regression Analysis of Greenway Trail Characteristics on Likability for All Groups

Group	Dependent Variables	Significant Independent Variables	Beta (β)	t-value	p-value	Adj. R^2
All Respondents	Inviting	Amount of vegetation	.218	5.809	.000	.142
		Built structures on trail	.170	3.877	.000	
		Background buildings	.131	3.006	.003	
		Adjacent auto traffic	.126	3.339	.001	
		Trail surface	.105	2.652	.008	
		Trail width	.007	1.961	.050	
		Trail facilities	.007	1.927	.054	
		Presence of water	.003	1.043	.297	

Result showed that presence of water and trail facilities on the trail were not predictors of likability of the trail. In this case the general hypothesis that specific characteristics would be related to greenway likability was partially confirmed. That is six of the eight characteristics measured did have predictive value in relation to how inviting the virtual trail was to the viewer.

Discussion of the Findings

Several variables were significant predictors in explaining the likability of the urban trail environment. These findings support those of others that cognitive evaluation is related to likability (Al-Kodmany, 2001; Hanyu, 1993; Kaplan & Kaplan, 1998; Lynch, 1960; Nasar, 1988a, 1990, 1998; Ulrich, 1983). The finding that affective response was a significant predictor of likability is also consistent with previous studies (Hanyu, 1993; Kaplan & Kaplan, 1989; Nasar et al., 1983; Nasar, Fisher, & Grannis, 1993; Russell, 1988; Ulrich, 1983; Ulrich et al., 1991). It was also found that greenway trail characteristics influenced respondents' likability.

In the analysis, the level of invitingness created by the environment had a strong positive relationship with many independent variables. As suggested in the literature, five independent variables in association with cognitive evaluation and affective response including pleasantness, distinctiveness, arousal, naturalness, and maintenance were found to have significant positive relationships with likability. Pleasantness was the strongest predictor among cognitive and affective dimensions to determine likability in urban greenway trail corridors. Because this study used a virtual tour, respondents might have an emotional reaction to a place rather than perceive and appraise tangible elements that cause cognitive evaluation. Since emotional reaction refers to an internal state such as pleasure (Russell & Snodgrass, 1989), pleasantness is often referred to as a primary dimension underlying affective response to places (Nasar, 1997).

In terms of greenway trail characteristics, six of eight variables had significant relationship with likability. In analyzing relationships between trail characteristics and likability, five point scales were used to measure trail characteristics. Each scale had five response categories ranging from one extreme to the other, for example too little to too much, with the middle category representing about right that were converted into numbers from left to right, 1, 2, 3, 4, and 5. However, in the analysis five point scales were recoded to three point scales. The middle category "about right" was recoded as the best score of 3 and both extremes "too little and too much" were recoded as the least score of 1. In order to measure likability of greenway trail characteristics, "about right" was considered to represent the best evaluation of each trail characteristic. Both extremes including too little and too much were interpreted as the least evaluation.

Amount of vegetation, trail width, trail surface, background buildings, built structures, and adjacent auto traffic on trail were significant predictors of likability. Research has confirmed that both positive and negative elements elicit strong evaluation of the environment (Appleyard, 1976). For instance, the most imageable building in a city in either positive or negative way was the one people remembered most.

Research has consistently supported the notion that natural features such as vegetation and water influence human response to the environment (Herzog, 1989; Nasar, 1987; Ulrich, 1979, 1981). Results showed that amount of vegetation had a significant relationship with likability. However, presence of water was found to have no significant relationship. This result differs from those presented in the literature. It is possible that respondents were not exposed to enough water features to create a

significant impact on their overall evaluation or it may be that water is not as influential in a linear environment.

Research found that people have sensitive reactions to human presence in the environment and those human elements are often preferred and provide comfort feeling (Kaplan et al, 1998). Because human elements in the natural setting are an indication of management which delivers a sense of caring. Research also found that human-made features can cause threat or caution at the same time. It indicated that human-made elements influence to human perception as positive or negative depending on various settings. Trail width and trail surface were found as significant predictor of likability. However, trail facilities were not found as significant predictors of likability. Although people perceive trail related facilities such as benches, light pole, and shelters that may provide comfortable feeling, it was not critical in their likability of greenway trails in this study.

Background buildings and built structures as human-made features in the environment were significant predictor of likability. Human have both positive and negative reaction to their surroundings and the imgaeable elements (Nasar, 1998). Research found that background buildings (urban skylines) have had a significant impact on urban aesthetic quality (Heath, Smith, & Lim, 2000a, b). On the other hand, a study found that people preferred if the fractal dimension of the skyline matches the fractal dimension of the surrounding landscape (Stamps, 2002). He found that the most preferred scene was to have all buildings below the mountain ridge line in the background. The least preferred scene had view corridors and buildings which broke the

ridge line. It is noted that background buildings in the virtual tour used for the main study tended to have consistency with the least preferred condition in the previous study. And built structures such as bridges, utility plants, and other human creations also played an important role in people's aesthetic responses to the greenway corridors.

Past research has found that presence of auto traffic in a scene had a negative impact to environmental evaluation (Nasar, 1987, 1990). Appleyard (1976b) also found that heavy traffic in residential area rated as less preferred in association with safety, noise, and air pollution. In this study, although respondents neither heard them, saw them moving, nor smelled their fumes, auto traffic was found as a significant predictor. The result supported past research that whether the respondents experiencing auto traffic *in situ*, where sound, motion, and odor would be present, or experiencing it in a virtual space, the correlation between auto traffic and preference is causal.

CHAPTER VI

EVALUATIONS OF SPECIFIC GREENWAY TRAIL CHARACTERISTICS AND THEIR RELATIONSHIP TO THE TRAIL EXPERIENCE

This chapter provides the results of the analyses in two sections. The first examined how manipulation of trail characteristics may influence perception and likability of greenway trails. The effects of a treatment at each viewpoint were tested in the analysis. The second examined the effects of travel direction on respondents' perceptions and likability of the virtual trail environment. Hypotheses H3 and H4 were tested using independent-samples t-tests.

H3: There will be significant differences between respondents' perceptions of manipulated and non-manipulated greenway trail characteristics.

Differences of Perceptions and Likability in Buffalo Bayou Trail

Results of Testing Differences between Groups Who Viewed Manipulated and Non-manipulated Characteristics along Buffalo Bayou Greenway Trail

In order to analyze the differences on perceptions of greenway trail characteristics with different travel environments (existing trail characteristics vs. manipulated greenway trail characteristics) by each viewpoint, each viewpoint in BBTF

was compared to the others in BBTM. Seeking difference between trail environments dealt with how people respond to the existing trail experience and the trail experience with manipulated greenway trail characteristics.

The independent-samples t-test was performed and grand mean scores were reported in Table 15. The results showed the changes of mean scores affected by treatments in each viewpoint. Seven of eight greenway trail characteristics were perceived significantly different depending on travel environments in BBT. Although the mean score of background buildings was expected to be significantly different between BBTF and BBTM, a slight but non-significant difference was found. This suggested that background buildings on the trail may not influence respondents' perception of the greenway trail corridor. Since other variables are adjacent to the trail tread that people interact during trail activities, physical distance of background buildings from tread may not influence in perceiving greenway trail corridors even if it was virtual environment. Overall, treatments which are manipulated greenway trail characteristics influenced perception of trail characteristics in BBTM. H3 was confirmed.

TABLE 15

Differences between Groups Who Viewed Manipulated and Non-Manipulated Characteristics along Buffalo Bayou Trail

Greenway trail characteristics (Treatments)	V.P [a]	Group	Perception Mean[1]	t-value	p-value	Likability Mean[1]	t-value	p-value
Background buildings	1	BBTF	3.49	.84	.405	3.05	-2.45	.017
(Buildings deleted)		BBTM	3.33			3.50		
Presence of water	2	BBTF	1.62	-9.51	.000	3.35	-4.35	.000
(Water added)		BBTM	3.14			4.25		
Trail facilities	3	BBTF	1.43	-11.80	.000	3.03	-1.82	.074
(Facilities added)		BBTM	3.56			3.50		
Trail width	4	BBTF	2.11	-7.20	.000	3.32	3.50	.001
(Trail tread widened)		BBTM	3.33			2.53		
Adjacent auto traffic	5	BBTF	2.86	-6.39	.000	3.03	.58	.562
(auto traffic added)		BBTM	4.22			2.86		
Built structure on trail	6	BBTF	3.57	3.86	.000	3.43	-2.63	.010
(Structures deleted)		BBTM	2.53			4.19		
Amount of vegetation	7	BBTF	2.97	-5.47	.000	2.95	-1.35	.181
(Vegetations added)		BBTM	3.94			3.36		
Trail surface	8	BBTF	3.65	4.47	.000	2.89	-.20	845
(Surface softened)		BBTM	2.56			2.94		

[a] Viewpoint

[1] each scale has five response categories ranging from one extreme to the other (e.g. too little to too much), with the middle category representing neutral that were converted into numbers from left to right, 1,2,3,4, and 5.

Results of Testing Differences of Likability between Groups Who Viewed Manipulated and Non-manipulated Characteristics along Buffalo Bayou Greenway Trail

The second independent-samples t-test was performed to test if and how respondents' likability might differ between treatments. This test was intended to examine if differences between perceptions of greenway trail characteristics influenced likability of greenway trail characteristics. This also suggested what greenway trail characteristics most influence likability. Likability of each trail characteristic with existing condition and treatment changed significantly along with perception as shown in Table 19. Those trail characteristics include background buildings (Figure 16), presence of water (Figure 17), trail width (Figure 18), and built structure on trail (Figure 19). However, trail facilities, auto traffic, amount of vegetation, and trail surfaces had no influence on respondents' likability although perceptions of those characteristics differed significantly. Overall likability was measured at the end of each trail experience. Grand mean scores were not significantly different between BBTF ($x=3.43$) and BBTM ($x=3.50$).

a. existing condition
(background buildings mean=3.49, likability mean=3.05)

b. deletion of background buildings
(background buildings mean=3.33, likability mean=3.50)

Figure 16. A Comparison of Perceptions of Viewpoint #1 on the Buffalo Bayou Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition
(presence of water mean=1.62, likability mean=3.35)

b. addition of water along the trail
(presence of water mean=3.14, likability mean=4.25)

Figure 17. A Comparison of Perceptions of Viewpoint #2 on the Buffalo Bayou Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition
(trail width mean=2.11, likability mean=3.32)

b. widened trail tread along the trail
(trail width mean=3.33, likability mean=2.53)

Figure 18. A Comparison of Perceptions of Viewpoint #4 on the Buffalo Bayou Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition
(built structure on trail mean=3.57, likability mean=3.43)

c. deletion of built structure on trail
(built structure on trail mean=2.53, likability mean=4.19)

Figure 19. A Comparison of Perceptions of Viewpoint #6 on the Buffalo Bayou Greenway Trail with Existing (a) and Manipulated (b) Views

Differences of Perceptions and Likability in Town Lake Trail

Results of Testing Differences between Groups Who Viewed Manipulated and Non-manipulated Characteristics along Town Lake Greenway Trail

The results presented the comparison of the mean scores between TLTF and TLTM. The greenway trail characteristics are presumed to influence the perceived trail environment during a virtual tour. The TLTF group experienced a trail environment with existing condition of the trail characteristics whereas the TLTM group experienced manipulated greenway trail characteristics based on its existing condition. The treatments for each viewpoint are presented in Table 16.

As shown in Table 16, all eight characteristics were significantly different at $p<.01$ level. Adjacent auto traffic remained the primary difference between TLTF and TLTM groups followed by presence of water, trail width, built structure on trail, trail facilities, amount of vegetation, background buildings, and trail surface. This result also showed that there were differences in perceiving greenway trails between the existing greenway trail corridor and the greenway trail corridor with manipulated greenway trail characteristics during a web-based virtual tour. Thus, H3 was also accepted.

TABLE 16

Differences between Groups Who Viewed Manipulated and Non-Manipulated Characteristics along Town Lake Trail

Greenway trail characteristics (Treatments)	V.P [a]	Group	Perception Mean[1]	t-value	p-value	Likability Mean[1]	t-value	p-value
Trail surface	1	TLTF	2.94	-2.81	.007	4.06	.51	.615
(Surface hardened)		TLTM	3.42			3.97		
Presence of water	2	TLTF	1.39	-7.50	.000	3.71	-2.00	.050
(Water added)		TLTM	2.85			4.12		
Background buildings	3	TLTF	4.35	2.93	.005	3.16	.74	.465
(Buildings deleted)		TLTM	3.76			2.97		
Trail facilities	4	TLTF	2.61	-4.71	.000	3.06	-1.54	.128
(Facilities added)		TLTM	3.58			3.42		
Adjacent auto traffic	5	TLTF	2.97	-10.55	.000	4.06	7.79	.000
(Auto traffic added)		TLTM	4.58			2.27		
Amount of vegetation	6	TLTF	2.90	-4.02	.000	4.39	1.12	.266
(Vegetation added)		TLTM	3.52			4.15		
Built structure on trail	7	TLTF	4.58	4.99	.000	2.29	-4.61	.000
(Structures deleted)		TLTM	3.48			3.48		
Trail width	8	TLTF	1.84	-6.49	.000	3.19	1.18	.242
(Trail tread narrowed)		TLTM	2.91			2.88		

[a] Viewpoint

[1] each scale has five response categories ranging from one extreme to the other (e.g. too little to too much), with the middle category representing neutral that were converted into numbers from left to right, 1,2,3,4, and 5.

Results of Testing Differences of Likability between Groups Who Viewed Manipulated and Non-manipulated Characteristics along Town Lake Greenway Trail

The independent-samples t-test was performed and grand mean scores were reported in Table 20. Result showed that likability of trail characteristics including presence of water ($p=.05$), auto traffic ($p<.001$), built structure on trail ($p<.001$) were significantly different between primary travel direction and treatments of primary travel direction. Existing condition of those trail characteristics and treatments for each viewpoint are shown in Figures 20 through 22.

On the other hand, trail surface, background buildings, trail facilities, amount of vegetation, and trail width resulted in no significant difference in likability for treatments of greenway trail characteristics. Presence of water, auto traffic, and built structure were suggested as most influential trail characteristics on likability of Town Lake Trail. However, overall likability indicated that there was no significant difference of mean scores between TLTF ($x=3.77$) and TLTM ($x=3.73$).

a. existing condition
(presence of water mean=1.39, likability mean=3.71)

b. addition of water along the trail
(presence of water mean=2.85, likability mean=4.12)

Figure 20. A Comparison of Perceptions of Viewpoint #2 on the Town Lake Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition
(adjacent auto traffic mean=2.97, likability mean=4.06)

b. addition of adjacent auto traffic
(adjacent auto traffic mean=4.58, likability mean=2.27)

Figure 21. A Comparison of Perceptions of Viewpoint #5 on the Town Lake Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition
(built structure on trail mean=4.58, likability mean=2.29)

d. deletion of built structures
(built structures mean=3.48, likability mean=3.48)

Figure 22. A Comparison of Perceptions of Viewpoint #7 on the Town Lake Greenway Trail with Existing (a) and Manipulated (b) Views

H4: There will be significant differences between respondents' perceptions of trail characteristics depended on the direction from which they view the trail.

Differences of Perception by Travel Direction

Results of Testing Differences between Primary Travel Direction and Alternative Travel Direction on Buffalo Bayou Trail

The changes of mean scores and the results of independent samples t-test are presented in Table 17. The mean score of trail facilities (BBTF x=1.51 and BBTB x=1.75) was significantly different at the .001 level. Background buildings (BBTF x=2.91 BBTB x=3.09) and presence of water (BBTF x=1.57 and BBTB x=1.72) were also significant at the .05 level. The mean scores of amount of vegetation (BBTF x=2.77

and BBTB x=2.66) were not significant. Other greenway trail characteristics including trail width, adjacent auto traffic, built structure on trail, and trail surface showed no significant differences between travel directions.

TABLE 17
Results of Independent-Samples t-Test for Differences between Primary Travel Direction and Alternative Travel Direction on Buffalo Bayou Trail (BBTF: N=296, BBTB: N=304)

Greenway trail characteristics	Group	Mean[1]	S.D.	t-value	p-value
Background buildings	BBTF	2.91	.81	-2.550	.011
	BBTB	3.09	.97		
Presence of water	BBTF	1.57	.71	-2.315	.021
	BBTB	1.72	.86		
Trail facilities	BBTF	1.51	.71	-3.792	.000
	BBTB	1.75	.85		
Trail width	BBTF	2.36	.88	-.257	.797
	BBTB	2.38	1.02		
Adjacent auto traffic	BBTF	3.23	.88	-.676	.499
	BBTB	3.28	1.03		
Built structure on trail	BBTF	2.79	.96	-.219	.826
	BBTB	2.81	1.11		
Amount of vegetation	BBTF	2.77	.79	1.602	.110
	BBTB	2.66	.97		
Trail surface	BBTF	3.27	.81	.653	.514
	BBTB	3.22	1.04		

[1] each scale has five response categories ranging from one extreme to the other (e.g. too little to too much), with the middle category representing about right that were converted into numbers from left to right, 1, 2, 3, 4, and 5.

TABLE 18
Results of Independent-Samples t-Test for Differences between Primary Travel Direction and Alternative Travel Direction on Town Lake Trail

Greenway trail characteristics	Group	Mean[1]	S.D.	t-value	p-value
Trail surface	TLTF	3.01	.54	1.332	.183
	TLTB	2.95	.57		
Presence of water	TLTF	2.52	.91	1.009	.313
	TLTB	2.43	1.04		
Background buildings	TLTF	3.70	.94	-.123	.902
	TLTB	3.71	.97		
Trail facilities	TLTF	2.31	.90	2.312	.021
	TLTB	2.13	.91		
Adjacent auto traffic	TLTF	3.64	.86	.570	.569
	TLTB	3.59	.89		
Amount of vegetation	TLTF	2.42	.88	-.017	.986
	TLTB	2.42	.94		
Built structure on trail	TLTF	3.68	.94	1.185	.237
	TLTB	3.58	.97		
Trail width	TLTF	2.73	.85	.518	.605
	TLTB	2.69	.88		

[1] each scale has five response categories ranging from one extreme to the other (e.g. too little to too much), with the middle category representing neutral that were converted into numbers from left to right, 1, 2, 3, 4, and 5.

Overall likability was measured at the end of the virtual trail experience which showed no significant difference between BBTF (x=3.43) and BBTB (x=3.34). While certain characteristics was perceived differently by travel direction, there were no significant influence on the whole trail experience (t=.433, p=.667).

Results of Testing Differences between Primary Travel Direction and Alternative Travel Direction on Town Lake Trail

The mean scores of greenway trail characteristics in Town Lake Trail by travel direction were compared in Table 18. Independent samples t-test were conducted to test statistical significance of the mean difference. In the analysis of the differences between primary travel direction and alternative travel direction in Town Lake Trail, trail facilities ($p<.05$) was the only significant characteristic. Other trail characteristics had no significant difference between groups. A test of overall likability indicated no significant difference between the two virtual tour experiences on the Town Lake Trail, TLTF ($x=3.77$) and TLTB ($x=3.72$), ($t=.250$, $p=.803$).

Discussion of the Findings

Perception and Likability of Greenway Trail Characteristics by Trail Environment

Several greenway trail characteristics had a significant influence on travel environments and between travel directions. In the analysis of the manipulated versus non-manipulated trail characteristics on Buffalo Bayou trail, perception of seven trail characteristics were significantly different by trail environment and three of them (presence of water, trail width, and built structure on trail) had a significant difference on likability. This result suggested that those three are the most influential trail characteristics on likability among other significant characteristics on perceptions. It also suggested that the addition of certain elements on the existing condition of the trail

corridor help make the greenway trail more likable. For example, added water and widened trail showed significant increase on respondents' likability scores. On the other hand, respondents rated likability higher when built structures such as a bridge on the trail were deleted.

Results also indicated that, despite no significant difference between groups in perceiving background buildings, the likability of that viewpoint was significantly different. It could be explained that respondents had a higher level of invitingness to composition of natural features than human-made features in a greenway trail corridor. It is consistent with a scene of deleted built structure on trail gained higher score on likability than a scene with built structure on trail.

Greenway trail characteristics on the Town Lake Trail were also compared to test if treatments were perceived differently at each viewpoint and if treatments influenced likability. All eight trail treatments were significantly different ($p<.01$) from the existing condition. Presence of water, auto traffic, and built structure on trail also produced significantly different likability scores (Table 16). The results indicated that the addition of water was one of the most influential treatments on likability. Deletion of built structure on the trail elicited significantly different likability scores. Added auto traffic also influenced likability on the Town Lake Trail. It suggested that the addition of natural features and reduction of human-made features created a higher level of invitingness on the trail. Other trail characteristic treatments such as trail surface, background buildings, trail facilities, amount of vegetation, and trail width were

significantly different from existing condition however there was no corresponding difference in likability.

Presence of water and built structures were significantly different in the way they were perceived for both trails. Results in Table 15 and Table 16 indicated that perceived differences of those characteristics may also have influenced different evaluations of the invitingness of the trail or its likability. Added water created more of an "about right" score of respondents' perception, and the level of invitingness also seemed to increase. High mean scores of built structure on trail in both BBTF and TLTF dropped with treatments (deletion of structures) to be close to "about right." This also seems to have increased the level of invitingness significantly on both trails.

Treatments on both trails related to trail facilities, trail surface, and amount of vegetation were perceived to be significantly different, but the level of invitingness did not differ for these viewpoints in spite of the change (treatment). Trail facilities had a mean score closer to "about right" after the treatment, but it did not make a significant difference in likability. The treatment of added vegetation increased mean scores of amount of vegetation from 2.97 to 3.94 (BBT) and from 2.90 to 3.52 (TLT) which are closer to "too much," but the level of invitingness had no significant difference. Perceptions of trail surface were also significantly different on both trails but neither was scored differently on likability.

Trail width revealed significant differences according to treatments on both perception and likability in Buffalo Bayou trail, but had only a significant difference on the perception on Town Lake Trail. Respondents showed significantly different levels

of invitingness ($p<.01$) between BBTF and BBTM while there were no significant difference between TLTF and TLTM. It suggested that trail width may not be a critical trail characteristic to determine the level of invitingness on Town Lake Trail.

Respondents perceived a significant difference on treatment of auto traffic in both trails (BBTF vs. BBTM and TLTF vs. TLTM). Yet, it influenced likability only on Town Lake Trail. The existing condition of TLTF (Figure 23a) contained much preferable features including water and maintained landscape than that of BBTF (Figure 24a) which confirmed in previous research (e.g. Kaplan et al., 1989). It suggested that added auto traffic as a treatment in TLTM (Figure 23b) elicited more significant influence to judge the level of invitingness than BBTM (Figure 24b). In addition, light poles in BBTF could be an indication of auto traffic and road over bump in the scene. It was more explicit in the virtual tour. Thus it can be explained that a trail corridor with natural features such as water and managed landscape has a higher level of invitingness than one with negative human signs (e.g. auto traffic). Figures 23 and 24 represent these treatments on both trails.

a. existing condition
(adjacent auto traffic mean=2.97, likability mean=4.06)

b. addition of water along the trail
(adjacent auto traffic mean=4.58, likability mean=2.27)

Figure 23. A Comparison of Perceptions of Viewpoint #5 on the Town Lake Greenway Trail with Existing (a) and Manipulated (b) Views

a. existing condition
(adjacent auto traffic mean=2.86, likability mean=3.03)

b. addition of auto traffic along the trail
(adjacent auto traffic mean=4.22, likability mean=2.86)

Figure 24. A Comparison of Perceptions of Viewpoint #5 on the Buffalo Bayou Greenway Trail with Existing (a) and Manipulated (b) Views

On the Town Lake Trail, background buildings created significantly different scores in the way they were perceived, but there was no corresponding difference in likability. It suggested that people had significantly different levels of perception of background buildings, but several features in the foreground such as water and maintained landscape in both TLTF and TLTM seemed to have a strong impression on the likability of the scenes.

Background buildings were not perceived significantly different on the way they perceived on the Buffalo Bayou Trail; however there was significant difference in likability. The existing condition of BBTF contained high-rise buildings in the background and had several man-made features such as vehicles, roads, light poles, and trash cans in the foreground. These foreground elements possibly distracted perception of background buildings in the scene. Although respondents perceived no significant difference of background of buildings between BBTF and BBTM, they felt the trail was more inviting when it had fewer man-made features.

Perception and Likability of Greenway Trail Characteristics by Travel Direction

Few greenway trail characteristics resulted in significant differences between primary travel direction and alternative travel direction in both trails. Since the nature of the greenway trail corridor is a linear open space associated with a number of natural and man-made features, the perception of certain viewpoints might be different within a trail corridor when one turns around, depending on surrounding landscape features.

However, results indicated that landscape features were perceived similarly along the trail corridor no matter which direction one was viewing.

As shown in Table 17, on Buffalo Bayou Trail, three of eight trail characteristics including background buildings, presence of water, and trail facilities had significant differences on the perception. Town Lake Trail also showed a significantly different perception of trail facilities dependent on travel direction. Differences in perceiving trail characteristics between travel directions had no influence on likability of the trail. No matter which direction the respondents travel, likability remained the same on both Buffalo Bayou Trail and Town Lake Trail.

CHAPTER VII

CONCLUSION

This chapter has four sections. The first section summarizes the general findings regarding the dimensions of aesthetic responses, relationships between aesthetic responses and likability, relationships between greenway trail characteristics and likability, and differences in greenways trail characteristics by groups. The second section describes theoretical implications of this study. The third section discusses managerial implications. The last section provides suggestions for future research related to this study.

Summary of Findings

The study presented an opportunity to expand the scope of aesthetic response research into the realm of urban greenway trails. Urban greenway trail corridors are emerging as potential tourist attractions in cities and are well recognized for their recreation opportunities in general. This study focused on the methodological and analytical issues involved in assessing human response to visual aspects of physical greenway environments using advanced communication technology. The concept of likability (Nasar, 1998) was used as a guiding concept in the study.

Likability studies have focused on likability as an evaluative meaning or affective response. Lynch (1960) identified that environmental image has three parts:

identity, structure, and meaning. However his work focused on identity and structure over meaning. Nasar asserted that imageability cannot be completely explained without meaning. He extended Lynch's work and suggested that evaluative meaning (affective response), in other words likability, interacts with imageability (cognitive aspects). He proposed that likability increases imageability; and imageability emphasizes likability. These researchers primarily focused on city form and community appearance.

Previous research has also used different types of cognitive and emotional dimensions such as naturalness, complexity, preference, and arousal to measure aesthetic responses. Preference could be a general measure along with all others. But if a specific place has specific questions to be solved, then we should have different kinds of measures and associated environmental characteristics. Different places have different values and purposes, which in turn, require different environmental characteristics (Sanoff, 1989). For example, in order to improve visual and/or physical qualities of greenways and trails, we need additional research on the physical and social impacts on the different dimensions of aesthetic responses. Because various visual qualities could transmit different meanings about activities and different values that may apply to different purposes (Nasar, 1998).

Two basic questions initiated this study: "What environmental variables are associated with greenway likability?" and "How do the visual aspects of the physical environment affect people's aesthetic response along a trail based greenway?" These questions elicited four research questions and results for each question are presented below.

What Are the Aesthetic Dimensions of Likability in a Greenway Trail Environment and Do They Differ from Other Environments?

Based on Lynch's concept of imageability and Nasar's likability, the study found the greenway trail corridor consisted of five aesthetic dimensions. Cognitive dimensions included maintenance, distinctiveness, and naturalness. Affective dimensions were pleasantness and arousal. In Chapter IV, comparisons of major components of cognitive and emotional dimensions among other researchers were made. However, it should be noted that there are premises directing the comparison of those concepts. Even though some concepts found in this study were classified into the same category with concepts from other research, there are some differences because of study characteristics. Previous studies have been conducted in more built up urban areas whereas this study examined a less developed urban greenway trail environment. Although the trail locations are in an urban environment, the characteristics of the trail include many nature-based components by design.

How Do Cognitive and Affective Dimensions, Based on Responses to Greenway Trail Corridors, Predict a Likable Greenway?

In the study, the level of invitingness conveyed by the environment had a very strong positive relationship with many independent variables. Five independent variables including pleasantness, distinctiveness, arousal, naturalness, and maintenance had a significantly positive relationship with likability. Pleasantness was the strongest predictor of likability among cognitive and affective dimensions in these urban

greenway trail corridors. Because this study used a virtual tour, respondents might have emotional reaction to a place rather than perceive and appraise tangible elements that cause cognitive evaluation. Pleasantness is often referred to as a primary dimension underlying affective response to places (Nasar, 1997).

How Do Visual Characteristics of the Environments in Greenway Trail Corridors Relate to Likability?

Greenway trail characteristics including amount of vegetation, built structures on trail, adjacent auto traffic, background buildings, trail surface, and trail width were significant predictors of likability. Literature has consistently indicated that natural features such as vegetation had a positive influence on response to the environment. This study confirmed that vegetation had a significant relationship with likability. The study found that background buildings, built structures, and auto traffic were significant in relation to likability. A managed and unique landscape can elicit a sense of security and enhance depth and intensity of the environment while some built structures such as bridges, utility plants, and other human structures can detract from people's aesthetic experiences in a greenway corridor.

Trail width and trail surface were significant, but trail facilities were not found as a significant predictor of likability. Although the relationship between trail facilities and likability was not significant, results in Chapter VI indicated that people perceived that the more greenway trails had trail facilities, the more people felt the trail is inviting environment. Once trail facilities such as benches, light poles, shelters, and a

playground were added in the manipulated scene, respondents' likability scores went up. This indicates that accommodation provided by these trail facilities in the trail setting may provide a more comfortable feeling and be more preferred by respondents.

How Can Specific Characteristics in a Greenway Trail Corridor Be Altered to Enhance or Detract from the Experience?

Several greenway trail characteristics had significant differences between trail environments and between travel directions. Presence of water, trail width, and built structure on the trail were found to have significant influence on likability for the Buffalo Bayou Trail. Those three were found to be the most influential trail characteristics on likability among other significant characteristics on perceptions. Adding water and widening the trail tread were related to a significant increase in likability. Respondents rated likability higher when built structures such as a bridge on the trail were deleted. On Town Lake Trail, presence of water, auto traffic, and built structure on trail also produced significantly different likability scores. The result indicated that for a specific viewpoint the addition of water apparently lead to significantly higher level of likability. Deletion of built structure on trail also elicited significantly different likability scores. Added auto traffic also influenced likability on the Town Lake Trail. These results suggest that addition of natural features and reduction of human-made features created higher levels of invitingness on the trail.

Few greenway trail characteristics resulted in significant differences between primary travel direction and alternative travel direction. Results indicated that landscape

features were perceived similarly along the trail corridor no matter which direction one was viewing. Differences in trail characteristics between travel directions had no influence on likability of the trail. No matter which direction the respondents traveled, likability remained the same on both Buffalo Bayou Trail and Town Lake Trail.

Theoretical Implications

The research framework that guided this study was that likability is a result of aesthetic responses to environmental attributes which is an antecedent to behave. In order to understand this process, and consequently draw a whole picture of aesthetic responses, this study investigated the relationship between cognitive evaluation, affective response, and environmental attributes.

The theoretical foundations for this study can be found in Lynch (1960) and Nasar's (1998) work. They emphasized the importance of environmental elements that influence city image and community appearance. Although Lynch (1960) recognized the importance of meaning and evaluation, his research emphasized identity and structure. The cognitive mapping studies have also overlooked the importance of the emotional and affective quality of these physical elements. Nasar (1990, 1998) argued that knowledge about imageability is not sufficient for shaping city appearance. Because people have feelings and associations, both positive and negative, about their surroundings and the imageable elements, these feelings and meanings are also crucial to people's perception of and reaction to the environment. As imageability helps people

orient and find their way around within a city (Lynch, 1960), evaluative response may affect people's movement in a city. People would be well oriented, and they could move easily.

Nasar (1998) examined the visual quality of the American cities by considering the shared public image of the city and its parts. He focused on the evaluative image or likability of the cityscape. He found that likeable places in the cities have two components: city form (imageability) and human evaluative response (affect). The environmental attributes of naturalness, upkeep/civilities, openness, historical significance, and order were classified as those people associate with likability of the city. Because of shared biology, socio-cultural factors, and environment, humans will show some agreement in their evaluative response (Nasar, 1998, p. 30). Evaluative response can be a criterion of decision-making in selecting livable places, shopping, recreation, and travel destinations. Given a real choice, people would rather go to attractive places and avoid unattractive ones. Good appearance should also relate to the delight people take in a place, how well they remember it, and whether they come back to it for the qualities it embodies (Nasar, 1990). Research has also found that evaluative images and meanings can provide valid, reliable, and useful information for the planning, design, and management of desirable surroundings (Kaplan & Kaplan, 1989; Nasar, 1988a; 1998, Purcell, 1986; and Zube 1980).

Research has found that the most imageable buildings in a city elicit the strongest evaluations both positive and negative (Appleyard, 1976a). If most people like the imageable elements, the city will probably convey a positive evaluative image. If they

dislike them, the city will convey a negative evaluative image. This brings an attention to the cities for changes their appearance (Al-Kodmany, 2001). The aspect of city image is what Nasar calls the *likability* of the cityscape. Nasar, therefore, focused on meanings which represent inferences about the quality and character of the place and its users. He stressed that the connotative meaning is relevant to shaping urban form and its importance to human *behavior*. Where people have the capacity to act, connotative meanings affect their behavior, influencing decisions about whether to go somewhere and how to get there (Nasar, 1998, p. 7). Nasar asserted that imageability and meaning can explain people's perception and reaction to the environment sufficiently. His study focused on relationships between visual properties (cognitive dimension) and evaluative meaning (affective dimension). The influence of those interactions to human behavior was not measured.

This study set out to better explain factors that affect the concept of likability so that it can better be accomplished in a specific setting. Investigating interrelationships among three dimensions (cognitive dimension, affective dimension, and human behavior) can help our understanding of the likability concept. This study proposed a new way of conceptualizing likability and a model of relationships leading to the likability of an urban greenway trail environment. This study tested perceptions of greenway trail corridors and their relationship to aesthetic response within a likability measure.

Three components that make up cognitive evaluation (maintenance, distinctiveness, and naturalness) and two components for affective response

(pleasantness and arousal) became apparent. Concepts found in this study were classified into the same categories with concepts from other research. However, previous studies (e.g. Lynch's and Nasar's) have been conducted in more urban areas with more built infrastructure as a part of the visual landscape. This study examined an urban trail environment. The characteristics of the trails include many nature-based components by design and present the viewers with a somewhat different composition of the landscape. For example, in earlier research, historic significance was included as an important cognitive evaluation for community appearance (Nasar, 1998), but it was not an appropriate measure in the greenway trail environments studied here.

Emotional meaning dimensions including pleasantness, arousal, exciting, and relaxing have been used to measure human responses to physical environments in urban scenes (Hanyu, 1993; Russell & Snodgrass, 1989; Ward & Russell, 1981). Further, connotative meanings such as safety (Nasar & Jones, 1997) and friendliness (Nasar, 1989), have often been mentioned as influences on emotional response and behavior. This study found two dimensions of affective response: pleasantness and arousal. Pleasantness is a fundamental dimension of emotional reaction related to relaxation; arousal is the earlier dimension of activity and excitement results from arousal.

Nasar recognized two components of aesthetic response. The first was imageability or cognitive evaluation. The second component he represented as emotional meaning or likability. However, it may not be sufficient to explain likability as emotion which results from an interactional model of aesthetic response as suggested in Chapter II. Likability could be more than an interrelationship between imageability

and meaning. It is proposed here that likability is a variable which can be the result of cognitive process and emotion which drive a person's desire to use that place or be in the place. This study has conceptualized likability as a variable at work between cognition, emotion, and behavior. It can represent an intent to behave. In order to understand this concept, it has been proposed that relationships among various interwoven constructs such as cognitive evaluation, affective response, and perceived trail characteristics have to be investigated. Findings of this study indicated that likability is a useful measure to examine perceptions of linear open space and their relationship to aesthetic responses. Results here suggest a new way of conceptualizing likability (Figure 25).

Despite an increased interest in greenways as a potential tourism attraction, little empirical research has actually been conducted on the topic, especially from a likability perspective. Likability research in open space or greenway settings is especially scarce: very few studies have focused on examining perceptions of linear natural settings and their relationship to aesthetic response. As found in many studies, likability measures and community appearance provide important implications for creating an objective basis for decision-making and policy development (Nasar, 1998). Recreation and tourism planning and design, including greenways, have a major role to play in the image that communities convey.

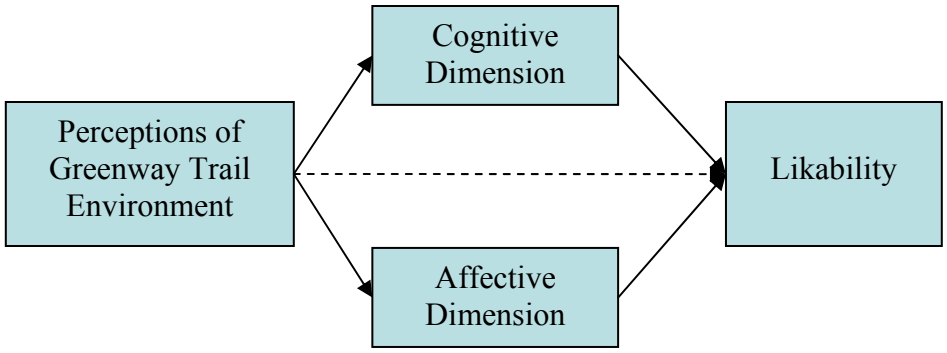

Figure 25. A Proposed Model of Relationships Leading to the Likability of an Urban Greenway Trail Environment

Managerial Implications

Greenways for Sustainable Communities

Greenways are often considered to provide a mechanism that balances needs for preserving environmental quality and allowing urban development (Conine et al., 2004). Greenways have evolved from a single-objective purpose of environmental protection or natural conservation to a multi-objective paradigm to meet various public demands such as recreation and tourism, environmental protection, and alternative transportation (Fabos, 1995). In order to meet public needs on multiple-objective greenways, planners, designers, and managers are confronted in incorporating many functions and maximizing benefits to satisfy their needs.

The majority of early efforts in greenways and trails studies are mainly concerned with their major functions such as ecological significance, recreational opportunities, and historic and cultural values. Much less attention has been paid to their benefits to communities. Empirical studies indicate that greenway trails contribute to the quality of life in many ways (Shafer, Lee, & Turner, 2000). Urban greenways can provide social and psychological benefits to society that could enhance urban dwellers' well-being and livability which induces sustainable communities.

Research has indicated that green spaces with visual quality may reduce stress (Ulrich, 1981), provide a benefit to mental health (Hartig et al., 1991), and provide a sense of tranquility (Kaplan, 1983). Visual quality influences enhancing the image of the city which make the city more attractive and promote it as a tourist destination. Many public and environmental professionals are concerned with aesthetics as a resource in developing public open spaces including greenways (Gobster, 1999). Green spaces can also increase social integration and interaction among residents (Coley et al., 1997) and promote the development of social ties (Kuo et al., 1998). Beside the social and psychological benefits, greenways can provide economic benefits such as increasing property values and tax revenues. Sustainable communities can be developed by considering not only ecological benefits but also the social benefits which are essential to human life.

Planning and Design of Greenway Trails

One of the major implications of this study was to identify a way (design cue) to improve the physical condition of greenway corridors in urban areas to better serve the multiple-objectives of greenways for sustainable communities. Nassauer (1995) suggested that design cues can reveal powerful messages of ecological beauty that shows human care and stewardship. For example, in greenway trails these design cues might include vegetation to screen unattractive nuisance elements. Several managerial implications on greenway trail design including trail characteristics are suggested based on the results of the study.

Greenway Trail Characteristics

Results contained various practical implications. The study can assist planners, designers, and managers of multiple objective greenway trails at several points in the project process. First, results showed that several trail characteristics elicited significant relationships to likability.

Vegetation along the Trail. Results indicated that amount of vegetation along the trail influenced likability of greenway trails and by increasing vegetation along the trail likability scores also increased. Vegetation plays significant roles in urban greenways. Research showed that crime rate *actually* reduced by increasing vegetation (Kuo et al., 1998). Appropriate management of vegetation may reduce stresses and increase restorative value (Kaplan et al., 1998; Ulrich, 1983). Color, shape, and texture of vegetation can also offer depth and character to greenway trails which may increase

likability. Research also confirmed that the high level of preference was given to both urban and natural environment with large amount of vegetation (Hartig et al., 1991; Kaplan & Kaplan, 1989). Gobster (1995) found that natural beauty is a top reason why people visit greenway trails and nature enhancement through full-scale vegetation management could enhance their visitation to come into contact with nature.

Vegetation can function in the form of screens and walls; for framing landscape and complementing surrounding elements, and buffering against visual confliction; and for outdoors rooms (Flink & Searns, 1993). Much research concerned that safety of urban openspaces are closely related to the management of vegetation (Gobster, 1995). Visibility is a major concern related to vegetation in urban greenways. Security can be enhanced by maintaining visibility and user surveillance, and avoiding blind thickets close to the trail. A study found that the more open sight from understory vegetation increased perceived safety in urban parks (Schreoder & Anderson, 1984). Planners and designers should consider where they place and how they manage vegetations associated with aesthetic and safety perspective. In terms of management, ecologically compatible and low-maintenance vegetation such as native plants should be considered from planning and design process.

Trail Facilities. Trail facilities such as lighting, bench, shelter, and trash containers were significant in perceiving greenway trails. The study found that both Buffalo Bayou and Town Lake trails have lack of trail facilities which elicited lower likability scores. Once trail facilities were added utilizing environmental simulation techniques, respondents rated higher likability scores to greenways trail with more trail

related facilities. Lighting is a critical issue in urban greenway trails. Lighting in greenway trails can increase nighttime uses and resolve safety, crime, and vandalism concerns (Luymes & Tamminga, 1995). The level of illumination and location should be reviewed before installation. The qualities of lighting in greenway trails can encourage people to bring in public areas after sunset (Painter, 1996).

Accommodation including benches and shelters are also critical in greenways (Gobster, 1995). Comfort and location are the major consideration to provide a place to rest and congregation. Trashcans are a necessary element in greenways trails for maintenance purpose. Consideration should be given to their location for both users and maintenance personnel, and size depending on location, adjacent facility, and amount of users. Another design consideration will be appearance and material. It needs to be compatible with surrounding environment.

One of most important elements of greenway trails is signage. Signage provides information in regard to facilities, education, regulatory, and safety. They must to be simple, clear, and readable (Flink & Searns, 1993; Luymes & Tamminga, 1995). In multi-ethnic communities, signage should provide information in multi-lingual that will lead users to an enhanced sense of secure. In addition, information provided by greenways, for example on-site signage and interpretive trails can be an important communication with public to convey knowledge of sustainability (Gobster, 1999).

Trail Tread. Trail surface can be an issue depending on various trail uses. Activities of pedestrian trail users may include walking and running that require relatively slow pace movement on smooth surface. Non-motorized vehicular trail users

are usually participated in bicycling and in-line skating who require relatively hard trail surface. A study found that smooth trail surface is one of top trail attributes and a rough trail surface was the strongest predictor of poor trail satisfaction in urban greenways (Gobster, 1995). Results confirmed that trail surface was a significant predictor of likability of both trails. Even though trail surface was a significant predictor of likability, there were no significant differences between hard surface and soft surface in likability. Since major activities in both trails include walking, running, and bicycling, a certain type of trails surface may not be required.

Less attention has been paid to the surrounding built environment such as background buildings in urban greenway trail settings. Results indicated that background buildings, built structures, and adjacent auto traffic had significant relationships with likability. Tourists and residents often responded that combination of well-managed natural and built environment is attractive in urban area which helps enhance the image of the city (Nasar, 1997). Kent and Elliot (1995) presented that church architecture and vernacular residential buildings are highly preferred landscape elements in New England. They found that cultural architecture contributed to visual quality of the region as much as natural features. It implied that planners and designers should consider how to minimize visual conflictions or to maximize visual access with certain associated elements on trail.

Designing appropriate types of trail corridors is not an easy task. Planners and designers may confront and struggle with a pre-condition of the place. A number of technical solutions should be reviewed to accomplish users' need and satisfaction. In

designing greenway trails, the issue of physical accessibility should be considered during planning and design process. Flink and Searns (1993) presented in their book *Greenways* that "a majority of the population will have some form of temporary or permanent disability at some point during their lives and that all facilities should be designed free of barriers and obstructions." The physical accessibility often mentioned with equity issue (Gobster, 1995). Equity or equal access is another key aspect of disparity of access to public open spaces that were mostly lacking in lower income and minority groups (Nilon & Huckstep, 1998). This issue has been emerging through public policy that encourages to expand outdoor recreation opportunities for elderly and young, racial and ethnicity groups, and disabilities, and non-mainstream recreational interest groups (Gobster, 2003).

Environmental Simulation in Planning Process

The benefits of public involvement in planning and design are widely documented (Al-Kodmany, 1999; 2001, Haklay, 2001; Howard, 1998; Kingston, 2001; Kingston et al, 2000; Roseland, 2000; Sarjakoski, 2001) that enhances peoples' stronger sense of commitment of the place, increases user satisfaction, and creates realistic expectations of outcomes (Sanoff, 1989; Smith & Hellmund, 1993). Literature suggests that participation can be enhanced through the use of visualization techniques for better communication (Howard, 1998). Also by using scientific research, it should more accurately predict eventual public meanings than would judgment by a jury of outsiders and design experts (Nasar, 1999).

Various techniques of modeling and analysis were being presented these days as key technological contributions to management of landscape aesthetic resources. Visualization provides a focus for a community's discussion of design ideas. It guides community members through the design process, raises their design awareness, and facilitates better communication. While effective hands-on methods of participation techniques are developed and described by several planners over time (Sanoff, 1989), the state-of-art in computer technology provides a unique opportunity to the public who change and enhance the way to interact with design using digital visual media (Al-Kodmany, 1999).

Additionally, the use of these technologies on the Internet is considered a promising mode to reach citizens who seldom participated or are unable to attend meetings. As the Internet continues to reshape how visitors react, planners have the opportunity to use Web-based technologies to widen access to decision making in tourism planning and design (Buhalis & Licata, 2002). Because the Internet is interactive, fast, and accessible world wide, the Internet has been recognized as a medium for two-way communication that would allow people to become both receivers and providers of information (Al-Kodmany, 2001).

Although a number of studies have illustrated empirical findings related to the issues mentioned above, other concerns still remain. In the literature, the relationship between visitor's experience and spatial distribution are often overlooked. Linking visitor's aesthetic response with the biophysical components of the environment would require that visitor's aesthetic response should be different by specific site and

experience. This is especially true in the linear landscape setting in terms of greenway. For example, even if "viewing the scenery" is often ranked at the highest portion in the landscape research (Gobster, 1995), they are frequently not asked to give about spatial information such as specific views, or what visual aspects of the landscape were valued (Mohamedahmed, 2000).

By investigating various visitors' aesthetic response by specific sites, planners, designer and managers could provide a clearer descriptive understanding of visitor preference and provide an improved design guideline of the site for future development. These aims are also intended to reinforce the concept that recreation and tourism development/planning require a collaboration of both visitor and professionals. Thus, visitors' response must be understood as the result of specific experience carried out in specific environmental resource concerns that requires geo-spatial representation.

Greenways and Urban Tourism

Cities have attracted much attention by academics and planners and have been described and evaluated for almost every aspect of the life and organization, with apparent exception of tourism. Large cities are arguably the most important type of tourist destination, thus, have always attracted visitors but until recently the tourism industry has not been perceived as a significant one, nor have these cities have been classified as tourist centers.

The skyscrapers, the arrangement of open spaces, and the vistas over the urban area can be attractive for visitors. Trails in greenways in urban areas have become a

typical feature of American cities. They can be used for commute, fitness, and recreation. Its role as a visual landmark has been strengthened in recent years through scenic quality in diverse urban landscape (The Conservation Fund, 2000). Since many cities concerned about their image as a potential tourism destination, the aspiring tourist city showed wish to consider its aesthetic quality, as it generally contributes greatly to the image.

Cities should have distinctive elements in order to have attention from the rest of the world, to attract visitors, and to induce decision makers and business enterprises for economic development (Law, 1994). To this end, it is not surprising that creating attractive and likable urban landscapes has become a critical issue for economic development and tourism strategy. Moreover, The Governor's Committee on the Environment reported that the governors of five New England states officially recognized open space as a key element in the quality of life in their region (Governor's Committee on the Environment, 1988). They credited quality of life with bringing rapid economic growth and a multi-billion dollar tourism industry to the region.

Greenways are often major tourist attractions which generate expenditures including lodging, food, and recreation related services. For example, Maryland's Department of Economic and Employment Development estimated the annual value of tourism and commercial activities directly related to the Chesapeake Bay was $31.6 billion in 1989. The San Antonio Riverwalk is considered the anchor of the $1.2 billion tourist industry in San Antonio, Texas. A user survey concluded that the Riverwalk is the second most important tourist attraction in the state of Texas (NPS, 1990).

Greenways can provide local opportunities and enhance tourist draw. Greenways promote tourism through year-round attractions and activities and support economic development. Florida statewide greenway system planning project revealed a number of benefits of greenways to the community (Carr & Zwick, 2002). Being an important asset to the community, greenways create a festival atmosphere for year-round activities; create space and activities that bring community together; focus on the arts and creates spaces for the display of art; provide aesthetic transitions from levees to neighborhoods; and preserve and protect aesthetic resources.

In sum, greenways function in a multitude of ways for the benefit of people, as well as the environment (Searns, 1995). Bischoff (1995) concerned that one of the purposes of greenways can also be extended to include a wide range of expression from verbal to visual. The potential powers of expression, encompassing the social, political, cultural, historic, and esthetic spectrum, can add richness to the fabric of the greenway heritage. It is very appropriate for the range of expressive powers to be considered as part of the greenway potential. In cities and other urban areas, greenways can encompass natural or man-made features and can be managed and developed as a great tourist attraction.

Suggestions for Future Research

Greenway trails have a major role to play in the image that communities convey. This study showed an example of likability for specific greenway trail corridors in

communities and the kind of information obtained. While this study revealed much information in regard with aesthetic responses to urban greenway corridors, few limitations should be reviewed in the future studies.

First, the samples should be diversified. Since articulate volunteers were needed in the main study, the majority of samples in the study were consisted of college students. There may be a bias in the results, therefore, future study should be conducted with a more representative sample of the general population. Since the sample was homogeneous, no differences were found to investigate the differences regarding perceptions on greenway trail characteristics among age, sex, or other groups. Investigating likability within different groups and subcultures will help enhance and maintain the quality of the environment that induces sustainable development. Planners and designers should also consider likability of special population such as children, the disabled, the elderly, and others who may have unique likability. In a broad sense, socio-cultural information including lifestyle, social class, ethnicity, and stage in life cycle should be considered for future study.

Second, in order to achieve desired appearance of a greenway trails, planners and designers should both consider public participation in the planning and design process, and have a comprehensive approach which can provide specific actions to achieve the guidelines for desired appearance instead of identified general guidelines from previous research. Even though planners and designers could understand how the public evaluates the visual landscape and how they react to various environments, still they need specific guidelines for design decision relating to appearance. A comprehensive

approach should be applied in the future study of aesthetic responses desired for the particular greenway project, context, and population. In practice, because each greenway design decisions need a specific guideline to accomplish desired appearance, a comprehensive approach in other words, aesthetic programming can be a crucial method to accomplish the project's purpose. Aesthetic programming is commonly used as architectural programming that one investigates, develops, gathers and organizes information to produce and aesthetic program or objective guidelines to achieve a desirable appearance (Nasar, 1997). In turn, through aesthetic programming, the programmer investigates, develops, gathers, and organizes environmental information (Sanoff, 1989) to produce design guidelines supportive of the goals for greenway trails. Likability is a useful measure to achieve this guideline. This also can be used to evaluate the project after construction and occupancy. (Nasar, 1997, 1998, 1999).

Third, it would be worth to apply these methods to environment of different settings. Research on likability should be extended at different scales and different places. In addition to studying different places and scales of places, consideration should be given to different groups. Because planning and design take place around the world, planners and designers were called to consider the extent to which the findings in a certain case apply elsewhere. This study could be a corner stone to develop methods and concepts for enhancing visual quality of places. Future direction for research in involving likability is the application and evaluation of the concept at different places and different scales, with consideration of methods in various scales, and group characteristics, and changes in the image over time.

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APPENDIX I

Section 1. The following questions ask about your use of trails

1. For each of the following trail activities, please indicate approximately how often you engage in each. If you never do that activity, please mark never.

Walking:

( ) never ( ) once a year ( ) few times a years ( ) monthly ( ) weekly ( ) daily

Running/Jogging:

( ) never ( ) once a year ( ) few times a years ( ) monthly ( ) weekly ( ) daily

Bicycling:

( ) never ( ) once a year ( ) few times a years ( ) monthly ( ) weekly ( ) daily

In-line skating:

( ) never ( ) once a year ( ) few times a years ( ) monthly ( ) weekly ( ) daily

Motorcycling/ATV:

( ) never ( ) once a year ( ) few times a years ( ) monthly ( ) weekly ( ) daily

Other (specify _____)

2. Thinking of the activity above that you participate in most often, about how much time would you spend doing that activity each time you participate?

_____ hour(s)_____minutes

3. How long have you been participating in that activity?

_____ years _____months

Section 2. In this section, remember to use the first full screen photo for each spot along the trail to explore the scene then when ready move to the next scene to score the scene.

1. Please evaluate this scene using each of the item pairs below. Mark one space for each pair to indicate how you feel it describes the scene.

plain	:---------:---------:---------:---------:	ornate
ordinary	:---------:---------:---------:---------:	distinct
wrinkled	:---------:---------:---------:---------:	pressed
simple	:---------:---------:---------:---------:	complex
typical	:---------:---------:---------:---------:	unusual
open	:---------:---------:---------:---------:	closed
inviting	:---------:---------:---------:---------:	repelling
good for wildlife	:---------:---------:---------:---------:	bad for wildlife
disarray	:---------:---------:---------:---------:	harmony
tidy	:---------:---------:---------:---------:	messy
understandable	:---------:---------:---------:---------:	confusing
rural	:---------:---------:---------:---------:	urban
casual	:---------:---------:---------:---------:	formal
obvious	:---------:---------:---------:---------:	mysterious
clean	:---------:---------:---------:---------:	dirty
natural	:---------:---------:---------:---------:	artificial
maintained	:---------:---------:---------:---------:	neglected
ordered	:---------:---------:---------:---------:	chaotic
common	:---------:---------:---------:---------:	unique

2. Once again, evaluate the scene by marking one space for each pair to indicate how you feel it describes the scene.

relaxed	:---------:---------:---------:---------:	tense
pleasing	:---------:---------:---------:---------:	annoying
safe	:---------:---------:---------:---------:	dangerous
exciting	:---------:---------:---------:---------:	boring
active	:---------:---------:---------:---------:	passive
calm	:---------:---------:---------:---------:	stressful
pleasant	:---------:---------:---------:---------:	unpleasant
friendly	:---------:---------:---------:---------:	hostile

3. The following questions ask you to evaluate specific characteristics of the scene. Please mark each item to best describe how you feel about characteristic in each scene.

Width of trail
too narrow about right too wide
:---------:---------:---------:---------:

Surface of trail
too soft about right too hard
:---------:---------:---------:---------:

Amount of vegetation
too little about right too much
:---------:---------:---------:---------:

Presence of water
not enough about right too much
:---------:---------:---------:---------:

Trail related facilities (e.g. benches, water fountains)
not enough about right too many
:---------:---------:---------:---------:

Presence of background buildings
not enough about right too many
:---------:---------:---------:---------:

Presence of built structure close to trail
not enough about right too many
:---------:---------:---------:---------:

Auto traffic
not enough about right too much
:---------:---------:---------:---------:

4. The following items ask you to evaluate how you feel about using this part of the trail. Please mark each item to show how much you agree or disagree.

I would not enjoy being on this part of the trail	Strongly disagree	Neutral		Strongly agree
The portion of the trail is inviting	Strongly disagree	Neutral		Strongly agree
The portion of trail that I just experienced would be a good place for walking	Strongly disagree	Neutral		Strongly agree
The portion of trail that I just experienced would be a good place for running/jogging	Strongly disagree	Neutral		Strongly agree
The portion of trail that I just experienced would be a good place for bicycling	Strongly disagree	Neutral		Strongly agree
The portion of trail that I just experienced would be a good place for in-line skating	Strongly disagree	Neutral		Strongly agree
The portion of trail that I just experienced would be a good place for motorcycling/ ATV	Strongly disagree	Neutral		Strongly agree

Section 3. Overall experience of trail (each segment)

The following questions ask you to evaluate your overall experience given the scenes you have just viewed along the trail. Please rate each item to best describe your feelings.

How much do you like this trail segment based on all the spots you viewed along it?	not at all	Very much
How much would you like to visit this trail?	not at all	Very much

Section 4. The following questions ask you to evaluate this virtual tour. Please rate the extent to which you agree or disagree with each statement.

During the virtual trail trip, I was unable to examine the attributes of the trail closely	Strongly disagree neither disagree nor agree Strongly agree :---------:---------:---------:---------:
During the virtual trail trip, I felt like I left the room	Strongly disagree neither disagree nor agree Strongly agree :---------:---------:---------:---------:
I felt more like I was looking at photographs rather than actually visiting the trail	Strongly disagree neither disagree nor agree Strongly agree :---------:---------:---------:---------:
If I visited the trail, I would not expect it to match my virtual trail trip	Strongly disagree neither disagree nor agree Strongly agree :---------:---------:---------:---------:
During the virtual trail trip, I felt like I was on the trail	Strongly disagree neither disagree nor agree Strongly agree :---------:---------:---------:---------:

Section 5. The following questions ask you to assess the instrument for this virtual tour. Please rate each to indicate how you feel it performed.

Size of photographs used to first show you each view point on the trail	too small about right too big :---------:---------:---------:---------:
Size of photographs for each viewpoint on response screen	too small about right too big :---------:---------:---------:---------:
Number of view points used to represent a trail segment	not enough about right too many :---------:---------:---------:---------:
Ease of use of this tour	too easy about right too difficult :---------:---------:---------:---------:
Speed of navigation during the tour	too slow about right too fast :---------:---------:---------:---------:

Amount of scene viewed for each viewpoint on the trail	not enough about right too much :----------:----------:----------:----------:
Sounds in the room which you were on the tour	too noisy about right too quiet :----------:----------:----------:----------:
Light in the room which you were on the tour	too dark about right too bright :----------:----------:----------:----------:
What is your overall assessment of this virtual tour	Poor fair good very good excellent :----------:----------:----------:----------:
How much did the map of trail contribute to your virtual trail experience?	not at all a little somewhat high very high :----------:----------:----------:----------:

Section 6. Demographic information

1. Are you? Male_____. Female_____.
2. What is your age? _____ years.
3. What class year are you in?
   freshmen____ sophomore _____ junior_____ senior_____ graduate _____
4. Are you color blind? Yes_____. No_____.
5. Please rate your photography skills. Poor fair good very good excellent
   :----------:----------:----------:----------:

APPENDIX II

Buffalo Bayou Trail Primary Travel Direction Panoramic Pictures

View Point 1

View Point 2

View Point 3

View Point 4

View Point 5

View Point 6

View Point 7

View Point 8

Buffalo Bayou Trail Alternative Travel Direction Panoramic Pictures

View Point 1

View Point 2

View Point 3

View Point 4

View Point 5

View Point 6

View Point 7

View Point 8

Buffalo Bayou Trail Primary Travel Direction with Manipulation Panoramic Pictures

View Point 1

View Point 2

View Point 3

View Point 4

View Point 5

View Point 6

View Point 7

View Point 8

Town Lake Trail Primary Travel Direction Panoramic Pictures

View Point 1

View Point 2

View Point 3

View Point 4

View Point 5

View Point 6

View Point 7

View Point 8

Town Lake Trail Alternative Travel Direction Panoramic Pictures

View Point 1

View Point 2

View Point 3

View Point 4

View Point 5

View Point 6

View Point 7

View Point 8

Town Lake Trail Primary Travel Direction with Manipulation Panoramic Pictures

View Point 1

View Point 2

View Point 3

View Point 4

View Point 5

View Point 6

View Point 7

View Point 8

APPENDIX III

Web-programming Example

```
<html>
<head>
<title>Pre-experience of trail</title>
<meta http-equiv="Content-Type" content="text/html; charset=euc-kr">
<SCRIPT LANGUAGE = "JavaScript">
<!--


function isReady(form) {
		if (form.id.value == "") {
		alert("Please, input the ID number!");
		form.id.focus();
		return false;
	}
	if (form.q1_1[0].checked || form.q1_1[1].checked || form.q1_1[2].checked ||
form.q1_1[3].checked || form.q1_1[4].checked || form.q1_1[5].checked) {
			;
		} else
		{
			alert("please answer all questions");
			return false;
		}
	if (form.q1_2[0].checked || form.q1_2[1].checked || form.q1_2[2].checked ||
form.q1_2[3].checked || form.q1_2[4].checked || form.q1_2[5].checked) {
			;
		} else
		{
			alert("please answer all questions");
			return false;
		}

	  if (form.q1_3[0].checked || form.q1_3[1].checked || form.q1_3[2].checked ||
form.q1_3[3].checked || form.q1_3[4].checked || form.q1_3[5].checked) {
			;
		} else
		{
			alert("please answer all questions");
			return false;
		}
```

```
                if (form.q1_4[0].checked || form.q1_4[1].checked || form.q1_4[2].checked
|| form.q1_4[3].checked || form.q1_4[4].checked || form.q1_4[5].checked) {
                        ;
                } else
                {
                        alert("please answer all questions");
                        return false;
                }


                if (form.q1_5[0].checked || form.q1_5[1].checked || form.q1_5[2].checked
|| form.q1_5[3].checked || form.q1_5[4].checked || form.q1_5[5].checked) {
                        ;
                } else
                {
                        alert("please answer all questions");
                        return false;
                }


        if (form.q2_1.value == "") {
        alert("Please answer all questions.");
        form.hour.focus();
        return false;
    }
    if (isNaN(form.q2_1.value)) {
       alert("Please, use number.");
       form.hour.value = "";
       form.hour.focus();
       return false;
    }

        if (form.q2_2.value == "") {
        alert("Please answer all questions.");
        form.hour.focus();
        return false;
    }
    if (isNaN(form.q2_2.value)) {
       alert("Please, use number.");
       form.hour.value = "";
       form.hour.focus();
       return false;
    }
```

```
                    if (form.q3_1.value == "") {
            alert("Please answer all questions.");
            form.hour.focus();
            return false;
    }
    if (isNaN(form.q3_1.value)) {
       alert("Please, use number.");
       form.hour.value = "";
       form.hour.focus();
       return false;
    }

            if (form.q3_2.value == "") {
            alert("Please answer all questions.");
            form.hour.focus();
            return false;
    }
    if (isNaN(form.q3_2.value)) {
       alert("Please, use number.");
       form.hour.value = "";
       form.hour.focus();
       return false;
    }
    return true;
}


//-->
</SCRIPT>
</head>

<body bgcolor="#FFFFFF" text="#000000">
<form name="form" method="post" onSubmit = "return isReady(this)" action=
"inputSection1.php">
<table width="750" border="0" align="center">
  <tr>
    <td>
      <div align="center"><font size="+1"><b>Pre-experience of trail</b></font></div>
    </td>
  </tr>
  <tr>
    <td>
       <table width="100%" border="0">
         <tr>
```

```
  <td>0. Please write your ID Number :
    <input type="text" name="id" size="20" maxlength="50">
  </td>
</tr>
<tr>
  <td>1. For each of the following trail activities, please indicate
    approximately how often you engage in each. If you never do that
    activity, please mark never.</td>
</tr>
<tr>
  <td> <b>Walking: </b></td>
</tr>
<tr>
  <td>
    <input type="radio" name="q1_1" value="1">
    never
    <input type="radio" name="q1_1" value="2">
    once a year
    <input type="radio" name="q1_1" value="3">
    few times a years
    <input type="radio" name="q1_1" value="4">
    monthly
    <input type="radio" name="q1_1" value="5">
    weekly
    <input type="radio" name="q1_1" value="6">
    daily </td>
</tr>
<tr>
  <td><b>Running/Jogging: </b></td>
</tr>
<tr>
  <td>
    <input type="radio" name="q1_2" value="1">
    never
    <input type="radio" name="q1_2" value="2">
    once a year
    <input type="radio" name="q1_2" value="3">
    few times a years
    <input type="radio" name="q1_2" value="4">
    monthly
    <input type="radio" name="q1_2" value="5">
    weekly
    <input type="radio" name="q1_2" value="6">
    daily </td>
```

```
</tr>
<tr>
  <td><b>Bicycling:</b> </td>
</tr>
<tr>
  <td>
    <input type="radio" name="q1_3" value="1">
    never
    <input type="radio" name="q1_3" value="2">
    once a year
    <input type="radio" name="q1_3" value="3">
    few times a years
    <input type="radio" name="q1_3" value="4">
    monthly
    <input type="radio" name="q1_3" value="5">
    weekly
    <input type="radio" name="q1_3" value="6">
    daily </td>
</tr>
<tr>
  <td><b>In-line skating: </b></td>
</tr>
<tr>
  <td>
    <input type="radio" name="q1_4" value="1">
    never
    <input type="radio" name="q1_4" value="2">
    once a year
    <input type="radio" name="q1_4" value="3">
    few times a years
    <input type="radio" name="q1_4" value="4">
    monthly
    <input type="radio" name="q1_4" value="5">
    weekly
    <input type="radio" name="q1_4" value="6">
    daily </td>
</tr>
<tr>
  <td><b>Motorcycling/ATV: </b></td>
</tr>
<tr>
  <td>
    <input type="radio" name="q1_5" value="1">
    never
```

```
            <input type="radio" name="q1_5" value="2">
            once a year
            <input type="radio" name="q1_5" value="3">
            few times a years
            <input type="radio" name="q1_5" value="4">
            monthly
            <input type="radio" name="q1_5" value="5">
            weekly
            <input type="radio" name="q1_5" value="6">
            daily </td>
          </tr>
          <tr>
            <td>Other (specify
            <input type="text" name="q1_6" size="70" maxlength="100">
            )</td>
          </tr>
          <tr>
            <td>2. Thinking of the activity above that you participate in most
            often, about how much time would you spend doing that activity each
            time you participate?
            <input type="text" name="q2_1" size="5" maxlength="5">
            hour(s)
            <input type="text" name="q2_2" size="5" maxlength="5">
            minutes </td>
          </tr>
          <tr>
            <td>3. How long have you been participating in that activity?
            <input type="text" name="q3_1" size="7" maxlength="7">
            year(s)
            <input type="text" name="q3_2" size="7" maxlength="7">
            month(s)</td>
          </tr>
        </table>
      </td>
    </tr>
    <tr>
      <td>
        <div align="center">
          <input type="submit" name="Submit" value="next">
        </div>
      </td>
    </tr>
  </table></form>
```

```
<p align="center"><font size="-1" color="#999999">Copyright ⓒ 2003 Jinhyung
Chon.
  All rights reserved. </font><br>
</p>
</body>
</html>
```

Database Example

inputSelection1.php

```
<?php

	setcookie("mem_id", $id , 0, "/");
	setcookie("tmStart", 0 , 0, "/");
	setcookie("tmEnd", 0 , 0, "/");
?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">

<html>

<head>
	<title>Untitled</title>
</head>

<body>

<?php

include "user_function.inc";

include "dbconn.inc";

$result = mysql_query("SELECT id FROM bbtbSection1 where id = '$id'");
if (!$result) {
  error("QUERY_ERROR");
  exit;
}

$num = mysql_num_rows($result);

if($num==0) {
$result = mysql_query("INSERT INTO bbtbSection1 (id, q1_1, q1_2, q1_3, q1_4, q1_5,
q1_6, q2_1, q2_2, q3_1, q3_2) VALUES ('$id', $q1_1, $q1_2, $q1_3, $q1_4, $q1_5,
'$q1_6', $q2_1, $q2_2, $q3_1, $q3_2)");

} else {
$result = mysql_query("UPDATE bbtbSection1 SET q1_1=$q1_1 , q1_2=$q1_2,
q1_3=$q1_3, q1_4=$q1_4, q1_5=$q1_5, q1_6='$q1_6', q2_1=$q2_1, q2_2=$q2_2,
q3_1=$q3_1, q3_2=$q3_2 WHERE id = '$id'");
}
```

```
if($result) {

        echo ("<meta http-equiv='Refresh' content='0; URL=section2intro.htm'>");
} else {
  error("QUERY_ERROR");
  exit;
}

?>

</body>
</html>
```

QuickTime VR & Survey Example

hs1.php

```
<?php
        if ($tmEnd == 0) {
                $timeEnd = time();
                setcookie("tmEnd", $timeEnd , 0, "/");
        }
?>
```

QuickTime VR

left.htm

```
<html>
<head>
<title>Untitled Document</title>
<meta http-equiv="Content-Type" content="text/html; charset=euc-kr">
</head>

<body bgcolor="#FFFFFF" text="#000000">
<br><br><br><br><br>
<OBJECT CLASSID="clsid:02BF25D5-8C17-4B23-BC80-D3488ABDDC6B"
WIDTH="480" HEIGHT="320"
CODEBASE="http://www.apple.com/qtactivex/qtplugin.cab">
                <PARAM name="SRC" VALUE="../movies/hshotspot1.mov">
                <PARAM name="AUTOPLAY" VALUE="true">
                <PARAM name="CONTROLLER" VALUE="true">
            <embed src="../movies/hshotspot1.mov" width="480" height="320"
autoplay="true" loop="true" controller="true" playeveryframe="false"
pluginspage="http://www.apple.com/quicktime/download/">
            </embed> </OBJECT>
<p align="center"><font size="-1" color="#339900">Copyright ⓒ 2003 Jinhyung
Chon.
  All rights reserved. </font></p>
</body>
</html>
```

VITA

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EDUCATION

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University of Pennsylvania, Philadelphia, Pennsylvania
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