THE EFFECT OF PLANTS ON HUMAN PERCEPTIONS AND BEHAVIOR WITHIN AN INTERIOR ATRIUM

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(Abstract)

Plants are frequently used as design components for various types of interior settings. Design professionals may specify plants because of a subconscious awareness of the human need for natural contact, or as in may cases, such as in a "sunspace", because it is traditional to do so. Past studies by behavioral and horticulture researchers have documented human preference for plants, and have shown that plants positively affect people psychologically, but little research has been done to determine whether the use of plants in interior environments can influence human behavior.

Interior plantscaping is a vital and expanding type of agribusiness, with millions of dollars being spent each year to install and maintain plants specified by design professionals. Plants are frequently used for clients in industry, health care, hospitality, retail, education, and in personal residences. Demonstrating that plants influence human physical behavior in interior environments would

increase their value as interior design components, and provide a powerful sales tool to the plantscaping industry. Because of the potential importance of understanding more about the influence of plants in interior spaces on human behavior, this research examines whether user behavior patterns and spatial perceptions can be changed by the simple addition of interior plantscaping.

This study was conducted to determine whether the introduction of trees and plants into an underutilized area of a newly constructed interior atrium would affect user perceptions of, and/or behaviors in the space. User perceptions of and activities within the atrium were recorded on questionnaires and behavioral maps, both before and after the installation of Ficus trees and Chinese Evergreen plants. Surveys were used to collect demographic information, suggestions for improving the atrium, and to determine user perceptions via the use of 13 polar adjective pairs on a six point semantic differential scale. Maps were used to record user behaviors on the lower atrium level where the plants were placed.

The majority of data were analyzed descriptively by frequencies and percentages. Semantic differential analysis was done using two-tailed t-tests at $p = .05$. T-tests did not prove to be significant. There was mean

movement of perceived perceptions from pre- to post-test. User behavior on the lower atrium level appeared to be affected by plant installation. A preference was shown for napping under the trees, and users spent more time on that atrium level when the trees and plants were present.

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TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGEMENTS v

LIST OF FIGURES viii

LIST OF TABLES ix

Chapter

I. INTRODUCTION. 1

The Use of Plants in Interior Design 3
Research Problem 6
Purpose 7
Research Questions 7
Limitations of the Study 7
Justification 10

II. REVIEW OF LITERATURE. 14

Plant Related Behavioral Studies 17
Related Studies Using Multiple Methodologies 24

III. METHODOLOGY 28

Experimental Setting 28
Instruments 38
The Survey 38
Pilot Test and Revision 40
The Sample 40
Distribution of the Survey Form 41
Behavioral Mapping 42
Plantscaping 45
Data Analysis 47
Survey Data Analysis 47
Hypotheses 49
Behavioral Map Data Analysis 50

IV. RESULTS AND DISCUSSION 51

Results 51
Limitations of the Experimental Setting . . . 51
Atrium Users Participating in the Study . . . 54
Survey Questionnaire Results 55
Demographic Information 55

User Matrix 57
Semantic Differential Analysis 59
Atrium Improvement Suggestions 68
Behavioral Mapping Results 70
Discussion 74
Additional Observations 78

V. SUMMARY AND IMPLICATIONS 80

Summary of the Study 80
Findings 82
Implications for Future Research 85

LITERATURE CITED 88

APPENDIX A: SURVEY QUESTIONNAIRE 92

APPENDIX B: BEHAVIORAL MAP 95

APPENDIX C: PROJECT BUDGET 97

VITA 99

LIST OF FIGURES

Figure Page

1. Photograph of the Wallace Hall Atrium 30

2. Floor 3 (balcony) floor plan 31

3. Photograph of the 2nd floor (mezzanine) of the Wallace Hall Atrium 33

4. Mezzanine floor plan 34

5. Photograph of the 1st floor (lower level) of the Wallace Hall Atrium 35

6. First floor plan 36

7. Map with tree locations and leaf circumferences . . 46

8. Photograph of trees adjacent to central seating on lower atrium level 48

9. Profile analysis showing changes in mean responses of lower level user perceptions . . 63

10. Profile analysis showing changes in mean responses of mezzanine user perceptions . . . 65

11. Profile analysis comparing averaged mean responses of both mezzanine and lower level users 67

12. Photograph of central seating on lower atrium during during post-test 84

LIST OF TABLES

Table Page

1. Atrium user demographic 58

2. Atrium users' reported activities by floor level . . 60

3. Written atrium improvement suggestions 69

4. Lower atrium level user seating choices 73

5. Average user time seated on
lower atrium level in minutes 75

Chapter I

INTRODUCTION

A building technique that has steadily grown in popularity since the 1970's is the use of an atrium to enhance or expand an existing facility. An atrium as defined by the New Webster's Dictionary of the English Language (1981), is a central open area within a building. Because an atrium often features large expanses of overhead glass, it can also function as a solarium, allowing the penetration of natural light into the building core. The atrium is then, by design, a light well. By using this method, old and new buildings can be joined successfully and attractively, to create functional new spaces.

Atriums have been designed for shopping malls, hotels, academic buildings, office buildings, airports, government buildings, residential complexes, and health care facilities. Functioning as a type of interior courtyard, they facilitate a variety of activities ranging from building circulation to private relaxation. Large public atriums are often the site of choice for special social events such as fashion shows or art exhibits.

The correct combination, location, and balance, of both functional and decorative components contributes to the perceived success of any interior space. Because an atrium

is often the same physical height as the building it joins, spatial volumes can be large. These voluminous spaces provide special interior design challenges.

An atrium permits the use of large scale decorative elements that contribute to visual drama. Exciting, functional atrium spaces have been created by using a variety of components such as furniture, fountains, waterfalls, glass elevators, decorative banners, sculpture, aviaries, and indoor plantscaping.

A successful interior space can be defined as one that fulfills the requirements of the client and functions as the architect or designer intended. If an atrium is designed to be used by the public, the success of the space may be measured by the number atrium users or the frequency of use. A low level of use by the public could indicate a design shortcoming.

Scott (1989) cites studies showing that people react strongly to perceptual as well as physical environmental conditions, and that perception for normal sighted people is predominantly a visual experience. Visual components of an interior include color, room size and shape, number and social make-up of the occupants, lighting, and decor (Rohles & Miliken, 1981). In addition to these visual clues, humans respond to psychological aspects of a space, including

comfort and a desired amount of privacy (Sommer, 1974; Zeisel, 1981).

Spatial characteristics such as volume, height, light, and overall view or vista, are often perceived as positive attributes of a public space. By contrast, if these characteristics are negatively perceived and alter the anticipated behavior of users in a space, they become problematic. For example, openness may elicit an avoidance response when visual privacy is desired. Sommer (1974) found that, in nature, the most common way an organism reacts to a "noxious" situation is by withdrawal. If people are uncomfortable in a space, they will not use it.

To summarize, because an atrium is by design a voluminous, open, light-filled space often intended for public use, the professionals designing it must consider human needs and behaviors in addition to architectural components for user acceptance. A successful atrium should satisfy visual, physical, and psychological needs of occupants within its unique spatial character.

The Use of Plants in Interior Design

An atrium may also be described as a "sunspace," where plants are frequently used as design components. A certain

amount of visual privacy in this type of interior environment is often accomplished by using innovative "plantscaping" techniques to provide aesthetically pleasing natural screening.

Research has shown that, in addition to their use as design components, plants can be used in a space to affect human well-being. A growing body of literature suggests that the presence of plants in the urban environment has a considerable affect on how people feel about the places in which they live and work.

Several researchers have found that urban environments with trees and plants are preferred over places without living plants (Heerwagen & Orians, 1986). Thayer and Atwood (1978) and Russell and Mehrabian (1978) measured the impact that plants have on visitors to a space, and found that the presence of plants increases feelings of pleasure. Campbell (1979) found that plants contribute to student comfort in faculty offices. Studies show how selected plants positively contribute to the perceived quality of indoor space (Laviana, Mattson & Rohles, 1983). Additionally, researchers have looked at the impact of plants on productivity, absenteeism, and employee morale. Randall, Shoemaker, Relf, and Geller (1992) found that office plantscaping positively affects worker satisfaction, and

that employees became psychologically attached to the plants installed in their office environments.

Most of the research dealing with plants in interior space focuses on human psychological responses. Research designed to investigate the impact of plants in the interior environment on human behavior has been minimal. In one related study, Evans and Malone (1992) found that plants influenced room occupancy patterns in the Opryland Hotel of Nashville, Tennessee.

This AAA four diamond facility boasts an annual occupancy rate of 85%, when the national average is 68%. This unique building complex contains two indoor atriums (12 acres) featuring over 600 species of indoor trees and plants. The hotel's annual horticulture budget for plant maintenance is approximately $1.2 million, requiring a staff of approximately 52 people. By comparing occupancy rates of rooms without an atrium view to occupancy rates of rooms overlooking the indoor gardens, the researchers determined that, although the rooms with garden views were $30.00 more per day, they were always the first to be reserved by repeat guests. Increased revenue from atrium-view rooms translates into an additional $7 million annually. The Opryland study indicates that plants may physically attract people, and that this attraction in turn influences human behavior: in

this instance room selection and consumer spending. No other studies have been identified investigating the possibility that plants might influence human behavior in interior space.

Major companies have incorporated plantscaping as part of their interior design policy. Despite substantial capital outlay, corporate decisions regarding the need for plants have not been founded on empirical research (Randall, Shoemaker, Relf, & Geller, 1992). Decisions concerning why and how plants are used in corporate environments could reflect personal preference, familiarity, past experience, air quality concerns, or numerous other reasons.

Research Problem

The popularity of the atrium has resulted in the increased use of plants as design elements for this type of sunspace. What impact plants may have on human behavior in, or perceptions of, this type of interior environment invites investigation.

Behavioral research on the way in which plants affect humans has been limited to preference studies, employee response, and indoor air quality improvement (Kaplan & Kaplan, 1989; Randall, Shoemaker, Relf, and Geller, 1992; Scott, 1989). Little is known about how plants influence

human behavior in buildings, or specifically whether the introduction of plants into an interior space would impact usage.

Purpose

The purpose of this study was to compare perceptions and behavior patterns of occupants in a newly constructed interior atrium before and after plants have been added to the space.

Research Questions

The two research questions addressed in this study were:

1. Can atrium user perceptions be significantly changed by the introduction of plants into the space?
2. Will lower atrium user behaviors change when plants are installed?

Limitations of the Study

Existing conditions in the three story atrium site could limit the scope of the study. These factors are present in the form of the following extraneous variables:

1. Exterior weather patterns (precipitation, light levels, and temperature)

Due to the nature of a sunspace, and the inability to control the internal temperature of the selected atrium site, the atmosphere of the space is dependent on external weather conditions. Daily atrium light and temperature conditions could fluctuate depending upon the type of weather situation outdoors. Increases in daily exterior temperature would cause corresponding increases in the temperature of the atrium. This condition may adversely affect the distribution of the sample population within the atrium, resulting in decreased use of the mezzanine in the afternoon, and a possible increase in the use of the lower level, which is always cooler and not as bright.

2. Inability to control the use of facilities adjacent to the lower atrium level.

Visual merchandising display windows and a gallery located on the level of behavioral observation will be used during the course of the study. Displays in both areas located adjacent to the main observational space may have some affect on the number and behavior of the lower atrium population. The researcher has no control over, or knowledge of when visual displays will be installed or changed. A child development center with public access located on

this floor may also affect sample behavior.

The college may use the atrium during data collection for scheduled public events, or class meetings. The researcher has no control over, or knowledge of whether such gatherings will occur.

3. Plant condition

Because plants had never been installed in the new atrium space, it was not known whether conditions were hospitable or conducive to sustaining plant life. Pretest evaluation of the atrium by university horticulture experts confirmed that there was sufficient daylight on the mezzanine level to sustain plants, but low light levels on the first floor indicated that plants could only be installed temporarily. Conditions of temperature fluctuation and humidity which would affect the physical appearance of the trees and plants were not known.

Trees chosen by horticulture consultants for use in this study were 15′ Ficus benjamina trees. Although frequently used in similar atrium installations with great success, Ficus trees do not react well to being moved, and require adjustments to new environmental regimes. Adverse reactions can include systemic shock and leaf loss.

Justification

Interior plantscaping is a vital and growing type of agribusiness. Each year millions of dollars are spent to install and maintain plants specified by interior designers and architects for clients in industry, health care, hospitality, retail, education, and residential facilities (Evans & Malone, 1991). Research has been conducted investigating preference for plants in various interior public environments, but has not been done to determine whether plants have the ability to alter human behavior by their presence in a space.

Plants are currently used in interior space because it is generally accepted that people like plants. Recent research has shown that people prefer natural elements in built environments for reasons of aesthetics, personal satisfaction, the perception of comfort, or perceived therapeutic qualities such as relaxation (Kaplan & Kaplan, 1989).

Demonstrating that plants affect human behavior in interior environments could prove to be a powerful sales tool for the plantscape industry, may serve as an occupant management tool for facility managers, and could influence the use of plants in interior design if they are found to be more than decorative components. Plants could conceivably

be carefully situated by retail facility managers to direct patrons into "slow" areas of shopping malls, into stores or store areas primarily designated as "impulse" spaces, or through less popular departments with high profit goods. Nursing homes could use plants to create a setting that encourages solitary elderly patients to socialize in public day rooms. Other health care facilities could provide indoor atriums or plant filled solariums that, in addition to the promotion of psychological well-being, might encourage physical stimulation (visitation) and patient mobility leading to accelerated recovery. There are many exciting possibilities.

Horticulture experts believe such research will have application to the development of the interior plant industry and to practices involved in installing and maintaining plants (Relf, 1992b). This research may encourage decision makers to use more plants in hotel, interior design, building/construction, and other related industries.

Few studies have focused on how the special people-plant relationship has influenced modern life and industry. Current literature attributes this lack of research to people taking plants so much for granted that their importance never occurred to them, or to a belief that plant-human relationships are so fundamental and generally

accepted that all important data had been acquired at some time in the past (Relf, 1992a). Horticulturists feel that through interdisciplinary research with other fields that use plants, new and valuable insight about plants and their role in human activity can be supplied.

Relf, in a 1992 paper titled "Human Issues In Horticulture", discusses why additional research in this area is needed. She quotes researchers Ulrich and Parsons (1991), who justify additional research with the following statement:

> Unfortunately, intuitive arguments in favor of plants usually make little impression on financially pressed local or state governments, or on developers concerned with the bottom line ... The lack of research on plant benefits also has tended to reduce spending for plants in other important settings, such as workplaces, health-care facilities ... Increased research in this area coupled with communications to make the public aware of the findings would increase significantly the appreciation and use of plants, and in so doing, would increase the demand for horticultural products and services, increase the number of jobs in the industry, and ultimately, increase the demand and funding for traditional horticulture research and education (p.9).

Findings resulting from such research could present important implications for the quality of life of all people occupying interior spaces, from office workers to elderly nursing home residents. Interior designers, whether residential or commercial, are fundamentally concerned with how people function in space and how to best facilitate

activities and psychological comfort through design. Interdisciplinary research with horticulturists and interior designers would provide a new avenue of insight into the people-plant relationship.

Because there is a limited understanding of how plants might affect the patterns of use in a public interior environment such as an atrium, this study would not only provide further information about the importance of plant-people interaction, but contribute to the understanding of the role plants play in the discipline of interior design.

Chapter II

REVIEW OF LITERATURE

Sommer (1974) stated that one concern of the design profession has been and still remains with the successful design of public environments. Both design practitioners and design researchers endeavor to find ways to facilitate human behavior and increase the aesthetic qualities of interior spaces. Environmental researchers also study the built environment, with emphasis on how it affects human activity and quality of life. A mutual interest of both is how people function in public interior spaces.

Of major interest to those studying the built environment and how it affects human behavior is the topic of privacy. Sommer, in his book Personal Space (1969), stressed the importance of privacy in public spaces. Privacy is a basic human need that stems from individual desire to defend territory. Sommer found that an area's shape has a direct effect on the defensive capabilities of its occupants. A large homogeneous area lacking lines of demarcation, barriers, or obstructions makes it difficult to stake out and defend individual territories. The inability to make a territorial claim results in the feeling that personal privacy has been compromised. An atrium, because of its voluminous, open design can be such an area.

Defense of territory by an individual is often indicated by any combination of physical position, posture, and gesture. An individual feels that if he can hold the "high ground," he can dominate the area effectively. It was noted that public territories such as courtyards (atriums) and parks provide a person with freedom of access, but not necessarily of action, usually lacking sufficient privacy for personal comfort (Sommer, 1969).

In his book Tight Spaces: Hard Architecture And How To Humanize It (1974), Sommer continues discussion of privacy in public spaces and comes to the conclusion that the design of some spaces actually decreases social contact. His work has shown that freedom from unwanted eye contact is of critical importance in preserving privacy. Sommer did a study which took place in a three story academic building constructed around a courtyard (similar to the atrium configuration used in this study). He found that the courtyard was never used because it provided no visual privacy to its users.

When considering dark interior building environments, Sommer made several suggestions about how to relieve the "dungeonlike quality" of internal windowless offices. He promoted the use of an atrium that would span several floors and serve as a "light well", bathing offices in natural

daylight. Sommer's studies have shown that an individual's access to daylight was more important than the amount of daylight he or she received. Sommer also acknowledged the innate therapeutic power of plants by suggesting that workers in offices with natural sunlight be given the opportunity to enhance their psychological well-being by having daily plant/flower contact.

Norris (1984) discussed the architectural importance of courtyards and atriums, stressing that these spaces are designed to be used, not just looked at. He feels that "the area would be dead space if no one used it" (p. 80). Acknowledging the therapeutic benefit of natural views, Norris stated that the atrium can be actively enjoyed, and provides visual relief from the demands of office work.

A related field of study dealing with natural environments is that of landscape architecture. Landscape architects are concerned with fulfilling the basic psychological needs of people in exterior settings such as gardens, yards, and courtyards. Because an atrium is an "indoor courtyard", research topics of interest to landscape architects are of mutual interest to interior design researchers.

One such mutual concern is visual privacy. Windows function as visual access to the world outside of an

immediate space, but could also function in a negative capacity as privacy intrusion points. Briggs (1986) stated that people may find window views unacceptable because they may find visual access to their private space by individuals outside their windows intimidating. They may feel that they are being subjected to constant external review. This is often the case in an atrium, where windows are located in walls common to both the atrium space and adjacent rooms to facilitate light transmittance from overhead glazing into the building core. Both individuals in the atrium and individuals in rooms with windows accessing the atrium may experience discomfort from a lack of visual privacy. Briggs suggests that to lessen the feeling of intrusion, plants should be used to create a sense of enclosure, where users will feel more at ease and secure despite the ability of others to visually access their territory.

Plant Related Behavioral Studies

In their article "Adaptations to windowlessness: A study of the use of visual decor in windowed and windowless offices," Heerwagen and Orians (1986) stated that recent architectural research provides evidence that building occupants strongly prefer windowed environments over windowless ones, and that individuals want visual access to

the external world. Building occupants also desire available daylight, sunlight, and fresh air. People consider windows to be an important element of a comfortable interior space. An atrium fulfills many of these human preferences.

Many theories seek to explain why and how contact with plants can be beneficial to people. One popular theory discussed by researchers Ulrich and Parsons (1991) is the "overload and arousal theory." This theory suggests that in the modern world our senses are literally bombarded with images and sounds, and that our surroundings can lead to psychological damage and physiological excitement. Plants and the natural environment are simpler, and less complex, and in their simplicity, reduce environmental arousal and feelings of stress.

Heerwagen and Orians (1986) also found that living organisms, and plants in particular, have an impact on the way people feel about their homes and work environments. Several studies (Kaplan, 1977; Talbot & Kaplan, 1984; Kaplan & Kaplan, 1989) have found that natural environments are preferred over urban "built" environments, and that urban environments containing trees, grass, and shrubs are preferred over places without plants. Talbot and Kaplan (1984) indicated that people know the value of daily contact with nature, even if nature is in a "modest amount". Getz,

Karrow, and Kielbaso (1982) reported that for humans, nature in close proximity need not be a big area of plants and/or trees. The sight of a few trees can provide satisfaction.

Heerwagon and Orians (1986) documented that windowless spaces most often contain photographs and artwork with nature themes, such as landscapes or floral still-lifes, and that some of the sensory and perceptual deprivations of such spaces may be overcome through the use of such amenities as "color, plants, variable lighting design, and manipulations of perceived spaciousness" (p. 636).

Campbell (1979), in an article titled "Interior Office Design and Visitor Response," states that research in a variety of environments points to a variable that could have a measurable impact on visitors: the presence of living things such as plants within an interior space. Discussing research by Thayer & Atwood (1978), Campbell explains that landscape scenes, whether photographs or paintings, increase the feelings of pleasure experienced by viewers in both residential and commercial interior settings.

Russell and Mehrabian (1978) reported that things associated with pleasure attract people. This attraction then leads to acceptance. Because of the popularity and acceptance of plants by the general public, the authors hypothesized that living things would lead to positive

responses on the part of visitors in an interior environment.

Aitken and Palmer (1989) discussed the effects of nonverbal environmental factors on the perceived attitudes of a visitor to a business. One such factor was the use of plants in the business environment. The study sought to determine whether having plants in an office environment could convince a visitor that the employees of that business were more personable and caring in their business relationships than people working in a business where no plants were present. When comparing data about visitor perceptions of a business with interior plantscaping to visitor perceptions of a business without plantscaping, it was found that plants do provide positive nonverbal messages about the people around them. Aitken and Palmer concluded that the presence of natural environmental elements, such as plants, in an office environment projected a positive, caring, corporate image.

Aiken and Palmer also wanted to analyze the impressions communicated to people by typical office contents, with emphasis on the role of plants and floral artifacts. Respondents to a survey indicated that green plants in an office make it more personal and increase visitor relaxation. Offices decorated with plants convey to the

visitor that the business is well organized, and plants add warmth and color to an otherwise sterile business environments. More than half of the respondents were aware of some form of person/plant communication. Based on the results of their study, Aiken and Palmer recommended that a few large healthy green plants be incorporated into interior environments to give an impression of caring and to balance the built environment with some natural elements.

In the same study, it was reported that a number of attitudinal surveys on windows show that people value the opportunity for contact with the external world and welcome access to daylight and environmental stimulation. Data indicate that visual contact with the natural world, including plants, may be a fundamental human need.

The belief that contact with plants and nature may be a fundamental human need is discussed by Conklin (1971), who takes the people-plant communication factor to another level. Interested in interior plant sales, he hypothesized in an industry related publication that the connection humans feel toward plant life may be "a primal association - an inborn link" (p.30) present on an unconscious level since the beginning of time. This could account for the pleasure response documented by many plant researchers. People often state that they feel more comfortable around plants but

don't know why. Conklin believed that plants are basic fundamental essentials of human life, equal in magnitude to food, air, and water.

In the 20 years since Conklin's article, research done by Ulrich and Parsons (1991) in urban forestry has furthered this belief. They report on various studies, which have shown that views of vegetation reduce stress because of a combination of beneficial effects: increasing positive feelings; reducing negative feelings such as fear, anger, or sadness; holding one's attention for a period of time appropriate for blocking or reducing stressful thoughts; and eliciting positive changes in various physiological systems. Ulrich also found that stress reduction in proximity to plants may not require conscious awareness of the plants, or direct views of the vegetation. Although direct visual access is important, recent findings suggest that the unconscious knowledge that nature is near may be enough to result in positive benefits.

Design research and behavioral research are both concerned with how people function in space and what conditions or elements may influence behavior. Interior design researchers also seek to investigate the aesthetic properties of interior space, and how aesthetics may enhance the functional aspect of an environment. Authors of classic

behavioral research, like Robert Sommer, stress the need to fulfill psychological human needs when creating a built environment, the need for privacy being one. Leading researchers have identified the human preference for sunlight and elements of nature such as trees and plants, whether actual or pictorial representations, to promote a feeling of well-being in built environments. Those specializing in plant/behavior research have shown that people like plants, and that the presence of plants in interior environments contributes to the enjoyment of a space, may positively effect job performance, and have been shown to be of therapeutic value.

Although the psychological influence of plants in interior space has been investigated, little research has been identified dealing specifically with the ability of plants to alter human behavior. Few data are available showing how such a relationship might positively impact the profitability of a business. Plant/behavior researchers are attempting to identify a primal association between humankind and plant life. Perhaps this link can be found to contribute to the way people behave around plants in interior environments.

Related Studies Using Multiple Methodologies

Leading researchers advocate the use of multiple research methodologies to ensure a sufficient quantity of data, to best analyze all facets of a study, and to add to the methodological vigor of the research (Patton, 1988; Zeisel, 1981). Robert Sommer advocated this technique in Personal Space (1969).

One popular research methodology is the written response questionnaire. Sommer believed that the questionnaire is an appropriate and efficient methodology, especially when using a college student sample, because they are accustomed to written examinations and often feel uncomfortable with the method of personal interview.

Another popular way to obtain data on human behavioral patterns is through observation. Behavioral observation is the act of watching people use their environments (Zeisel, 1981). Observers look at how a specific physical environment supports or interferes with behaviors occurring within it, and especially how it affects the actions of individuals or groups of individuals. Observing behavior in a physical setting, whether interior or exterior, generates data about human activity, related relationships, and regularities of behavior. Researchers can learn about expected uses, new

uses, and misuses of a place; and how environments suggest behaviors or behavioral restraints (Zeisel, 1981). This methodology is often chosen to supplement information obtained via questionnaire.

An observational method that is used less frequently is behavioral mapping. Behavioral mapping entails recording the activities of a chosen sample on floor plans, diagrams, or maps, and is the most convenient method for observing and analyzing several people in one general area at the same time. Mapping also provides the ability to record behavioral sequences in settings where people have a choice of several paths. Behavioral maps can include physical location data such as architectural elements (columns and floor tiles), and can be constructed with a measurement element intact such as a grid pattern to indicate proximity (Zeisel, 1981). Behavioral mapping facilitates detection of user patterns, and relates these patterns to user characteristics. It has been found to be an economic, simple, and unobtrusive means of gathering information to supplement more traditional techniques like attitudinal surveys and observational methodologies (Kates & Adams, 1981; Zeisel, 1981). Sommer (1969) also recommended behavioral mapping for its simplicity and ability to be randomized. He

believed that survey and behavioral mapping are best used in tandem to increase the validity of a study.

The most frequently employed methods for studying people-plant interaction are sample survey via questionnaire, and preference response to visual surrogates (photographs or slides). Slides and photographs allow researchers to conduct experiments much more easily than could be done in the field, by offering realistic representations of actual outdoor and indoor settings. On site experimentation often limits sample size and access (Aitken & Palmer, 1989; Kates & Adams,1981; Kaplan & Kaplan, 1989; Randall, Shoemaker, Relf, & Geller, 1992).

In summary, Interior Design professionals seek to facilitate human activity in indoor environments, while maintaining high levels of aesthetic quality. An important component frequently used by designers in built interior environments is plantscaping. Researchers in related fields such as behavioral psychology, also study the human reaction to built environments to identify basic psychological needs. Behavioral and horticulture researchers have identified a subconscious human affinity for plants. This people-plant research has been primarily in the areas of personal preference for plants, and how plants affect the psychological or physiological well being of people.

Limited information is available pertaining to whether the presence of plants in interior space can affect the behavior of individuals or change their perceptions of an interior environment. Such a study could be accomplished with a multi-methodology approach, combining a survey questionnaire and behavioral mapping. These complementary techniques might identify a link between plants and the way people act when they are around them.

Chapter III

METHODOLOGY

Because of the lack of research pertaining to how plants may directly affect human behaviors and perceptions, this study was designed to investigate those possibilities within an indoor atrium space. A complementary multi-methodology approach was taken, employing the instruments of a written survey questionnaire and behavioral mapping.

Experimental Setting

The setting for this experiment was a recently constructed atrium on the campus of a large mid-Atlantic landgrant university. The atrium addition was part of an infill project to expand an existing academic building.

The atrium functions as a bridge between the original building and a new building addition. The superstructure forming the ceiling of the atrium is constructed from metal framing with fixed, tinted glass. The resulting space was designed to function as a multi-level, multi-use, public area or interior courtyard. It is a long rectangle four stories high where it connects to the roof of an added floor of the original building, and three stories high where it joins the new building. Facing westward, overhead atrium

glazing provides a central core of natural light to laboratories, faculty offices, and the newly created three level interior courtyard (see Figure 1).

Each level of the atrium is unique. The highest level, or third floor consists of a small carpeted balcony lounge with modular seating. At the opposite end of the atrium, a tiled balcony connects original and building circulation. These two spaces are self-contained; the north balcony is accessed from a hallway outside of the atrium, the south balcony lounge is accessed from an exterior hallway and is also connected to the mezzanine level below by a staircase. From either balcony, most of the second floor mezzanine and a narrow portion of the lower floor can be observed. For the study, both areas on the third level were referred to as the balcony level (see Figure 2).

Stairs at the balcony lounge descend to the second floor mezzanine level. The mezzanine is accessed by corridors at the second floor level, which is the level of access to the building from the direction of the main campus, and is used to reach faculty offices and classrooms. The mezzanine seems to be the most heavily used space, overlooking the main central seating area of the lowest floor of the atrium. It is carpeted and furnished with an abundance of seating options: tables for four, modular

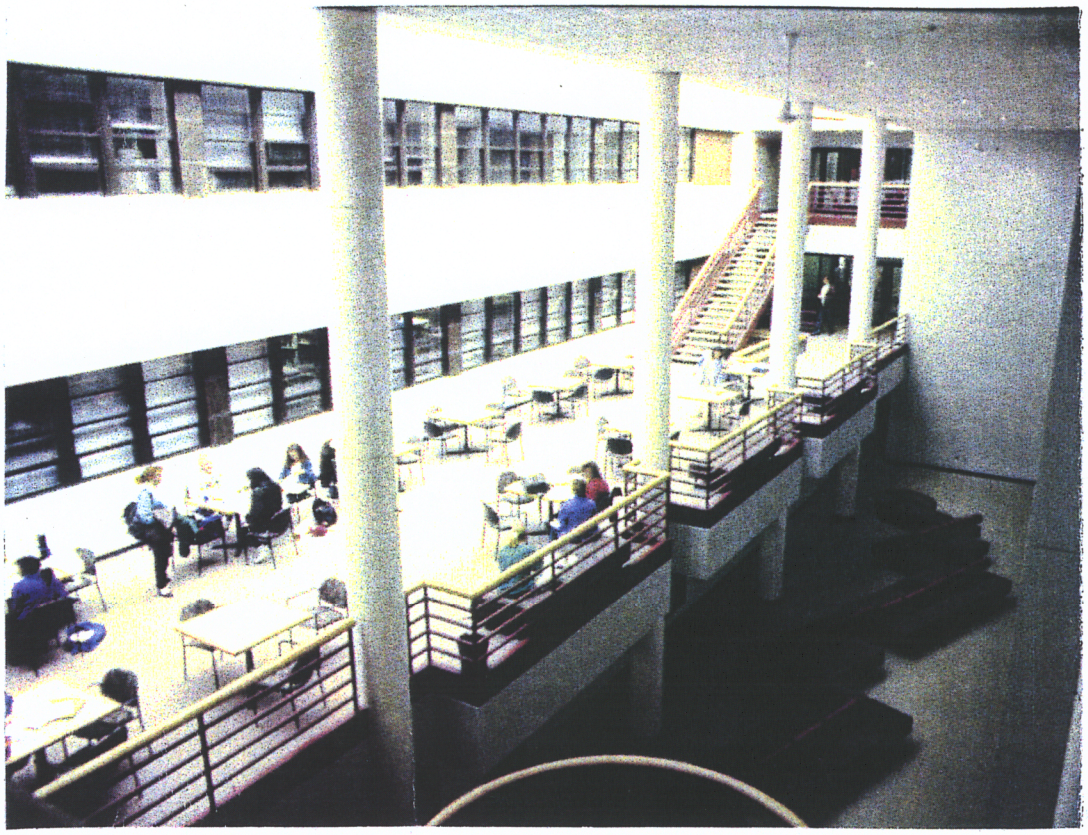

Figure 1. - Photograph of the Wallace Hall Atrium, from the North. Balcony lounge (third level) can be seen top left.

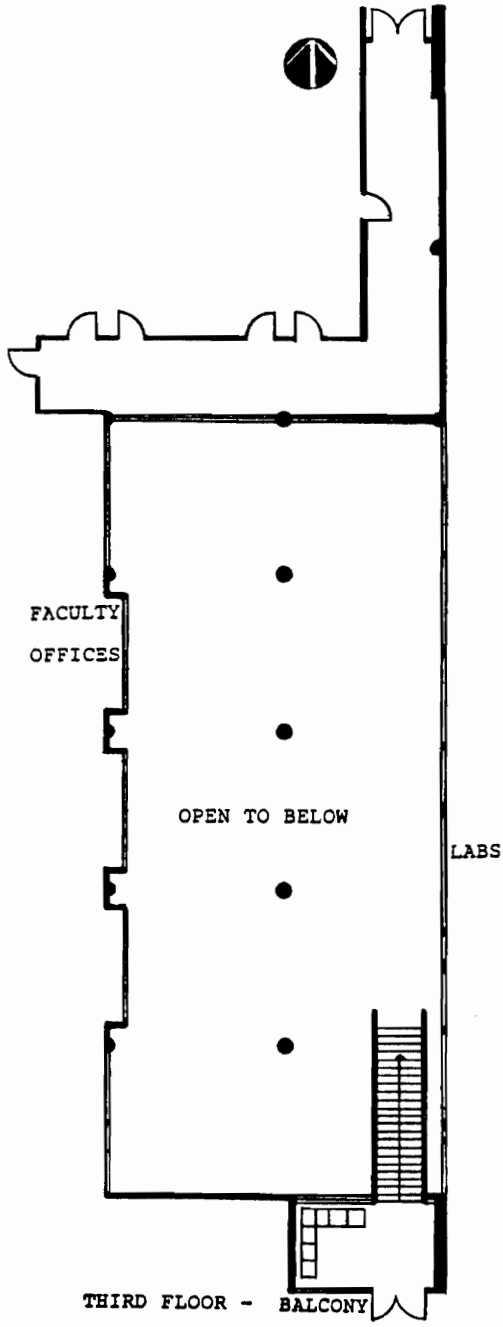

Figure 2. - Floor 3 (balcony) floor plan

seating, loveseats, sofas, and armchairs (see Figure 3). A narrow, L-shaped planter, was constructed below the staircase for potted plants. Stairs at the opposite end of the mezzanine descend to the lower level (see Figure 4). For this study, the second level was referred to as the mezzanine.

The lowest level of the atrium is the same width as the mezzanine. In addition to the faculty offices and laboratories, the lower atrium level lounge area accesses a gallery space, a pre-school child development laboratory, an adult day care center, display windows for a historic costume collection, and visual merchandising display windows (see Figure 5). It provides physical and visual access to the gallery and day care centers, and visual access to merchandising displays and historic costume collection. This floor is finished with ceramic tile. Beneath the staircase is a D-shaped planter. A central zig-zag arrangement of modular furniture with deep seats and low cylindrical bolsters, is fully visible from above, and L-shaped configurations of the same furniture nestle beneath the mezzanine overhangs at either end (see Figure 6). For this study, the floor was referred to as the lower level.

Overhead glazing stretches the full length and width of the mezzanine, providing bright sunlight to that level that

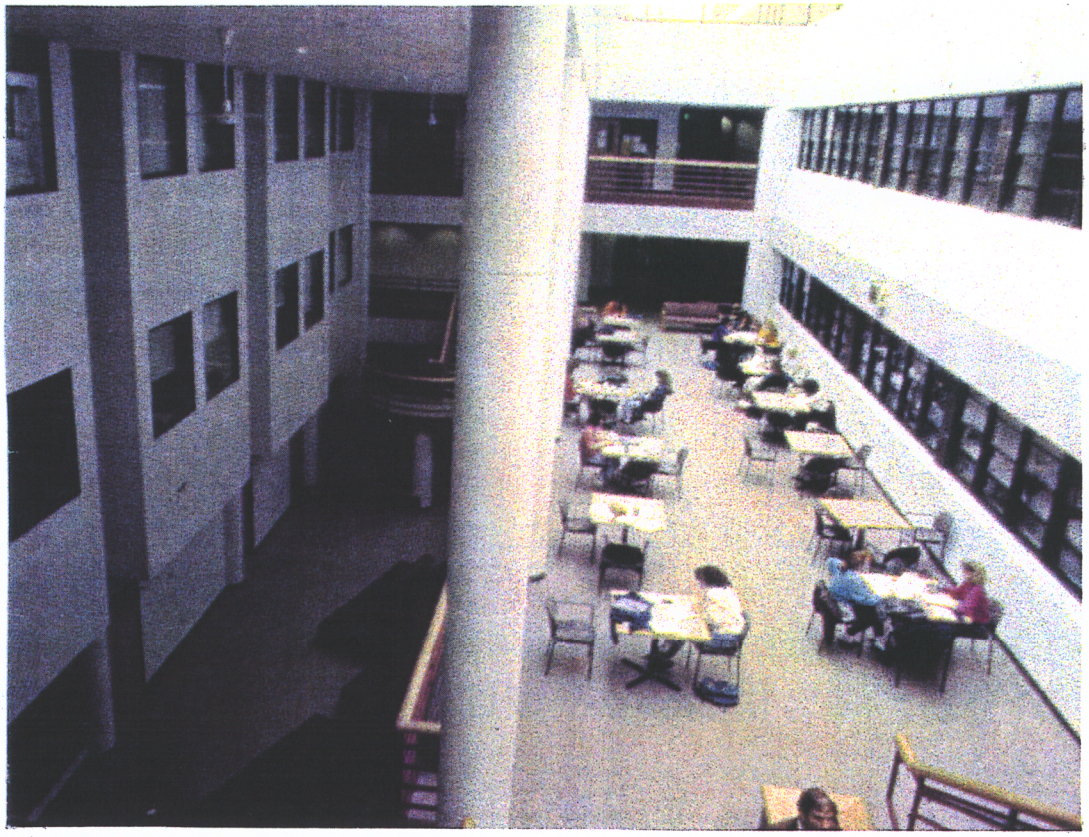

Figure 3. - Photograph of the 2nd floor (mezzanine) of the Wallace Hall atrium from the South. The third floor balcony can be seen near the center of the photo.

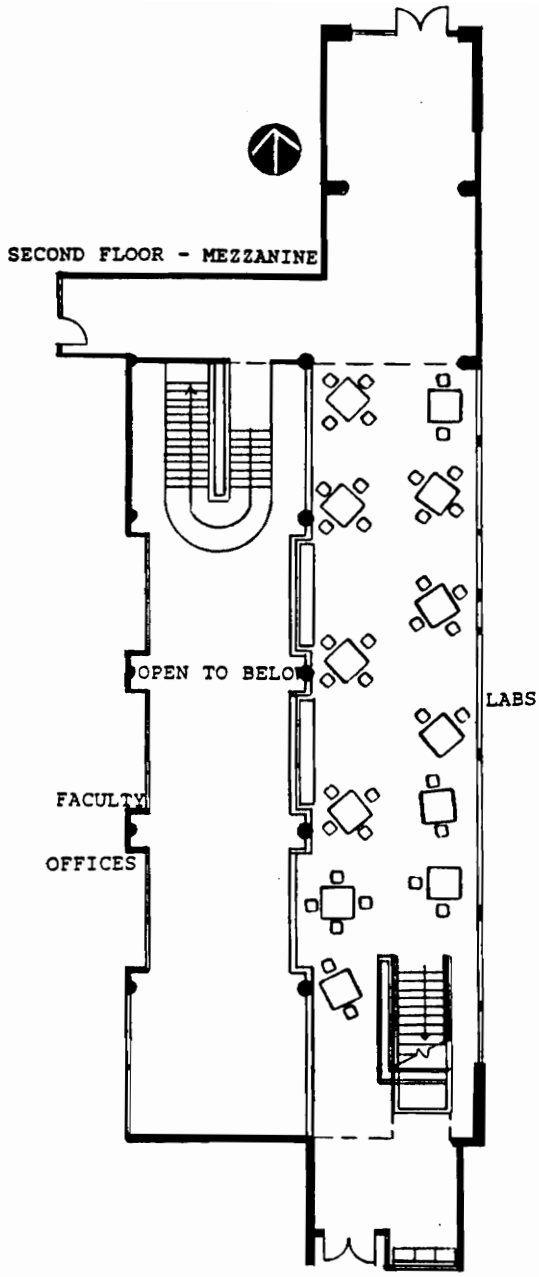

Figure 4. - Mezzanine floor plan.

Figure 5. - Photograph of the first floor (lower level) of the Wallace Hall atrium, from the North.

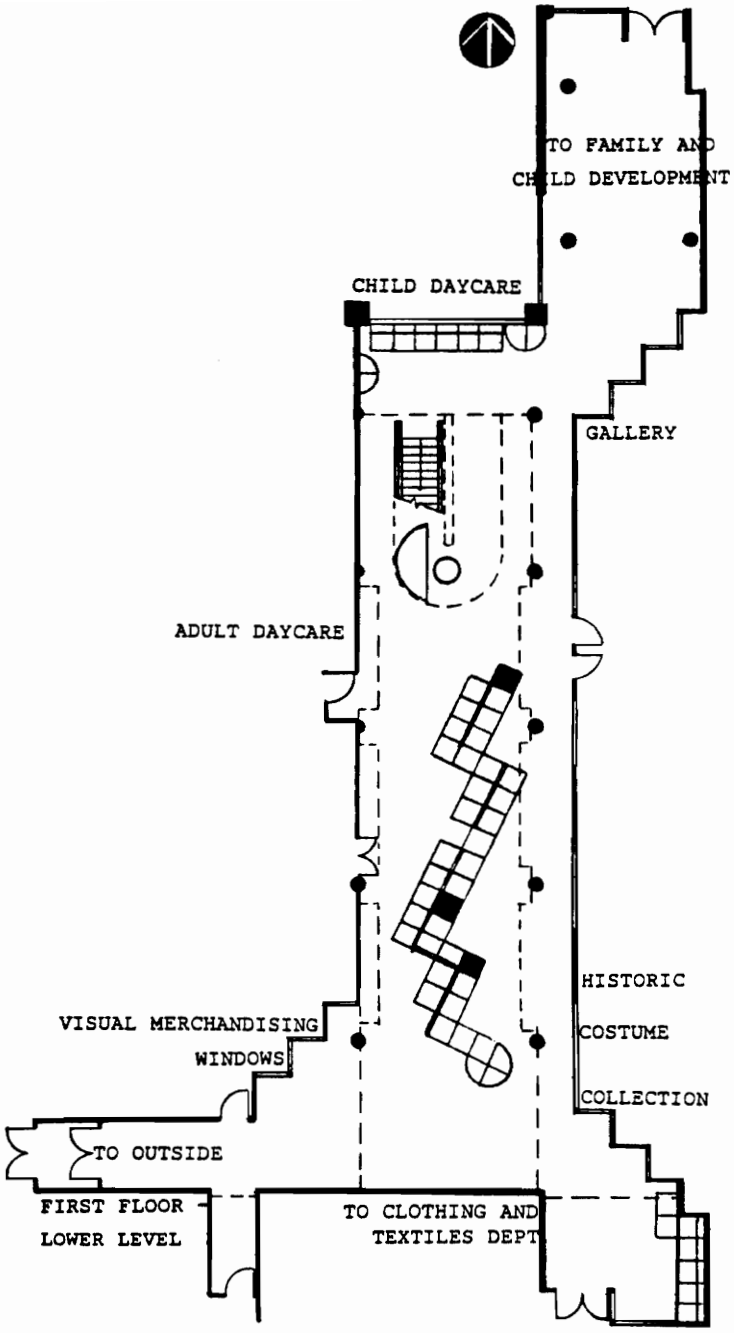

Figure 6. - First floor (lower level) floor plan.

is strongest in the afternoon. During the spring months when this study was conducted, the balcony and lower level received reflected light that was strongest between the hours of 11 AM and 3 PM.

The atrium super-structure is outfitted with fans that automatically activate when the heat at the peak of the glazed area reaches 20 degrees above the temperature at the mezzanine level. The atrium is not air conditioned, but does contain an air circulation system that relies on the principle of convection. Heated air is collected at the top of the atrium and released on the lower level. Additional conditioned air enters the atrium when any of the seven doors connecting the atrium space to other building areas is opened. Prior to the time of the study there were no plants in the atrium.

Following initial furniture installation, casual observation had shown that the mezzanine level of the atrium space was continuously used throughout the day, sometimes "crowded", while the frequency and number of users on balcony and lower levels was considerably lower.

The absence of plants in the atrium was made more obvious by the empty planters, and the fact that "sunspaces" of this sort which transmit an abundance of natural light typically contain plants. This new atrium provided the

perfect setting for investigating whether or not the introduction of trees and plants into a public space could influence user perceptions of it, or affect user behaviors.

Instruments

The Survey

A survey form was designed to collect the following data:

1. User perceptions of each atrium level
2. Frequency and type of user activities per atrium level
3. Demographic information of the sample population

The survey form consisted of three parts: a section requesting demographic information; an atrium usage matrix which identified uses for each level of the atrium and frequency of those activities; and a semantic differential section utilizing a Likert-type scale, providing 13 polar adjective pairs for determination of user perceptions of each level. Space was also provided at the end of the form for candid suggestions for improving the atrium space (see Appendix A).

The user matrix identified 3 floor levels and 6 user activities, with an additional space "other" for miscella-

neous activities not specified. This section indicated the popularity of individual atrium levels, which activities were engaged in on each level, and how often users participated in each activity per week. This information was used to compare any changes in activities by level or time spent engaged in activities that may have resulted from the introduction of plants into the space.

Floor levels were labeled: 1st Floor (lower), 2nd Floor (mezzanine), and 3rd Floor (balcony). Specific user activity choices were: meetings, socializing, studying, eating, waiting, and resting.

The semantic differential section was used to gauge user perceptions of the atrium space both before and after plant installation on the lower level. Descriptive adjectives and their polar opposites were separated by a six point scale.

Semantic differential scales are most often configured with seven spaces, allowing for a noncommittal neutral or center position. For this study the neutral point was omitted forcing either positive or negative response. Positive and negative adjective positions were also randomly reversed on the form to avoid a conditioned response.

Those surveyed were instructed to mark the scale position that best described their response to each of the

adjective pairs as they related to their personal perceptions of the atrium. Adjective pair choices were: Pleasant/Unpleasant, Drab/Colorful, Finished/Unfinished, Quiet/Noisy, Gloomy/Cheerful, Exciting/Boring, Convenient/Inconvenient, Private/Public, Unfriendly/Friendly, Light/Dark, Crowded/Roomy, Impressive/Unimpressive, and Airy/Stuffy.

Pilot test and Revision

A pilot test of the survey form was administered to 12 student volunteers before the actual study. The form was checked for clarity, organization, and precision. Changes concerning choice of semantic differential adjective words, and how the matrix graph was organized, were made based upon feedback provided by pilot test participants.

The Sample

The sample was random, consisting of individuals using the atrium during predetermined periods for data collection. Users of the space included college administration, staff, faculty, graduate and undergraduate students, and any visitors to the building.

Data Collection

Distribution of the Survey Form

To facilitate data analysis, survey forms were color coded with identification dots according to points of distribution within the atrium: pink dots for the balcony and mezzanine levels (because they visually appear as one continuous space), and green dots for the lower level. Survey forms were distributed to atrium users during periods of data collection.

The initial questionnaire distribution functioned as a pre-test, taking place at the same time as the first week of behavioral mapping, providing baseline information about atrium usage and perceptions of the space prior to the installation of plants. The surveys were again distributed after plant installation in conjunction with the second phase of behavioral mapping to determine any changes in attitudes or behaviors.

Wallace Hall is a multi-functional academic facility containing classrooms and laboratories operating on alternate day class schedules. Surveys were distributed to atrium occupants on balcony, mezzanine, and lower levels at peak periods of atrium use, taking into account the alternate day traffic patterns. Distribution took place on

Wednesdays between 9:45 and 10:15 AM, 12:45 and 1:15 PM, and between 3:45 and 4:15 PM. On Thursdays the distribution schedule was between 9 and 9:30 AM, 12 and 12:30 PM, and 3 and 3:30 PM. Because there are fewer classes on Fridays, the volume of atrium use and user traffic patterns vary considerably from the days mentioned above. To account for this, forms were distributed on Fridays throughout the day during observed periods of peak atrium use.

Survey participants were instructed to place completed forms in fluorescent green cardboard boxes labeled "survey," which were attached to all atrium exit doors. Box contents were collected, batched, counted, and labeled daily after 5:30 PM.

Behavioral Mapping

Following atrium construction, ongoing observation of user activity had shown the lower level to be used less frequently than the more popular mezzanine level. Because the purpose of the study was to determine whether the introduction of plants into an underutilized area could affect user behavior or overall use of the space, behavioral observation occurred only on the lower level to determine changes.

To record user behaviors, an 8 1/2" x 11" map of the lower level of the atrium consisting of a floor plan showing walls, staircase, current furniture layout, and exits was drawn from a set of construction blueprints. At the bottom of each map, a chart was included for coding the behaviors of atrium users recorded on that sheet (see Appendix B).

Behavioral mapping took place from 8 AM to 5PM, Monday through Friday for a two week period. The first week of mapping functioned as a pre-test to determine lower atrium user behavior, and occurred during the first week of survey distribution. The second week of mapping which functioned as a post-test, began after the installation of trees and plants in the lower atrium space, and was used for determining any behavioral changes associated with interior plantscaping. This phase was concurrent with the second week of survey distribution.

Daily observation was divided into shifts, with one mapper working per shift. Mapping shifts consisted of two hour intervals between the hours of 8 AM and 4 PM, and a one hour period between 4 PM and 5 PM. These hours were selected to better insure a consistent light level for daily observation, and to eliminate the variable of extreme light level fluctuation after 6 PM.

Six individuals hired as "mappers" were selected from a group of graduate and undergraduate students in the college. Criteria for selection included dependability, attention to detail, and level of interest in the study.

Mappers were thoroughly trained by the researcher prior to commencement of the study on how to observe and record lower atrium level occupant behaviors. They were assigned to a mapping station centrally located within view of all lower atrium areas. Mappers emulated individuals studying, so as not to arouse suspicion and inadvertently alter user behavior in any way.

Prior to the beginning of their shift, each mapper was given a packet of maps, a set of colored markers, and a wrist watch. Behaviors, specifically how users circulated through the space, how often and how long individuals paused while passing through the space, where occupants chose to sit, and how long they remained were symbolically coded on each map. Mappers color coded subjects with markers and keyed them to a chart on the base of each map page indicating the time they spent engaged in a specific observed behavior. Mappers recorded all users of the space, including those just passing through the atrium.

The circulation path of each individual entering the lower atrium was indicated by a colored marker line drawn on

a map. Mappers drew arrows on each line to indicate the user's direction of travel. To simplify data analysis, a maximum of nine colored marker lines was used per map with one color assigned to each atrium user, except during peak periods of circulation. During heavy traffic periods, more than one individual traveling the same route was sometimes represented by one colored marker line. The number of people represented by each line was indicated by the mapper (see Appendix B).

At the end of each shift, the mapper recorded the date and shift period on each map, batched all maps used for that shift, and placed them in a collection box. After 5:30 PM, the researcher collected the maps used daily, batching and coding them for data analysis.

Plantscaping

Following the pre-test, six large Ficus benjamina trees ranging from 12 to 15 feet were installed in the lower atrium space (see Figure 7). Because roof glazing did not extend over the lower level, the floor was too dark for ongoing plant survival. It was anticipated that the study would be completed and the plants relocated to one of the

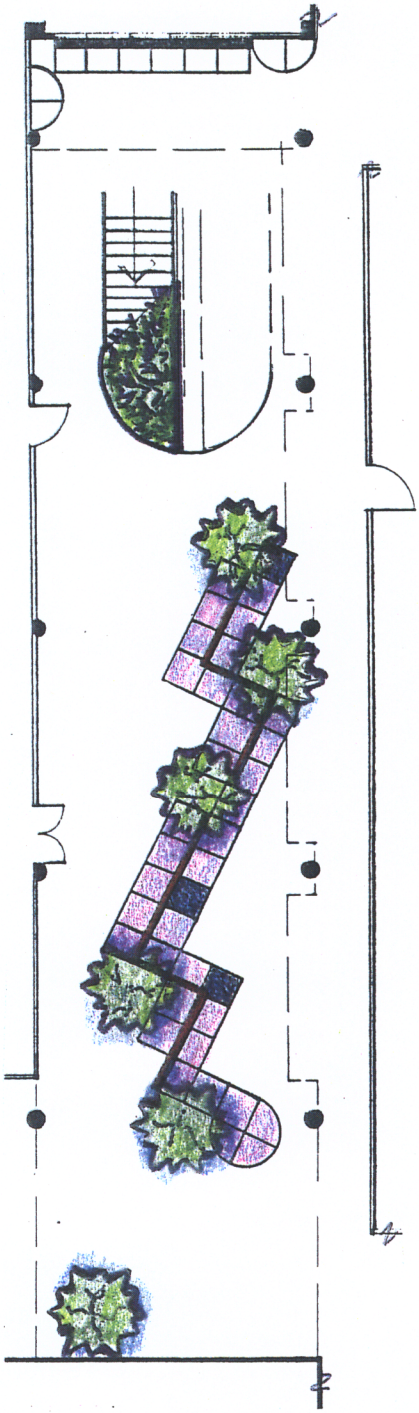

Figure 7. - Map with tree locations and leaf circumferences.

upper atrium levels, before any extreme change in light level would adversely affect them.

The trees were placed adjacent to central seating, theresulting leaf canopy providing some visual privacy screening from occupants of the mezzanine level (see Figure 8). The installation took place during the weekend when the lower atrium is usually unoccupied and mezzanine use is minimal.

Following an acclimatization period of one week, which allowed atrium users to become accustomed to the plantscaping, behavioral mapping and survey distribution were repeated to determine any changes in atrium use or atrium perceptions by users of the space.

Data Analysis

Data collected from survey forms and behavioral maps were used to determine if the introduction of plants into the atrium had any effect on spatial perceptions or behavior patterns of atrium users. This was accomplished by comparing data collected before and after the plants were installed.

Survey Data Analysis

Descriptive statistics are used to report survey data

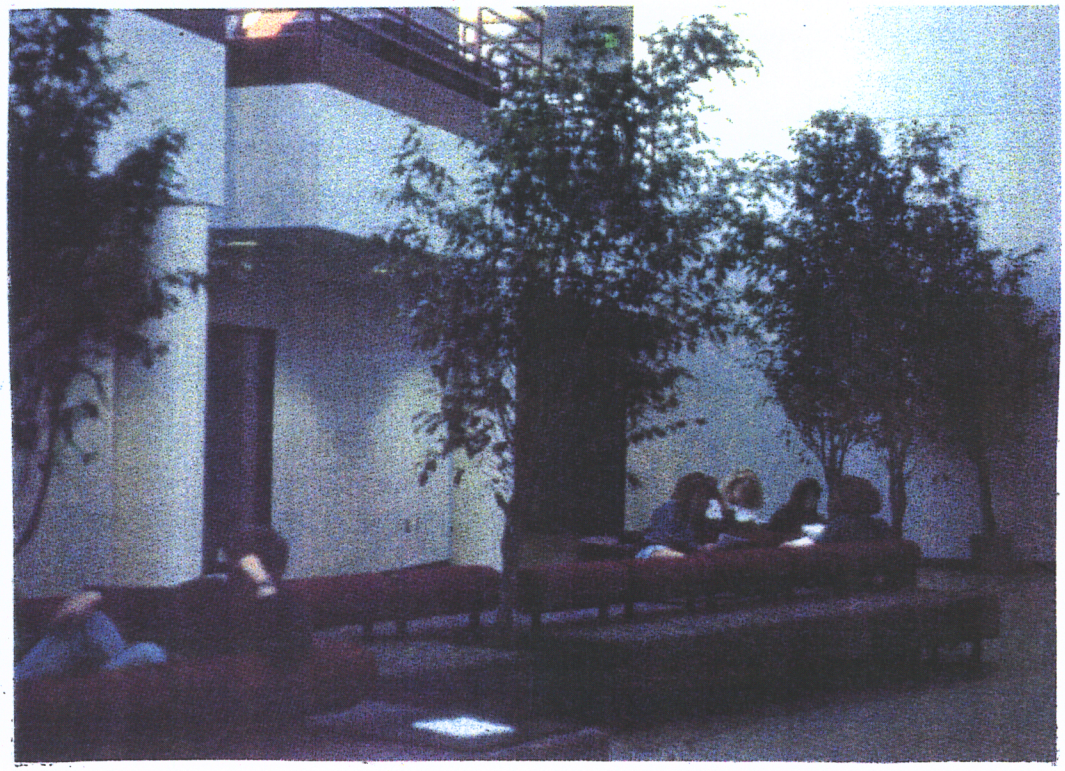

Figure 8. - Photograph of trees adjacent to central seating on lower atrium level.

regarding sample demographics, atrium area use, and written atrium improvement suggestions. All survey sections except demographic data, pertain to research question one, which asked if the introduction of plants into the atrium would cause changes in users perceptions of the space.

Perception changes of atrium users as recorded on the semantic differential portion of the survey were analyzed statistically by using two tailed t-tests at a significance level of $p = .05$. Independent variables were the random sample and the plants. Dependent variables were user perceptions and user behaviors.

Hypotheses

For the t-tests, the hypotheses were as follows. The hypothesis was that plants have an effect upon user perceptions of the atrium space, the equation being:

$$H_1 = \bar{x}_1 \neq \bar{x}_2$$

The null hypothesis was that plants will not affect user perceptions of the atrium, the equation being:

$$H_o = \bar{x}_1 = \bar{x}_2$$

$\bar{x}$ = The sample mean score

Changes were also measured by comparing the mean response of each of the 13 polar adjective pairs on the

semantic differential scale before and after the introduction of plants into the atrium. The mean responses were then charted on a profile analysis line graph.

Behavioral Map Data Analysis

Behavioral mapping was conducted on the lower atrium level to collect data on research question two, which asked whether the introduction of plants onto that underutilized floor would change user behaviors. Behavioral maps recorded both before and after the introduction of plants, were analyzed using simple tabulations to measure changes in:

1. The number of lower level users
2. The number of users per circulation path through the lower level
3. The average time users spent seated per seating location
4. The frequency, length of time, and location of user pauses along circulation paths.

Circulation frequency and path choice were determined by counting the numbered directional lines on each map. Time seated, pause locations, and the amount of time users spent while pausing were tabulated by analyzing the time record charts on each corresponding map.

Chapter IV

RESULTS AND DISCUSSION

The purpose of this research was to determine whether the introduction of plants into an interior public space would affect user perceptions of the space or their behavior within it. Data were collected using both survey and behavioral mapping methods. The survey recorded user perceptions of the selected site and the sample's reported uses of the space. Behavioral maps documented user activities on the floor where the plants were installed. Pre- and post-tests were completed to make a comparative analysis.

Results

Results of the study were based on data collected in an academic building within a recently added atrium space, on the campus of a large mid-Atlantic landgrant university. The study took place during the spring semester of 1992. The pre-test was conducted during the week of April 6-10, and the post-test was carried out during the week of April 20-24.

Limitations of the Experimental Setting

Existing conditions in the three story atrium proved to limit the scope of the study. External weather conditions

affected the climate of the atrium during data collection. Fluctuations in daily exterior temperatures and light levels caused a corresponding change in the interior environment, and may have subsequently altered usage of the space.

The biggest impact was felt when sunny, warm conditions increased the indoor temperature of the entire atrium space to an uncomfortable level. Paddle fans are located in the ceiling superstructure, which were preset to automatically activate when the temperature was 20 degrees higher at the peak of the glazing than at the floor level of the mezzanine. This formula did not prove adequate in alleviating perceived physical discomfort on the mezzanine level, and may have resulted in fewer mezzanine users, or their relocation to the lower atrium level which was considerably cooler and darker.

Rain may also have caused a general decrease in the overall atrium population. During the post-test, the geographic area experienced heavy rain and flash flooding. During the one day that rain and flooding occurred, commuters who would have normally contributed to the sample may not have been present, or their daily routines may have been significantly altered.

Class activities associated with visual merchandising display windows on the lower atrium level also impacted user

numbers and behaviors. Clothing and textile students were required to observe and evaluate displays, and sometimes were present in groups near central seating on days when new displays were installed.

The last week of the study was also the week before semester finals. The fact that regular class meetings ended mid-week may also have altered normal atrium user behaviors.

An additional problem during the study resulted from the condition of the Ficus trees. As stated in the introduction, the recently completed atrium had never contained plants of any kind prior to this study.

The trees provided for this exercise were grown outdoors in the humid, tropical setting of Homestead, Florida. They were transported in an enclosed tractor trailer for two days. Upon their arrival, a period of one week was set aside for atrium users to become accustomed to the presence of the plantscaping, so that the "newness" of the plants would not be reflected in the data collected.

During the week of acclimatization, it was determined that the atrium was excessively dry, with each of the trees consuming over two gallons of water per day. Some leaf drop started as the post-test began. Unusually low light levels occurred with regional rain and flooding during the week of

the post-test, perhaps contributing to leaf loss. The trees began dropping leaves at an accelerated rate by the third day of data collection. Although an effort was made by both the building maintenance crew and the researcher to keep the leaf piles off of the floor and central seating adjacent to the trees, the loss of leaves and the presence of leaves on the furniture may have discouraged some use of lower atrium central seating. There was no problem with the Chinese Evergreen plants, which appeared to thrive in the environment.

Atrium Users Participating in the Study

During the pre-test, 120 people returned questionnaires. Sixty-one questionnaires were collected during the post-test. Maps recording lower atrium behavior, indicate that during the pre-test, a daily average of 454 people used all areas of the lower atrium level, with a weekly total of 2,269. The total number of individuals who passed through or used seating located in the central portion of the lower atrium area where plants were later installed was 1,294, with a daily average of 259.

Data from post-test mapping show that 2,057 used all areas of the lower atrium level, with an average count of 412 people per day. There were 1,329 people who passed

through or sat within the central seating/tree interaction area of the lower floor of the atrium, with a daily average of 266. Although a daily average of 42 fewer people used the lower atrium level when plants and trees were present, of the individuals using the level, 35 more chose to frequent the plant interaction area than during the pre-test week.

Survey Questionnaire Results

The questionnaire was divided into four sections: a sample profile section which provided demographic information, an atrium user matrix which identified user activities and time spent by floor level, a semantic differential scale containing 13 polar adjective pairs to gauge user perceptions of the atrium by floor, and a write-in comments section.

Demographic Information

The first section of the questionnaire was used to collect demographic information on the random sample of atrium users. It was felt that a thorough understanding of who used the atrium might assist in future data analysis by determining whether daily activities and traffic patterns afforded users an opportunity for plant interaction. Not

knowing what demographic information would prove to be valuable, a user profile of atrium occupants including educational status and department of study was desired. Identifying the user's department of study would help determine whether they chose atrium floor levels in close proximity to offices or laboratories affiliated with their departments, or if they chose an atrium level by independent preference alone.

Findings show that atrium levels were usually populated by students enrolled in college departments located on that level. The mezzanine was most often used by Housing, Interior Design, and Resource Management students with the department office located directly off the mezzanine, or by students from the department of Human Nutrition and Foods with the department office located on the third floor of the building. Students not enrolled in the College of Human Resources also frequented this level from other locations on campus.

The lower atrium level was also usually occupied by students with their departments' offices and/or labs on that floor. Clothing and Textile, and Family and Child Development majors used the lower level the most during both pre- and post-tests. Occasionally, majors from other de-

partments or students not enrolled in the College visited the lower atrium.

Participants were asked whether they were a student, member of the faculty, member of the building staff, or a visitor to the atrium. Students comprised the majority of the atrium population during both the pre- (74.9%) and post-tests (67.8%), with staff and faculty using the space occasionally. Results are recorded in Table 1.

User Matrix

Questionnaire participants were also asked to complete the user matrix "chart" by entering the best estimate of time spent per week in any of the selected activities by floor level. This information obtained from all surveys collected was needed to understand how the sample used the overall atrium space, and to speculate on how much time participants had to spend in selected activities. Some users followed directions, entering their best time estimates, while others simply put an "X" on the chart for each activity in which they participated.

Concerned that this discrepancy might confound the results, data were analyzed by activity only, and not time spent engaged in each activity. Pre- and post-test results were combined to get an overall profile of the space during

Table 1. - ATRIUM USER DEMOGRAPHIC

Respondent Status						
	Pre-Test		Post-Test		Total	
	N	%	N	%	N	%
Staff	19	16.1%	10	16.1%	29	16.1%
Faculty	11	9.3%	10	16.1%	21	11.7%
Freshman	12	10.2%	5	8.1%	17	9.4%
Sophomore	8	6.8%	4	6.4%	12	6.7%
Junior	24	20.3%	15	24.2%	39	21.7%
Senior	32	27.1%	14	22.6%	46	25.5%
Graduate	12	10.2%	4	6.5%	16	8.9%
Total	118	100.0%	62	100.0%	180	100.0%

ATRIUM USERS BY DEPARTMENT						
	Pre-Test		Post-Test		Total	
	N	%	N	%	N	%
HIDM	25	31.3%	8	21.6%	33	28.2%
HRIM	5	6.2%	6	16.2%	11	9.4%
CT	10	12.5%	1	2.7%	11	9.4%
HNF	10	12.5%	7	18.9%	17	14.5%
FCD	17	21.3%	7	18.9%	24	20.5%
Other	13	16.2%	8	21.7%	21	18.0%
Total	80	100.0%	37	100.0%	117	100.0%

HIDM - Dept. of Housing, Interior Design, and Resource Management
HRIM - Dept. of Hotel, Restaurant, and Institutional Management
CT - Dept. of Clothing and Textiles
HNF - Dept. of Human Nutrition and Foods
FCD - Dept. of Family and Child Development
Other - Majors outside of the College of Human Resources

the period of data collection. Almost all participants ignored the balcony floor level, indicating in the commentary that they never used the balcony lounge, or did not realize it was there. Because of this, breakdown of activity by floor level was done only on the lower (1st floor) and mezzanine (2nd floor) levels. Results obtained from tabulating all surveys collected can be found in Table 2.

Participant numbers indicated that the mezzanine was used much more than the lower level, with studying and socializing being the most popular activities, and eating and waiting following in frequency. The lower level was used most often for studying and socializing, waiting and resting. The mezzanine was least used for resting, while the lower level was least used for meetings.

Three respondents indicated "other" activities for the lower level of the atrium included scheduled events, and/or class activities such as viewing the visual merchandising windows or gallery displays. These results show that the mezzanine level is the area of choice for most activities.

Semantic Differential Analysis

Two tailed t-tests at a significance level of $p = .05$ were conducted on responses for each of the 13 polar pairs collected during the pre- and post-tests, to identify any

Table 2. - ATRIUM USERS' REPORTED ACTIVITIES BY FLOOR LEVEL

	Floor 1 (lower)		Floor 2 (mezzanine)		Total	
	N	%	N	%	N	%
Socializing	21	20.2%	83	20.0%	104	20.0%
Meetings	8	7.7%	59	14.2%	67	12.9%
Studying	26	24.0%	97	23.4%	123	23.7%
Eating	14	13.5%	66	15.9%	80	15.4%
Waiting	18	17.3%	66	15.9%	84	16.2%
Resting	17	16.3%	44	10.6%	61	11.8%
Total	104	100.0%	415	100.0%	519	100.0%

statistically significant change in atrium user perceptions resulting from the introduction of plants into the space. For analysis, the data set was programmed by assigning a value one through six for each of the six semantic scale increment positions, with 1 being the most positive choice, and 6 being the most negative position. Any confounding that may have resulted from differences in random sample size from pre- to post-test, was accounted for by test breakdowns for both equal and unequal variances. Tests were run on each adjective pair by floor level for both weeks.

The only statistically significant result was obtained by using the filter variable of floor for the pleasant /un-pleasant adjective pair. This filter variable was used to determine if there was any significant difference between floor level mean responses from pre-test to post test, when both pre and post tests showed that the mezzanine was perceived to be more pleasant than the lower atrium level.

This test showed that during the pre-test, the mezzanine level was considered to be more pleasant than the lower level with a probability level of .0032 at 32 degrees of freedom, having a first floor user mean response of 3.47 (1 being the most positive, 6 being the most negative), and a mezzanine user mean of 1.94. This indicates that mezzanine users' perceptions of pleasantness were significantly

greater than lower level users' perceptions of pleasantness during the pre-test. Post-test results comparing the user mean responses for each floor when the plants were in place were not significant.

During the post-test, mezzanine respondents also indicated a greater perception of the area being crowded, with a pretest mean of 3.31, and a post-test mean of 3.71. The probability level was .0590 with 171 degrees of freedom, just shy of statistical significance at $p = .05$.

A lower level result very close to significant with a probability level of 0.0515, was the perception of quiet. The pre-test mean was 2.43, with the post-test showing a mean of 2.34. First floor atrium users may have felt the floor was quieter when the trees were present.

Although not considered significant when testing at the level of $p = .05$, the following post-test user mean responses were slightly more positive than the pretest (see Figure 9). Lower level users reported in the post-test that the space seems to have felt slightly more colorful (3.11-3.08), finished (3.49-3.40), cheerful (3.65-3.57), roomy (2.60-2.55), and airy (3.08-2.85), when the plants were present.

Negative mean movement of lower level perceptions during the post-test was identified for perceptions of

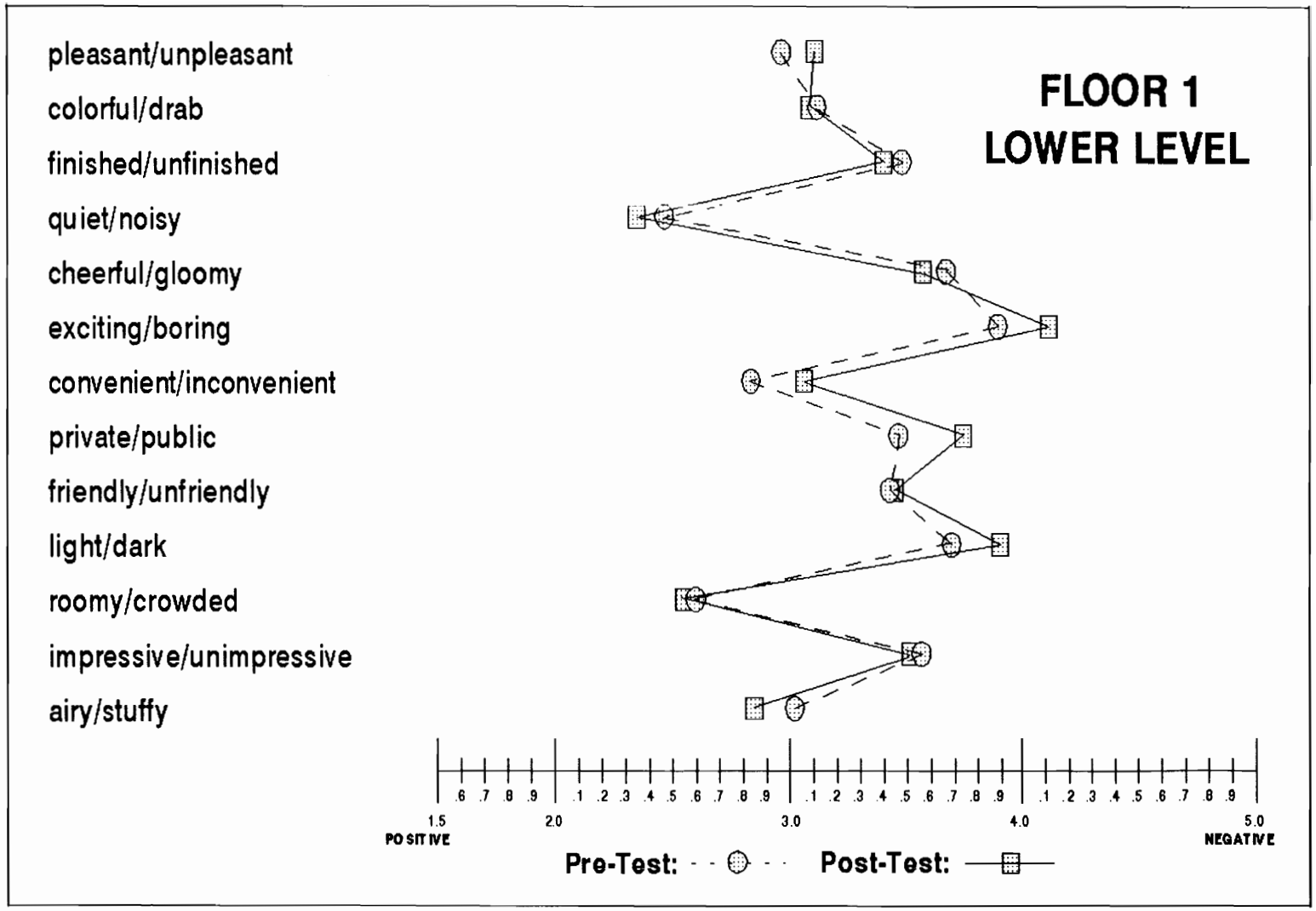

Figure 9: - Profile Analysis Showing Changes In Mean Responses of Atrium User Perceptions

pleasantness, excitement, convenience, privacy, and light level. Atrium users may have felt that the lower level was slightly less pleasant (2.96-3.10) because of the excessive leaf drop. A lower excitement rating (3.89-4.10) could be interpreted as a positive factor influencing the close to significant increase in a feeling of quiet. The feeling of loss of convenience (2.85-3.06), could have resulted from tree placement along previously unhindered circulation paths. Perceptions of the loss of privacy on the lower level (3.47-3.73) might have resulted from an increase in overall time spent by lower atrium users during the second week. The lower atrium level was darker during the post-test because of leaf canopies blocking more light from above, and from rainy weather.

Another interesting finding when comparing pre- and post-tests, was that all perceptions concerning the mezzanine during the second week of data collection either stayed essentially the same or moved slightly toward the negative (see Figure 10). The only result that showed a positive directional movement was that users considered that floor slightly more cheerful with a pre-test mean of 2.28, and a post-test mean of 2.22. These results, combined with suggestions for adding plants to the mezzanine level found on second week surveys, may indicate that users liked the

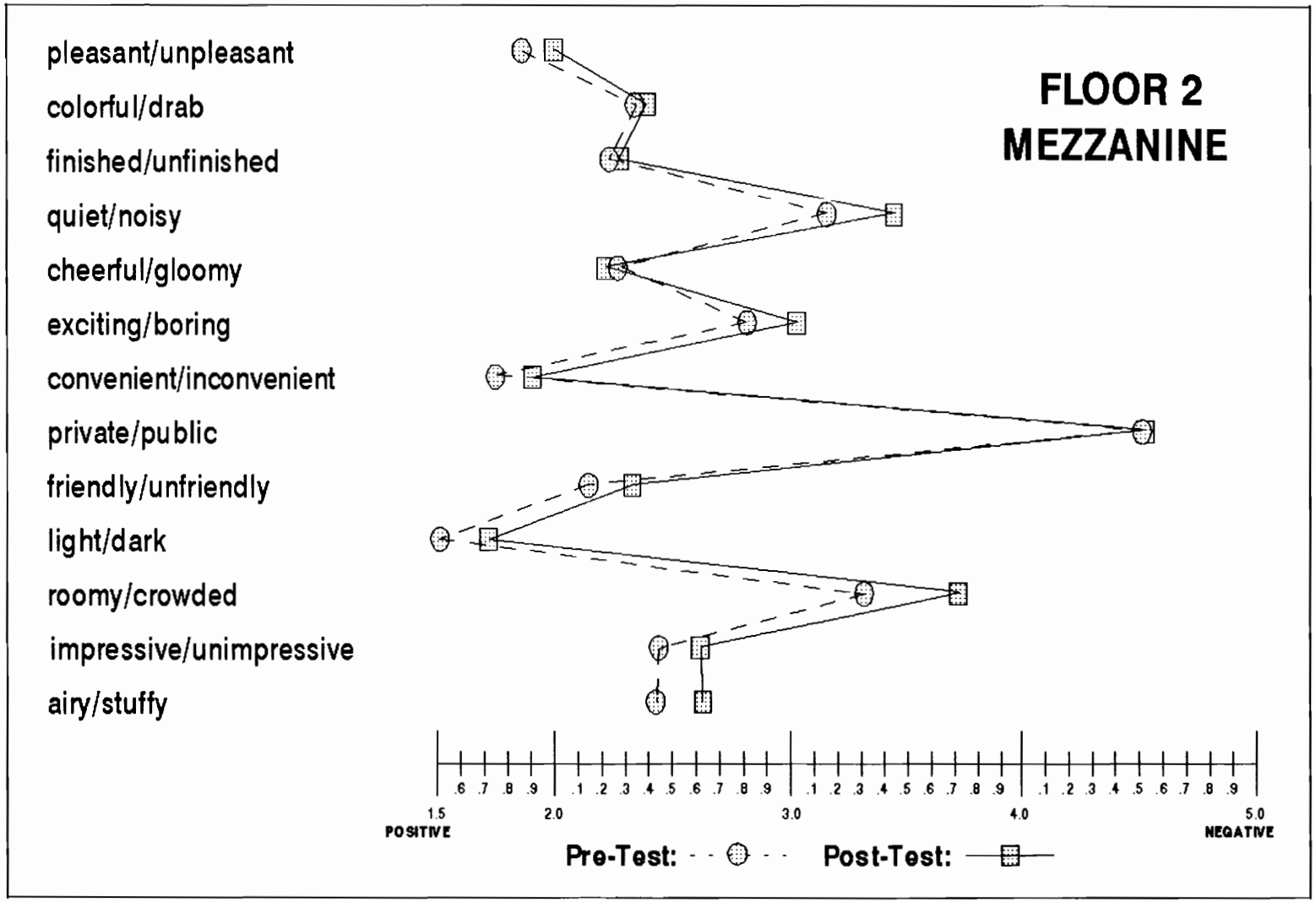

Figure 10: - Profile Analysis Showing Changes In Mean Responses of Atrium User Perceptions

plants on the lower level, and may have interpreted the mezzanine as less desirable when the trees and plants were installed on the level below.

Figure 11 indicates that when the mean responses for each adjective pair from the pre- and post-tests were averaged together and plotted in a profile analysis, the mezzanine level continued to evoke more positive perceptual responses from users for the duration of the study, than did the lesser used lower atrium level (see Figure 11).

Although no movement proved to be statistically significant, to summarize perception changes after plant installation on the lower level: six appear to have improved, five moved in a more negative direction, and two remained essentially unchanged. Changes in overall perceptions of the mezzanine level after plantscaping indicate that one may have improved, nine appear to have declined, and three remained the same.

Because no t-tests dealing with the perceptual changes of the atrium from pre- to post-test proved to be statistically significant, the null hypothesis stating that the introduction of plants into the atrium space would not significantly change perceptions of it is accepted.

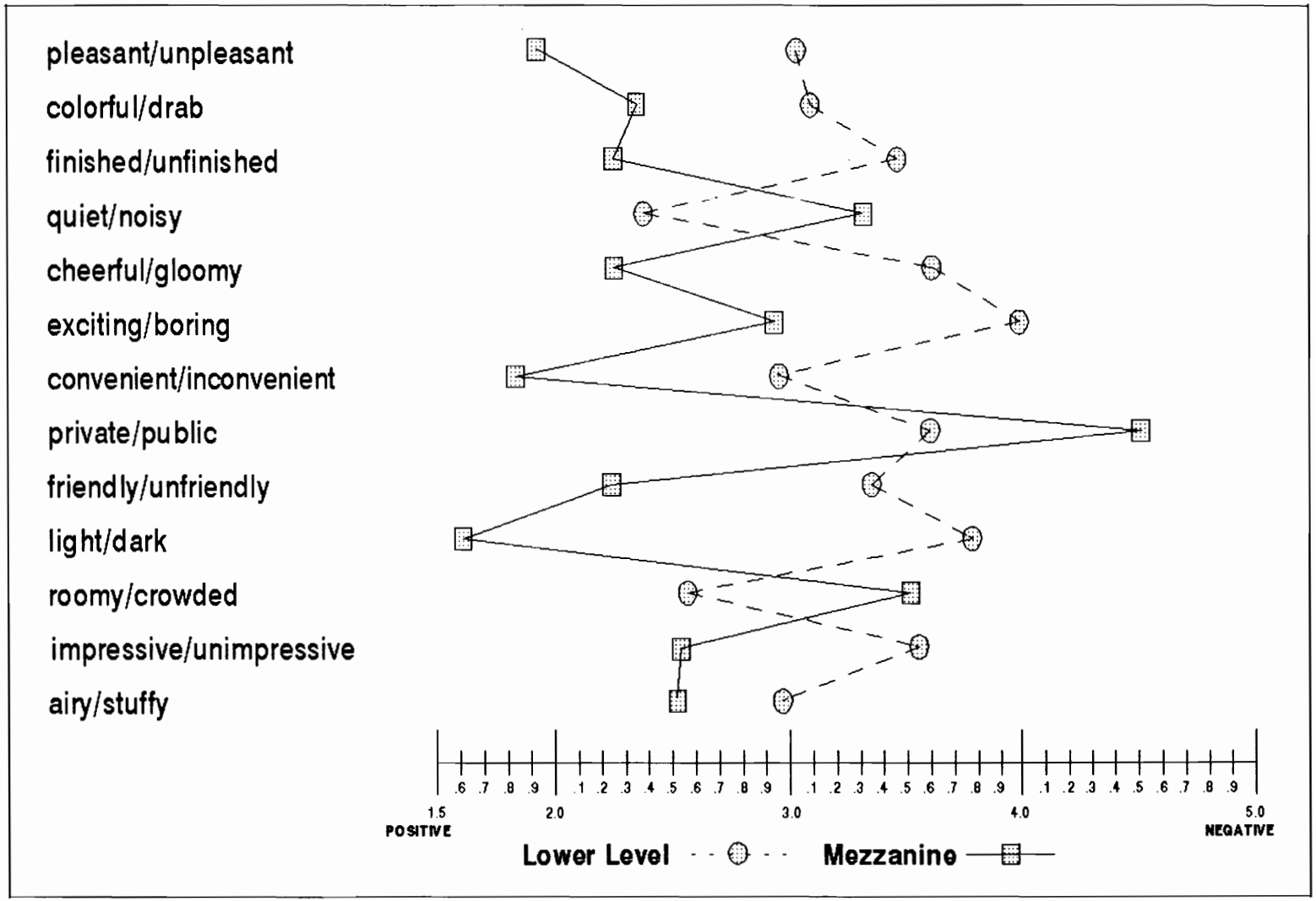

Figure 11 - Profile Analysis Comparing Averaged Mean Responses of Lower Level and Mezzanine Users

Atrium Improvement Suggestions

Results for this section of the questionnaire were obtained by tallying the frequency of specific requests for improving the overall atrium space (see Table 3). During the pre-test week, the most frequent request was for better climate control (24.3%, mezzanine level was too hot), followed by the suggestion to add plants to the space (17.6%). Other suggestions included the addition of artwork or some kind of banners, adding more tables to the lower atrium level, and adding more light to the lower atrium level.

After plant installation, the most frequent suggestion for improving the atrium was for climate control on the mezzanine (45.8%). Second to this response were comments approving of plant installation (15.3%), followed by requests for more plants (11.1%) and suggestions that plants be installed on the mezzanine level (8.3%). Other comments in order of frequency were those positive about the atrium and those recommending the addition of more tables, color to the space, and light to the lower level.

During the pre-test, 13 of 74 suggestions (17.6%) concerned adding plants. After plant installation, reactions to their presence comprised 25 of 73 (34.2%), with

Table 3. - WRITTEN ATRIUM IMPROVEMENT SUGGESTIONS

Pre-Test	N	%
Climate control (mezzanine too hot)	18	24.3%
Add plants to the atrium	13*	17.6%
Add artwork/banners	10	13.5%
Add tables to lower level	6	8.1%
Add light to lower level	6	8.1%
Liked the atrium	4	5.4%
Need better maintenance	4	5.4%
Dislike furniture, 1st floor	3	4.1%
Other	10	13.5%
Total	74	100.0%

Post-Test	N	%
Climate control (too hot)	33	45.8%
Like the plants	11*	15.3%
Add more plants	8*	11.1%
Put plants on mezzanine	6*	8.3%
Like atrium	4	5.6%
More tables	4	5.5%
More light, lower level	3	4.2%
More color	3	4.2%
Total	72	100.0%

*Plant Comments Pre-test: 13 (17.6%)

*Plant Comments Post-test: 25 (34.7%)

14 (19.4%) suggesting adding more plants to the space. This was an increase in plant comments of 16.7% from pre- to post-test.

Behavioral Mapping Results

Behavioral maps were analyzed for changes in lower level user behaviors before and after Ficus trees and Chinese Evergreen plants were installed in the space.

Users of the lower atrium level were observed to determine:

1. The number of people who used the first floor atrium level.
2. How the space was used.
   a. For circulation only
   b. For specific activities
3. If they chose to sit, lie down, or pause while passing through the area of tree installation.
4. Where they chose to sit, lie, or pause.
5. The total amount of time spent on the lower atrium level.

Results were hand tabulated and averaged for comparison.

Analysis of directional paths of recorded individuals showed that the lower level is used most often for circulation, with a majority of people passing through the central area of the space to use the stairs leading to the mezzanine

level. The next most frequent users are individuals in the Department of Clothing and Textiles, followed by individuals associated with the Department of Family and Child Development, that have facilities at either end of that floor. The number of people pausing was higher during the first week, when both a gallery exhibit and new merchandising displays in the Clothing and Textile windows were installed. During both weeks more people stopped to look at the visual merchandising windows than the gallery exhibit.

Data collected during the pre-test indicates that 2,269 people circulated through the 1st floor (lower) level of the atrium, with 1,294 of them passing through the area of central seating where trees were later installed. Following the introduction of the trees, 2,057 people circulated through the lower level, with 1,329 of them passing in close proximity to central seating and the trees. Although there were 12 fewer people that used the lower atrium during the post-test, 35 more individuals passed within tree interaction distance. The pre-test showed that 57% of users passed by or used central seating, with 65% of post-test users doing the same when plants were present. This is an overall user shift toward the trees of 8%.

User seating choices were recorded to determine whether the proximity of the trees to central seating would attract

individuals to those seating locations. Before plantscaping, central seating provided no visual privacy from any atrium level. Peripheral seating located in sheltered "alcoves" provided visual privacy from the two atrium levels above and from some observation angles on the lower level itself. Trees were not placed near peripheral seating.

Although the circumference of tree branches was limited by tree size and the manner in which they were wrapped for shipment, the placement of the trees created small leaf canopies above some central seating locations, increasing visual privacy from higher atrium levels. From the mezzanine, the trees looked almost crowded, and the leaves dense. From the lower level, they appeared smaller, farther apart, and the leaves sparse. The leaf canopy did not affect visual privacy from other vantage points on the lower level.

During both pre-and post-tests, user seating choices remained the same with approximately 68% using central seating and 32% using peripheral seating (see Table 4). During the post-test, individuals choosing to nap on the lower level preferred to lie under the trees. During the first week of observation, two people napped, with one choosing central seating, and one choosing more private peripheral seating. When the trees were adjacent to central seating, all three people napping slept under the trees.

Table 4. - LOWER ATRIUM LEVEL USER SEATING CHOICES

Pre-Test					
	Central seating		Peripheral seating		Total
Monday	9	52.9%	8	47.1%	17
Tuesday	13	54.2%	11	45.8%	24
Wednesday	32	74.4%	11	25.6%	43
Thursday	10	66.7%	5	33.3%	15
Friday	19	86.4%	3	13.6%	22
Total	83	68.6%	38	31.4%	121

Post-Test					
	Central seating		Peripheral seating		Total
Monday	13	72.2%	5	27.8%	18
Tuesday	11	84.6%	2	15.4%	13
Wednesday	10	76.9%	3	23.1%	13
Thursday	8	53.3%	7	46.7%	15
Friday	10	55.6%	8	44.4%	18
Total	52	67.5%	25	32.5%	77

Also of interest is the analysis of actual time spent by users in seating locations during the pre- and post-test periods. During the post-test, individuals spent more time in both central and peripheral locations on the lower atrium level on all days except Tuesday, with an average increase of 4.1 minutes per person (see Table 5). On Tuesday the occurrence of regional flooding probably affected sample numbers, or dramatically altered their daily routine. The effect of regular classes ending on Wednesday and finals beginning on Friday is not known.

Discussion

Demographic information cited shows that the atrium was used primarily by students. Students said that they most often used the space for studying and socializing.

T-tests done on atrium user perceptions as recorded on semantic differential scales, indicated that the mezzanine level of the atrium was considered to be significantly more pleasant than the lower level during the pre-test, even though it was perceived to be crowded. Although not found to be statistically significant at $p = .05$, when comparing pre- and post-test data, there were changes in the mean responses of user perceptions when plants were installed in the atrium.

Table 5. - AVERAGE USER TIME SEATED ON LOWER ATRIUM LEVEL IN MINUTES

		Pre-Test		Post-Test		
		Number Users	Average Minutes per Person	Number Users	Average Minutes per Person	Time Change
Monday	C	9	2.6	13	20.0	17.4
	P	8	8.5	5	63.0	54.5
Tuesday	C	13	43.0	11	19.0	-24.0
	P	11	25.5	2	10.0	-15.5
Wednesday	C	32	12.0	10	17.0	5.0
	P	11	13.0	3	17.0	4.0
Thursday	C	10	20.0	8	20.0	0.0
	P	8	9.0	7	19.0	10.0
Friday	C	19	10.0	10	14.0	4.0
	P	3	18.0	8	23.0	5.0
Total		115	17.2	77	21.3	4.1

C = Users in central seating (Where trees were installed during post-test)

P = Users in peripheral seating

NOTE: Tuesday of Post-Test week was the day of regional flooding. Sample numbers and light levels were affected. Sample time spent may have been affected by exams beginning Friday of Post-Test.

After plantscaping on the lower level, lower level data indicated that there was mean score movement toward the positive in the perceptions of color, cheerfulness, appearance of a more finished space, quiet, roominess and airiness. Mean score movement also indicated a negative trend in the perceptions of excitement, convenience, privacy, and light level. Negative movement in the perceptions of excitement and convenience could have resulted from tree placement adjacent to the previously unobstructed central path of circulation, excessive leaf drop, and an increase in time spent on the lower level by users during the post-test. The increase in the perception of darkness was apparent, resulting from the leaf spread blocking more reflected light from glazing over the mezzanine level, and lower light levels during rainy weather.

During the post-test, perceptions of the mezzanine level either stayed the same, or became more negative, while lower level perceptions most often improved or remained the same. However, none of these changes were statistically significant. When factored in with atrium improvement suggestions, mezzanine users may have felt that level less desirable having no trees or plants.

Because comparative t-tests analyzing data from all semantic differential pairs collected during the pre- and

post-tests showed no statistical significance, the null hypothesis that the installation of plants in the atrium would not change user perceptions was accepted.

The majority of user suggestions recorded during both weeks of data collection concerned the inability to alleviate the excessive heat and stuffiness in the atrium, especially on the mezzanine level directly under overhead glazing. The second most frequent comments concerned plants: pre-test data requesting their installation, and post-test data requesting additional plant installation, or showing positive reactions to those installed. Plant comments increased from pre- to post-test by 16.7%.

Behavioral mapping done during the post-test showed that 35 more individuals passed through the central seating area of the lower atrium (within tree interaction distance) than during the pre-test, a user shift toward the trees of 8%. Results indicate that the lower level is used most often for circulation to the mezzanine level via the central staircase, and for access to college departments and offices located on level one.

During both pre- and post tests, lower level seating choices were evenly divided between central and peripheral seating. During the pre-test nappers were divided between both locations, but during the post-test all nappers

preferred to lie under the trees. This behavioral change may have resulted from increased feelings of visual privacy from higher atrium floors, the proximity of the trees creating abbreviated leaf canopies over central seating closest to users. The feeling of privacy from those above did not include a feeling of increased privacy from other users of the lower level. Post-test perception mean movement indicates a decreased feeling of privacy by lower level users, perhaps resulting from the increase in time spent by all users of that level during the second week of data collection.

Lower level users spent more time on that atrium level when plants were present. This result may or may not have been affected by the end of regular classes on the Wednesday of post-test week, and increased opportunity to study for finals beginning that Friday. These findings suggest that the trees may have had an affect on lower atrium user behavior patterns.

Additional Observations

Additional observations regarding the use of plants within the atrium space were made by the researcher during the weeks that the plants were present, and following their removal. Atrium users, students, faculty, and staff seemed to have developed an interest or curiosity about the trees.

Users of the lower level during the week after installation and during the post-test, referred to sojourns in the atrium as "sitting in the woods", or sitting out in the "jungle". Concerned with the excessive leaf drop problem, many individuals asked if the trees were being watered properly, if the space was too hot for them, and following their removal, whether the trees had died.

After plants and trees were removed, building occupants wanted to know where they were, if the trees were sick, and when they would be returned to the space. Users felt that the space looked "empty" without plants, and some said it was "unexciting" when the atrium was returned to its pre-test appearance.

Chapter V

SUMMARY AND IMPLICATIONS

Summary of the Study

One of the primary concerns of the Interior Design profession is the creation of interior environments which are visually pleasing to inhabitants and which successfully facilitate activities the space will support. Many design components are needed to accomplish this task, including an architectural framework, supporting building systems, furniture, and finishes. These components are interdependent and must be complementary as well as functional.

Plants have traditionally been used as design components in various types of interiors ranging from residential to commercial. Since the 1970's, plants have become increasingly popular in interior "sunspace" applications which feature large expanses of glazing that invites natural sunlight into a building's interior. Limited research has been done investigating why plants are felt to be necessary design elements in such installations.

Researchers in related disciplines such as landscape architecture, human behavior, and horticulture, have contributed to research concerning human preference for plants, and the therapeutic influence plants have when in

proximity to humans. These studies are valuable in understanding why people like to be around plants, and highlight the psychological contributions plants make when in daily contact with people. Few studies can be identified which have investigated whether plants also affect human behavior or the way that people feel about interior environments.

This study was undertaken to determine if the installation of plants in an atrium sunspace could alter user perceptions of the interior environment, or could change the behaviors of atrium users. Finding that plants change peoples' feelings and movements within an interior space would not only attach new significance to plantscaping as a design function, but could provide a valuable sales tool to designers and related horticultural industries. Plants would no longer be considered exclusively as attractive natural elements, but as tools for behavioral modification.

A newly constructed atrium sunspace devoid of plantscaping was used to conduct a study on how users behave and perceive the space both before and after the introduction of trees and plants.

In order to obtain the needed data, two collection instruments and methodologies were designed and employed; a written survey questionnaire to determine user perceptions and activities within the atrium, and behavioral maps to

track and record user behaviors on the lower atrium level where plants were installed. Data collection took place during a two week period in the spring of 1992. Data were collected for one week with the atrium in its original state, and again, two weeks later for another week following the installation of Ficus trees and Chinese Evergreen plants on the lower level of the three story atrium. The week between was set aside to allow atrium users to become accustomed to the presence of the plants.

A random sample of atrium users was asked to complete the surveys, while behaviors of lower level users were tracked by behavioral mappers. The semantic differential section of the survey instrument was statistically analyzed using two tailed t-tests at a significance level of $p = .05$. Other sections of the survey instrument were analyzed using descriptive analysis.

Maps were descriptively analyzed to determine any changes in behavior patterns, especially changes in user seating preference and time spent on the lower atrium level.

Findings

This study indicates that plants may have an effect on human behavior in interior settings, as shown by a preference for napping under the trees during the post-test, and

an increase in participant time spent on the lower atrium level during the week of plant installation (see Figure 12). Although data collected did not attribute any statistical significance to changes in atrium user perceptions, user mean responses did show movement during the post-test.

Overall, plants seemed to have had a positive effect on the atrium environment. The desire for plants in the space was reinforced by a substantial increase in comments concerning plant presence in the atrium during the post-test. Users said they liked the plants, wanted more plants in the space, and requested plant installation on all levels of the atrium.

It was also suggested that building users may have become increasingly interested or curious about the plants, as witnessed by the researcher after the Ficus trees were removed from the atrium. Users voiced concern about the welfare of the plants, questioned their removal, and requested their expedient return to the space. A newly constructed space felt to be exciting and pleasant before plants were installed, was felt to be boring and empty when they were taken away. This finding supports horticulture studies cited in chapter two by various researchers investigating the psychological attachments people have for plants.

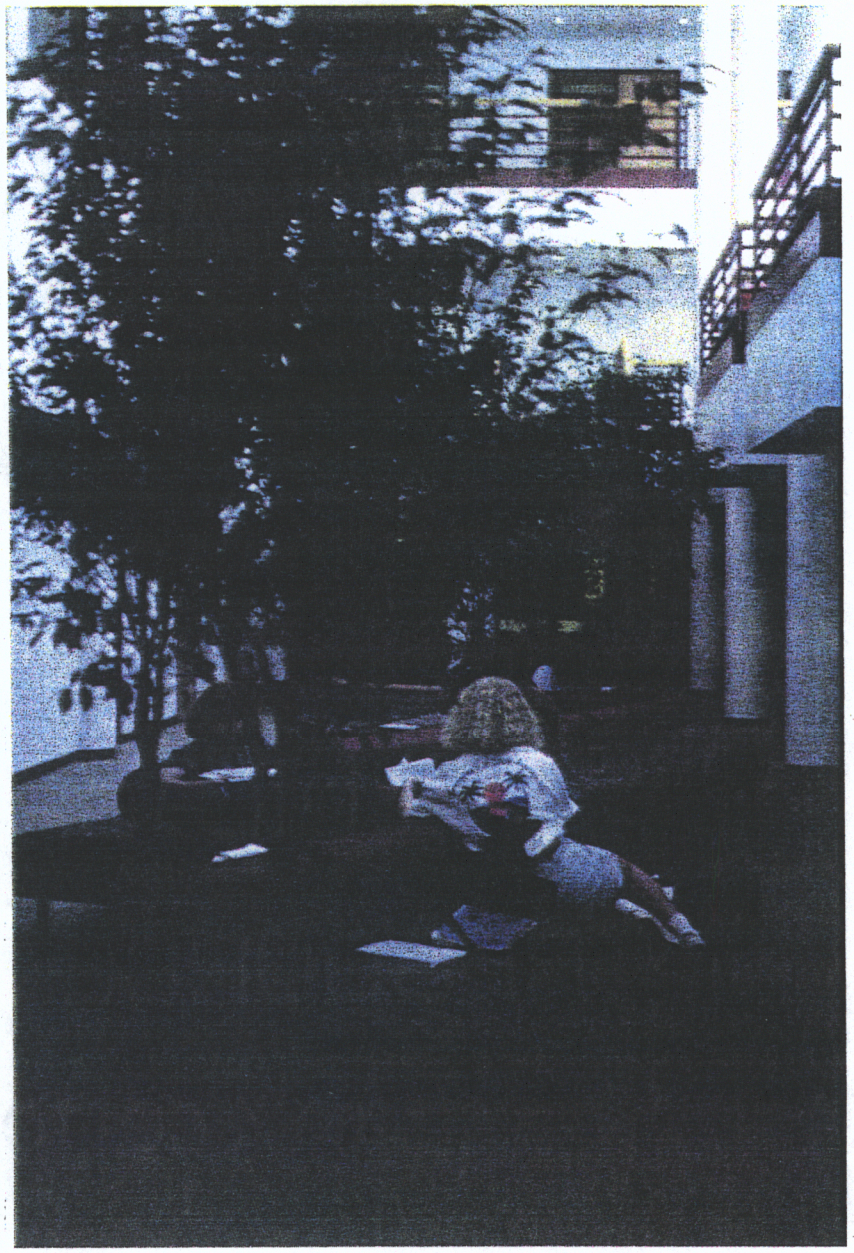

Figure 12. - Photograph of central seating on lower atrium during the post-test.

Although t-tests did not determine that user perceptual changes were significant at a level of $p = .05$, smaller changes in the mean responses of participants indicate that the trees may have had some effect. The only significant finding was that pre-test mezzanine users felt that atrium level was far more pleasant than the lower level at the time of data collection. There was no significant change in pleasantness from pre- to post-test.

Implications for Future Research

This study invites many possibilities for follow-up and related research activities. This particular exercise was performed within a "window of opportunity" afforded by the newly constructed atrium during the Spring semester of 1992. The length of the study was dictated by the fact that most students would be leaving for the summer. Significance may have improved had the study been four weeks in duration, with two weeks of observation both before and after plants were installed. This may have substantially increased user numbers, the volume of data, and helped to establish any behavioral trends not evident with only two weeks of observation.

There was also concern that the brief time set aside for users to become familiar with the presence of the trees

may have had an adverse affect on survey compliance. Half as many surveys were retrieved during the post-test as were collected during the initial week of data gathering. This may have resulted from frequent atrium users recognizing the survey form and thinking that they had taken the survey already, not understanding that there was a second survey distribution. Increasing the period between pre- and post-tests could avert any anticipated problems.

Had more time been available for the design of the study, some extraneous variables contributing to the hostile plant environment, such as lack of humidity/water might have been compensated for. Unfortunately, the design of the atrium makes it impossible to compensate for excessive heat and light levels on the mezzanine, and poor light level on the lower floor where the plants were installed.

Atriums provide their own set of site limitations, as does any sunspace that is directly affected by exterior climatic changes. Any further research done in this type of space must accommodate these exterior influences (extraneous variables) and compensate for them during data analysis. Descriptive analysis is more in keeping with this type of setting. If statistical significance at the level of $p = .05$ is essential, an interior environment should be chosen that has consistent levels of heat, humidity, and light.

A random sample can affect data analysis by confounding the results. If there are large discrepancies in sample sizes from one data collection period to another (as was the case in this study), unequal variances are often the result. Also, if the same sample members are participants in both pre- and post-tests, they may be reluctant to complete a questionnaire during the second week of data collection. This may have been the case in this study, which would account for the difference in survey numbers from pre- to post-tests. In a more controlled environment, a select, reliable sample might yield more information.

Another method for behavioral observation, such as a two way mirror, might also provide additional information that this study could not. Some atrium users, especially daily visitors, could have been affected by the presence of the mapper and being aware of data collection activities.

This study indicates that plants may affect some behavioral changes in humans within interior environments, but more extensive research is needed to confirm this observation. One suggestion for a follow-up study would be to cluster plants in an interior space, conduct observation, and then move the plants to a different location within the space to see if user behaviors change in response.

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APPENDIX A

SURVEY QUESTIONNAIRE

BALCONY LEVEL (THIRD FLOOR)

What are your perceptions of the balcony level (third floor) of the atrium? Please mark the scale position that best describes your response to the following adjectives.

PLEASANT	___ : ___ : ___ : ___ : ___ : ___	UNPLEASANT
DRAB	___ : ___ : ___ : ___ : ___ : ___	COLORFUL
FINISHED	___ : ___ : ___ : ___ : ___ : ___	UNFINISHED
QUIET	___ : ___ : ___ : ___ : ___ : ___	NOISY
GLOOMY	___ : ___ : ___ : ___ : ___ : ___	CHEERFUL
EXCITING	___ : ___ : ___ : ___ : ___ : ___	BORING
CONVENIENT	___ : ___ : ___ : ___ : ___ : ___	INCONVENIENT
PRIVATE	___ : ___ : ___ : ___ : ___ : ___	PUBLIC
UNFRIENDLY	___ : ___ : ___ : ___ : ___ : ___	FRIENDLY
LIGHT	___ : ___ : ___ : ___ : ___ : ___	DARK
CROWDED	___ : ___ : ___ : ___ : ___ : ___	ROOMY
IMPRESSIVE	___ : ___ : ___ : ___ : ___ : ___	UNIMPRESSIVE
AIRY	___ : ___ : ___ : ___ : ___ : ___	STUFFY

What suggestions do you have that might improve the atrium?

Cool the place
plants should be on 2nd floor to
plants were a nice addition to
1st floor.

Thank you for your participation.

Please give the completed form to the survey collector, or place in green boxes labeled "Survey" near atrium exit doors before 5:30pm today.

Date 4/23

WALLACE HALL ATRIUM USER SURVEY

Your answers will help us understand how the atrium is being used.

Please check appropriate response.

___ Staff ___ Faculty ___ Visitor

✓ Student Academic Level: 4O

Major: HIDM

I use the atrium as circulation space (just pass through it)

Yes ___ No ✓

If you use the atrium for more than building circulation, please complete the following chart.

Put the best guess of your time spent per week doing any of the follwing activities

	1st floor (lower)	2nd floor (mezzanine)	3rd floor (balcony)
Meetings			
Socializing			
Studying	2hrs.	6hrs	never
Eating			
Waiting			
Resting			
Other (Please specify)			

(over)

LOWER LEVEL (FIRST FLOOR)

What are your perceptions of the lower level (first floor) of the atrium? Please mark the scale position that best describes your response to the following adjectives.

Example: If you think the atrium is more warm than cold, mark

WARM	___	___	X	___	___	___	COLD

PLEASANT	✓	___	___	___	___	___	UNPLEASANT
DRAB	___	___	___	___	✓	___	COLORFUL
FINISHED	___	✓	___	___	___	___	UNFINISHED
QUIET	___	✓	___	___	___	___	NOISY
GLOOMY	___	___	___	___	✓	___	CHEERFUL
EXCITING	___	___	✓	___	___	___	BORING
CONVENIENT	___	✓	___	___	___	___	INCONVENIENT
PRIVATE	___	___	___	___	✓	___	PUBLIC
UNFRIENDLY	___	___	___	___	✓	___	FRIENDLY
LIGHT	___	✓	___	___	___	___	DARK
CROWDED	___	___	___	___	✓	___	ROOMY
IMPRESSIVE	___	___	✓	___	___	___	UNIMPRESSIVE
AIRY	___	✓	___	___	___	___	STUFFY

MEZZANINE LEVEL (SECOND FLOOR)

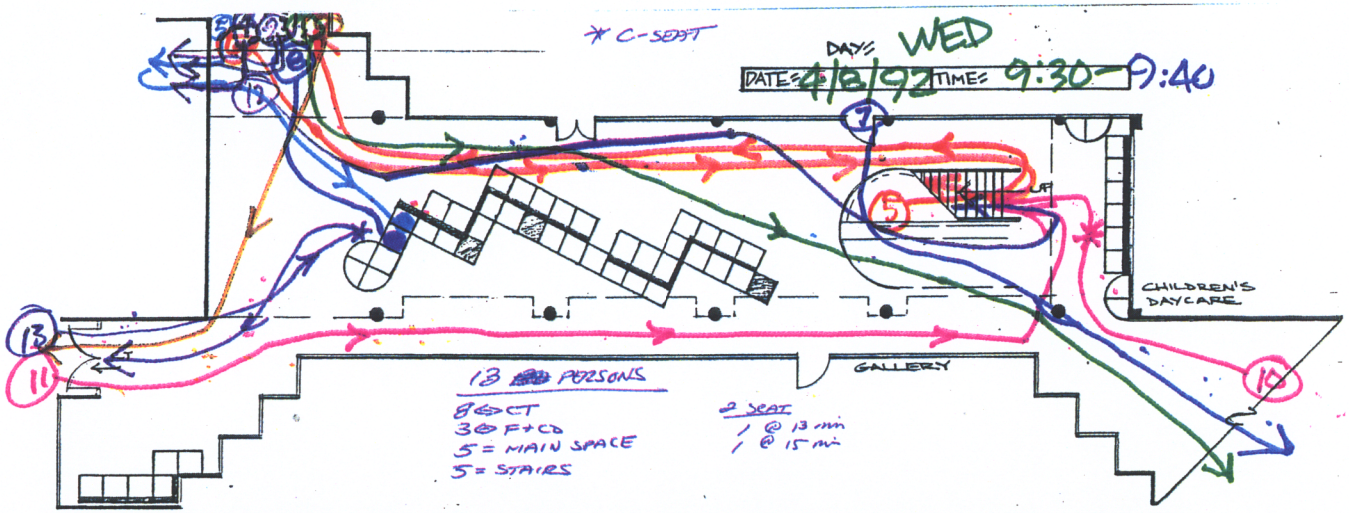
What are your perceptions of the mezzanine level (second floor) of the atrium? Please mark the scale position that best describes your response to the following adjectives.

PLEASANT	✓	___	___	___	___	___	UNPLEASANT
DRAB	___	___	___	___	___	✓	COLORFUL
FINISHED	___	___	✓	___	___	___	UNFINISHED
QUIET	___	___	___	✓	___	___	NOISY
GLOOMY	___	___	___	___	✓	___	CHEERFUL
EXCITING	✓	___	___	___	___	___	BORING
CONVENIENT	✓	___	___	___	___	___	INCONVENIENT
PRIVATE	___	___	___	___	___	✓	PUBLIC
UNFRIENDLY	___	___	___	___	___	✓	FRIENDLY
LIGHT	✓	___	___	___	___	___	DARK
CROWDED	___	___	___	✓	___	___	ROOMY
IMPRESSIVE	___	✓	___	___	___	___	UNIMPRESSIVE
AIRY	___	___	___	___	___	✓	STUFFY

(OVER)

APPENDIX B

BEHAVIORAL MAP



#	COLOR	TIME: START – FINISH
5		9:36 – 9:49 – 13 MIN.
8		9:38 – 9:53 – 15 min

#	COLOR	TIME: START – FINISH

A. Lynch

APPENDIX C

PROJECT BUDGET

BUDGET

EXPERIMENTAL SETTING

6- 15′ Ficus benjamina trees in 17" grow pots *
25- 12" Chinese evergreen plants in 8" grow pots *
Shipping and delivery for above from Homestead, FLA. *

3- 18" drainage saucers @ $4.50	$13.50
3- 18" used drainage saucers @ $2.50	$ 7.50
25- 5" vinyl drainage saucers @ $.38	$ 9.50
2- bags pine bark nuggets @ $1.96	$ 3.92
1- watering can @ $2.84	$ 2.84
Virginia state sales tax @ 4.5%	$ 2.11
Setting Total:	$39.37

DATA COLLECTION

1- behavioral mapper 9 Hrs. daily for 10 days @ $6.00	$540.00
1- set fine line magic markers	$ 6.50
1- legal size clipboard	$ 1.67
8- 8" x 8" x 4" shipping boxes @ $2.26	$18.08
4- cans dayglo green spray paint @ $3.14	$12.56
1- lettering stencil @ $.70	$ .70
5- 2PK. small suction cups @ $.74	$ 3.70
500- copies atrium map @ .05	$25.00
250- copies survey form @ .05	$12.50
2- rolls 35mm B&W film @ $3.50	$ 7.00
2- rolls 35mm 400 slide film @ $5.50	$11.00
Photograph and slide processing	$150.00
Document reproduction and binding (4 sets)	$96.00
Virginia state tax where appropriate @ 4.5%	$15.51
Collection total:	$900.22

PRESENTATION OF RESEARCH RESULTS

Travel to National IDEC convention in Idaho	$510.00
Lodging, food, expenses of convention	$401.70
Grand total:	**$1950.59**

*** Plants and additional research funding were provided by the American Landscape Contractors Association (ALCA)**

VITA

Cathy Hillenbrand-Nowicki, daughter of William J. Hillenbrand, Jr. and Lois Sarsfield Hillenbrand, was born January 23, 1958 in Pittsburgh, Pennsylvania, and graduated with honors from Thomas Jefferson High School in 1975. In 1979, she graduated Summa Cum Laude from Seton Hill College in Greensburg, Pennsylvania with a Bachelor of Arts degree in Art, and was listed in Who's Who in American Universities and Colleges and in The National Dean's List.

After working for 10 years, she entered the graduate program in Interior Design at Virginia Polytechnic Institute and State University. While at Virginia Tech, Mrs. Hillenbrand-Nowicki held graduate teaching assistantships, won first place in the 1991 IBD/Knoll National Student Design Competition, and received a one year appointment as an Interior Design Instructor. The requirements for a Master of Science Degree were completed in May of 1993.

The author is a member of the honor societies of Phi Kappa Phi and Kappa Omicron Nu, and is a graduate member of the Interior Design Educator's Council (IDEC).

Cathy Hillenbrand-Nowicki

Cathy Hillenbrand-Nowicki