

THE IMPACT OF INTERIOR HOUSEPLANTS IN UNIVERSITY CLASSROOMS  
ON COURSE PERFORMANCE AND ON PERCEPTIONS  
OF THE COURSE AND INSTRUCTOR

THESIS

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**ABSTRACT**

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**SUPERVISING PROFESSOR: TINA MARIE CADE**

While the aesthetic values of interior greenery are obvious, some research has suggested that interior living plants may offer some psychological and restorative values, such as reduced tension, better coping mechanisms, and increased concentration and attention. The main objective of this research was to investigate the impact of plants within a university classroom setting on course performance, course satisfaction, and student perceptions of the instructor. The study was designed to include a minimum of two classes of the same coursework, taught by the same professor in the same room.

Three sets of two classes each, and 385 students were included within the study. Throughout the semester, the experimental class of students was treated by including an assortment of tropical plants within the classroom. Plants were not present in the control classroom of the study. A survey administered to each classroom of students at the end of the semester asked students to provide demographic data including class rank and gender. The professor for each course provided information on each student's grade for the course, and replaced each student's name with an assigned code number to insure anonymity of students. The Texas State University-San Marcos end-of-semester course evaluation survey was used to collect information on student satisfaction with the course and with the instructor. An analysis of variance test compared treatment and control group grades and course satisfaction evaluation scores. No statistically significant differences were found in course grades or course and instructor evaluation scores in comparisons of overall treatment and control groups, although present level of interest in the subject was higher for the overall treatment group. Individual course comparisons between treatment and control groups revealed no statistically significant differences in course grade nor course and instructor evaluation in the classroom with color, space, and a second-floor view of green trees. The treatment group received statistically significantly higher course grades than the control group in the third-floor cramped classroom with a view of the tops of trees. Comparisons between treatment and control groups of the stark, windowless classroom revealed statistically significant differences in course and instructor evaluation scores. Nine individual responses from the course and instructor evaluation and present interest in the subject were statistically significantly higher for the treatment group in the windowless environment. Comparisons of Freshman, Sophomore, and Senior grades and course and instructor evaluation scores revealed no statistically significant differences. Freshman and Junior interest in the subject was statistically significantly higher for the treatment group at the end of the semester. Junior course grades and course and instructor evaluation scores were statistically significantly higher for the treatment group when compared to the control group. No statistically significant differences in demographic comparisons of ethnicity, gender, or of those who indicated they took the course for reasons of "Major Elective", "General Studies Required", or "Minor Related Field". "Major Required" treatment group grades and present level of

interest in the subject were statistically significantly higher than the control group. “General Interest” course and instructor evaluation scores and level of interest in the subject at this time were also statistically significantly higher for the treatment group when compared to the control group. The results demonstrate value added to the classroom experience and help to justify consideration of the added expense of interior plants in meeting the goals of instructor and curriculum.

## CHAPTER I

### INTRODUCTION

A study conducted by researchers at the University of Missouri-Columbia reported that after much research regarding the question of what makes a college student value their course, “there is still little consensus as to what will help students form the most positive assessments of their classes and their instructors” (Filak & Sheldon, 2003, p. 235). The study listed a number of examples that students viewed as good teaching such as encouragement, organization, and enthusiasm. They found camaraderie with the instructor to be positive, but not necessarily a component of effective teaching.

To be satisfied with a professor, the traits present within the instructor that were important to MBA students were to be knowledgeable, committed, flexible, and likeable (Ferguson & Pannirselvam, 2000). Even in web-based instruction, “social interaction with instructors and collaborative interaction with peer students are important in enhancing learning and active participation in on-line discussion” (Jung et al., 2002, p.153).

Research at the University of San Francisco (Think, 2003) found that, “A premium should be placed on ensuring that all teaching environments provide the best possible conditions to stimulate learning. Light, acoustics, ventilation and ergonomics all contribute to a positive experience for faculty and students” (p. 2). These components demonstrate care and detail in planning for a positive learning environment. Movable

seating is encouraged in all but auditorium classrooms. Inexpensive plans should be made for adjusting to future technology. Windows should provide plenty of daylight (Think, 2003).

Other studies have shown that windows and natural elements within the interior environment are important environmental factors. In one study, artificial lighting was suspected as causing 'building sickness' (Robertson et al., 1989). The study found, "There was a significantly higher prevalence of work-related headaches and work-related lethargy in the air-conditioned building than in the naturally ventilated one. There was also less daylight in the air-conditioned building and lower mean luminance and illuminance of the work positions despite there being more lights on" (Robertson et al., 1989, p. 47).

Interactions with nature, whether passive or active, have restorative mental and physical effects on humans (Lewis, 1996). Incarcerated criminals and hospital patients who passively encountered natural areas through window views showed positive effects expressed by fewer reported incidences of illness when compared to those who did not encounter natural area views (Ulrich, 1984). A study with attention deficient children showed that the greener the play space, the less the child exhibited attention deficit disorder symptoms (Taylor et al., 2001).

A sense of self-sufficiency was improved when people contacted nature through gardening (Hassan and Mattson, 1993; Patel, 1991). Research demonstrated that active participation with nature through gardening resulted in positive psychological benefits including reduced stress levels, increased self-esteem, and an increase in social

interaction (Cammack et al., 2002; Kaplan, 1973; Lewis, 1978; Patel, 1991; Waliczek et al., 1996).

### *Problem Statement*

The intent of this study was to examine the effects of live interior plants within the classroom environment on university students.

### *Purpose*

The main objective of this research was to investigate the impact of plants within a university classroom setting on course performance, course satisfaction, and student perceptions of the instructor. The specific objectives of this study were:

1. To compare final course grades of students in classrooms that had plant material during instruction to final course grades of students in classrooms with no plant material present.
2. Compare overall instructor and course satisfaction scores between students in classrooms that had plant material present within the classroom during instruction to students that had no plant material present within the classroom during instruction.
3. To compare specific classrooms of students to determine if any particular classroom appeared to benefit more from the presence of plant material in the classroom.
4. To observe whether any particular demographic group appeared to benefit more from the presence of plant material in the classroom.
5. To observe whether instructors felt plant materials in the classroom were beneficial or detrimental in any way.

### *Definition of Terms*

Course satisfaction: "... output measure of teaching quality... Course satisfaction is used to indicate how satisfied students are with the education and service provided..." (Edith Cowan University, 2005). Course satisfaction is used as the level of satisfaction, positive or negative, a student experiences within a course.

Instructor satisfaction: Satisfaction is stated as "The fulfillment or gratification of a desire, need, or appetite" (The American Heritage Dictionary of the English Language, 2000). Instructor satisfaction is the level of satisfaction, positive or negative, a student experiences with the instructor of the course.

Course performance: Performance is described as "Something performed; an accomplishment" (AHDEL, 2000). Course performance is used to describe the level of achievement demonstrated by the student, given the individual course requirements.

Interior houseplant: A houseplant is "Any of a wide variety of plants grown indoors, often for decorative purposes" (AHDEL, 2000). It is those plants, typically tropical plants, suitable for an indoor environment.

### *Limitations*

Because of time limitations, students often witnessed the placing or removal of plants.

Control and experimental class sessions were held at different times during the morning class sessions.

The study was conducted with only Texas State University-San Marcos students.

*Basic Assumptions*

It was assumed that professors would honor the request of not discussing the study with students involved in the study.

It was assumed that students were similar in control and experimental sessions.

It was assumed that students were representative of most students on campus.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

#### *Importance of student satisfaction at universities*

##### *A. Student motivation, instruction, and university quality*

A quality school attracts quality educators, who in turn provide a quality education (Groen & White, 2003). “How” a student is taught is what motivates a student to learn, not “what” is taught (Mullen, 2003). Presenting course content in an organized fashion is one of the “hows” in motivating a student (Mullen, 2003). Students are also motivated to learn when given relevant examples that they can apply personally to their lives, by being given clear examples when receiving explanations (Mullen, 2003). Other important motivating factors to student learning are the students’ perceptions of the respect and support of their instructors and interaction of instructor and student (Ryan & Patrick, 2001), such as is demonstrated when an instructor quickly learns and uses names, recognizes students and knows their interests (Patrick et al., 2002).

It was found that the competence and the likeability of a professor were important factors in predicting the influence of an instructor. Autocratic professors, ones who wield power as a dictator, were rated least likeable by both female and male students. Students rated democratic professors as more likeable and competent when compared to autocratic professors (Larocca, 2003).

The closeness that teachers and students perceive between each other is called immediacy. Immediacy and a positive student attitude have been correlated (Mullen, 2003). Body language is one way to express immediacy, making students feel relaxed. Also, vocal expressions and smiles encourage a positive attitude among students (Mullen, 2003).

Results of a survey showed that student satisfaction with an instructor indicated the likelihood a student will take another course with that instructor and refer others. Students satisfied with an instructor increased the likelihood of increased student enrollment, which in turn can increase the frequency a course may be offered (Ferguson & Pannirselvam, 2000). The results showed that character traits of a professor are a primary reason for repurchase (Ferguson & Pannirselvam, 2000).

A survey measuring student satisfaction was administered to students in a university M.B.A. operations management course. There were three sections of this graduate course, all taught by the same instructor, and all M.B.A students were required to take the course. The students' overall course satisfaction in general, course satisfaction with this instructor, and satisfaction with the instructor of the course were measured (Ferguson & Pannirselvam, 2000).

In the study, it was found that the organization of the course and topic relevance were large determinants in the design of the course (Ferguson & Pannirselvam, 2000). When rating the grading process, fairness in grading and clarity strongly determined how satisfied the student was overall with the process (Ferguson & Pannirselvam, 2000). Materials that were clear, understandable, relevant, and covered the topics affected overall course satisfaction (Ferguson & Pannirselvam, 2000).

Traits found desirable in a professor were that they be knowledgeable, flexible, committed, and likeable (Ferguson & Pannirselvam, 2000). However, teaching effectiveness may be enhanced by improving nonverbal skills, as the wrong signal can be sent to a student (Ambady & Rosenthal, 1993). For example, it could be perceived that when a professor does not smile, he or she is not approachable (Ambady & Rosenthal, 1993). Teaching methods using case discussions, games, and videos help students to apply what they are learning and help to keep them interested (Ferguson & Pannirselvam, 2000).

Research with students in a video-conferencing course found that there was very little rapport between instructor and student, but this amount of rapport was perceived by both students and instructor to be sufficient (De Clercq, 1996). When students and instructors within a classroom setting were studied, the responsiveness and demandingness of the instructor and the students' motivation and achievement outcomes appeared to be related (Mullen, 2003). If an instructor appeared to be too controlling, requiring non-relevant work or demanding too much work, a student may not only begin to miss classes, but may drop out, making the student's perception of their instructor a factor in retention rates (Mullen, 2003).

Students rated personal leaders as more competent and more likable when dealing with the care of group morale (Larocca, 2003). Male students and female students evaluate professors differently (Larocca, 2003), which suggests instructor satisfaction may, in fact, vary from student to student regardless of other factors. Though there may be a relation between the perception a student has of the quality of academics and the actual standards of the academics (Saroyan & Amundsen, 2001), it has been shown that

teaching assessments may be influenced by factors not related to the process of teaching, such as the size of the classroom (Greenwald & Gillmore, 1997).

Two factors, “student motivation” and “instructor evaluation,” were analyzed from 1292 student responses from the psychology classes of 81 universities (Frances & Gruber, 1981). Instructor, course, and student characteristics were identified. Variables that had a significant effect on student motivation and instructor evaluation were the grade expected in the course, the age of the instructor, and whether the instructor was full-time or part-time faculty (Frances & Gruber, 1981). Student ratings of personal motivation and of their instructors were more positive if the instructor was younger and full-time, and if the student had higher expectations for their grades (Frances & Gruber, 1981).

Students listed “a comfortable and supportive learning environment” and “when I am interested in the topic” as important factors in an effective teaching environment (Lawson & Askell-Williams, 2001, p. 8). “In particular, participants’ concerns with lecturers’ pedagogical understandings, learning support and learning relevance provide fertile ground for further research” (Lawson & Askell-Williams, 2001, p. 10).

#### *B. University competition and state interests in quality universities*

It is in the interest of the state to attract individuals of high ability and retain them, and the state uses universities to attract individuals of high ability (Groen & White, 2003). These individuals pay more taxes and are a bigger contributor to development, economically speaking. The ability of these students to earn higher wages may mean that a state could realize financial gain when high ability students are attracted to their universities (Groen & White, 2003). “Students are important stakeholders in higher

education, and the fact that national budget systems increasingly are linked to student choices make the process of attracting and keeping students satisfied more important to institutions” (Wiers-Jenssen et al., 2002, p. 186).

Top universities are more likely to attract top students when compared to other universities. Conversely, universities of lesser quality attract students with lower levels of ability (Groen & White, 2001). Research has found a correlation between the quality of a university and the return rate of students (Brewer et al., 1999). University ratings were divided into three categories. The most competitive universities received an “elite” or “top” rating. Competitive or very competitive universities were given a “middle” rating. Those universities that were the least competitive or not at all competitive were rated as “bottom” (Brewer et al., 1999). A student attending a higher quality university was more likely to return, when compared to a student who attended a university of lesser quality. The suggestion was that a higher quality university could realize higher tuition rates due to the greater return of higher quality students, when compared to universities of lesser quality (Brewer et al., 1999).

### *C. Impact of a positive emotional state for maximum cognition*

Stress can inhibit maximum performance of cognitive tasks (Glass & Singer, 1972; Hockey, 1983) such as proofreading. It is not surprising, then, that research has seen stress recovery accompany an increase in performance of cognitive tasks (Glass & Singer, 1972; Hockey, 1983). In one study, natural as opposed to urban views relieved stress and increased performance of the task of proofreading (Hartig et al., 1991).

It has been demonstrated that negative versus positive states of emotion have different effects on memory and on solving problems (Isen, 1990). “ ‘Higher-order’

cognitive functioning involves integrating diverse material or associating in a flexible way previously unrelated information or concepts. Higher-order functioning is required for forming remote associations and for creative problem solving” (Ulrich, 1993, p. 110). Studies have shown that people’s scores increase significantly on high-order functioning tests and creativity tests when they are in a positive emotional state (Isen, 1990). When subjects had negative feelings, their performance on high-order functioning tests and creativity tests was actually lowered (Isen, 1990).

When negative emotions such as failure and anxiety are present, limited attention may exist. Conversely, broadened attention can be predicted when a person is in a positive state such as success or optimism (Basso et al., 1996; Derryberry & Tucker, 1994). Associations made while a subject feels they are in either a positive, negative, or neutral state of feeling may all cue memory recall. When in a positive emotional state, positive and neutral associations of information are cued (Isen, 1985). However, sadness and other negative emotions cue some negative information, but the connection of this information to further information is limited. Negative information does not provide as many cues to connect with other information, unlike the cues that exist with positive information, and therefore greater creativity is scored with those who experience positive feelings (Isen, 1985). With negative feelings, the information that is integrated for recall is impeded, creativity is hindered, and focus of attention is restricted.

This is not to say that positive feelings improve performance on minor tasks that do not require great attention or focus. It appears they do not. In fact, it may be that there are cases where performance is actually reduced in the presence of positive feelings when

performing a lower-order task, such as proofreading, where associations to trigger recall are rejected (Ulrich, 1993).

### *Preferred classroom environmental factors*

#### *A. Sensory and architectural environmental preferences for students*

A variety of environmental preferences are found to be universally important including perceptions of temperature (Stoops, 2001) and environmental perceptions which include the senses of vision, hearing, and smell (Ulrich, 1981). Vision has been established as the most important of the senses concerning the influence of outdoor environments on well-being (Ulrich, 1979). In stressed persons, emotional states were significantly improved by viewing nature, and urban views were a hindrance to well-being (Ulrich, 1981).

Architecture is an expression of our presence in that it can give evidence to the productivity and creativity of the environment (Osterberg, 1993/1986), and can affect the first impression of a student. It can stimulate social interaction and encourage students to spend more time on campus, helping to increase both social and academic activity for students (Wiers-Jenssen et al., 2002). The amount of involvement with an institution can then influence a student's satisfaction with that institution, as can psychological factors of happiness and well-being (Wiers –Jenssen et al., 2002).

Social support, the support of others, has been found to have a significant impact on stress and wellness (Berkman & Syme, 1979). Since heavy furniture that cannot be moved restricts social contact, interior design is important in increasing social interaction (Ulrich, 1991). The University of San Francisco offered suggestions for constructing a classroom including size, location, and modernization. The university stressed lighting,

acoustics, ventilation and ergonomics as important contributions to the teaching environment for a positive experience. It was not recommended to have fixed seating in a mid-sized or small classroom (Think, 2003).

Movable tables and chairs make a more comfortable room possible with more physical flexibility within the classroom, allowing students and instructors to quickly reconfigure a classroom (Think, 2003). Moveable furniture allows for easier reconfiguration than with fixed seating or with the limiting proportions of tablet chairs.

Classroom construction should include the consideration of sound insulation and acoustics (Think, 2003). Acoustics should be such that sound from other rooms does not enter (Think, 2003). Within the room, sound should reverberate so that all sounds involving instruction can be heard by students. When constructing a classroom, consideration needs to be given to the fact that technology is constantly changing, and access to power and networking should be included (Think, 2003).

Ideal lighting is daylight since energy is conserved and a connection is made between the interior and the exterior. Natural lighting with windows that open was suggested for smaller university classrooms (Think, 2003), to have promoted a feeling relaxation and space (Butin, 2000b). Lighting specified for tasks, combined with indirect lighting, was recommended as a solution for proper reading light (Butin, 2000a, 2000b). Indirect fluorescent lighting was suggested to be installed for general lighting (Think, 2003).

An additional learning environment that was once considered an unnecessary expense is the student commons (Butin, 2000b). Student commons are places of social interaction, and are now considered areas for distance learning and consultation where

students may work in small or large groups (Butin, 2000b). Comfortable and inviting furnishings encourage student interaction and study (Butin, 2000b).

Research has found that plants benefit the classroom aesthetically, provide oxygen, and absorb toxins (Hart, 1999). Using a survey of students (Dinsmore, 2003), a middle school teacher studied the perceived effects of plants, lighting, and music on students' behaviors while in the classroom. When asked if these three variables affected their learning, 43% of students responded positively to the presence of plants saying it created a more comfortable atmosphere, 65% said soft music was effective in promoting a comfortable and inviting atmosphere, and 76% said soft lighting positively contributed to the atmosphere (Dinsmore, 2003). These numbers supported the teacher's personal observations from journal entries and a seating chart that indicated behavior in different settings.

### *General benefits of passive and active interactions with plants to people*

#### *A. History of human perceptions of nature*

Ancient Egyptian nobles' gardens, Mesopotamia (the Persian settlements), and Chinese cities in medieval times had merchant gardens, which show us the effort ancient urban cultures made to stay in contact with nature (Hongxun, 1982; Shepard, 1967). More recently in the last two hundred years, it was thought that nature could help to reduce stress and aid in physical and psychological health. Therefore, parks and nature within cities, as well as wildlife preserves were formed in some countries, for the physical and emotional well-being of all (Parsons, 1991; Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991).

In the 1700's, interior plants were considered to be capable of suffocating a person while they slept. Still, people kept plants in their homes, despite the warnings (Gowan, 1987), demonstrating an inherent desire for plants. A landscape architect from the nineteenth century, Frederick Law Olmsted, wrote of his insight into the physiological and emotional benefits of viewing plants and other nature. He believed viewing nature was a way to exercise one's mind without tiring it. He surmised that because views of nature hold our attention and block out stresses of modern city life, the mind can be active but not stressed. He held strongly enough to this belief to be instrumental in the making of Central Park in New York City (Olmsted, 1865). Later, speculation was made that recovery from mental fatigue can be experienced with contact to natural settings when work involved effortful, prolonged attention (Kaplan & Kaplan 1989; Kaplan & Talbot, 1983).

With the Industrial Revolution, mankind seemed to have forgotten about our natural surroundings and our ties to it (Fjeld, 1996). Natural things replaced artificial things. While a walk in the woods may have been a familiar act that allowed people to let down their defenses, an urbanized lifestyle meant that a person spent 80% or more of their time in a building. When a person is in an unfamiliar environment, that person's mental energy is taxed (Fjeld, 1996).

#### *B. General benefits of passive encounters with plants to people*

Studies found that vegetation can hold a person's attention, making them forget themselves and their problems (Ulrich, 1979, 1981; Katcher et al., 1984), and can elicit restorative physiological and emotional responses (Ulrich & Parsons, 1992). Further, if a

view of plants produces a liking to the plants, the psychological effect of a more positive feeling may be shown (Ulrich, 1990).

A survey (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991) supported the finding that viewing nature can aid in stress recovery, even when viewed for short periods of time. Recovery was fostered with scenes and elements of nature because of the positive feelings they draw out. Scenes of nature reduce feelings of anger and fear, capture interest, and may help to combat stressful thoughts. Research also has shown that restoration from physiological stress is more complete and faster in the presence of nature views, as opposed to urban views without nature (Ulrich, 1979; Ulrich & Simons, 1986; Honeyman, 1987).

Research found that an individual felt more positive if an aesthetic liking to plants was obtained when plants were viewed (Ulrich, 1990), and found that stressed individuals experienced a positive restorative effect when viewing plants (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991). To induce stress in one study, 120 persons first watched a movie about accidents at work. They then viewed a videotape of one of six urban or natural settings. Subjects who viewed the natural settings recovered more completely and quickly than those who watched a video with urban environments (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991).

By 1993 relatively little research within the psychological field had focused on the study of nature and human transactions. But the social and scientific significance was recognized by some, and studies began to take place on the value and benefits of natural areas to humans, particularly regarding human preferences in aesthetics of landscapes (Ulrich, 1993). This includes the proposition that genetics may play a role in human

preferences to and benefits from natural settings (Ulrich, 1993), though most of the studies looked at preferences and beauty (Daniel & Vining, 1983; Kaplan & Kaplan, 1989; Nasar, 1988; Ribe, 1989; Smardon, 1988; Ulrich, 1983, 1986b; Zube et al., 1975).

When the social sciences began studying landscape preferences, it was believed that preferences, behavior, and thoughts were developed through culture and learning (Ulrich, 1993). However, results have demonstrated that though there are some variations of liking between variables such as age (Zube et al., 1983), the differences are usually small. What emerges is counter to the idea that natural preferences are learned. In most cases, diverse groups from Asia, Europe, and North America showed much more similarity than differences when viewing natural scenes (Daniel & Boster, 1976; Hull & Revell, 1989; Shafer & Tooby, 1973; Ulrich, 1977; Wellman & Buhyoff, 1980). As a specific example, Texans and Koreans were shown pictures of natural settings that were clearly and distinctively from one culture or the other. The cultural differences that appeared in the results were relatively minor compared to the high overall agreement in their preferences in aesthetics, particularly showing a liking to savanna-like scenes (Yi, 1992).

In general, it has been found that people more often prefer an urban scene that contains nature when compared to a similar urban scene that lacks nature (Ulrich, 1993). Trees and other vegetation significantly increased a penchant for a variety of urban settings (Anderson & Schroeder, 1983; Asakawa, 1984; Chokor & Mene, 1992; Lambe & Smardon, 1986; Nasar, 1983; Schroeder & Cannon, 1983; Sheets & Manzer, 1991). Even those living in the arid city of Tucson preferred views with savanna-like qualities (Kennedy, 1989). The preferred scenes did not include brown vegetation nor cacti, but

rather scenes with green. An exception to this was when a person was from a high crime area and had learned to fear places where surveillance was limited, such as is the case with thick vegetation (Hull & Harvey 1989; Schroeder & Anderson, 1984).

Studies on urban natural spaces such as urban parks usually showed stress relief as a benefit (Kaplan, 1983; Schroeder, 1989; Ulrich & Addoms, 1981), though it is difficult to distinguish what role green spaces play in that effect compared to other factors such as physical exercise (Ulrich, 1993). Though it may not be clear to what extent it is effective, research has shown that exposure to natural settings does have a restorative benefit (Ulrich & Parsons, 1992).

### *C. General benefits of active interactions with plants to people*

“... a Natureza tem o poder de consolar-nos quando as palavras o nao conseguem” (Laferle, 1997, p. 78). (Translation: “Nature has the power to console us when words cannot.”) It was therapy for a young hospitalized child to declare he would care for his plant as his nurse cared for him, but would not give his plant a shot (Jessee et al., 1987). For one family, the sampling of a grandfather’s ferns, removed and replanted at each new location a family moves to, and shared with each subsequent generation, testifies to the value of plants for communication and healing (Laferle, 1997). Though perspectives change, value in including the beauty of plants in everyday life can be found by all (Rappaport, 1994).

Primary schools have found agricultural activities can help deepen a child’s view of nature, helping them with self-control, and increasing their understanding of what work is. Agricultural activities can be beneficial to the development of handicapped children (Konoshima, 1995). Recreation in wilderness settings has shown to be a

consistent stress relieving activity (Knopf, 1987; Ulrich, Dimberg, & Driver, 1991).

Environmental service projects involving children and senior citizens working together showed increased self-esteem in the children involved in the study (Ogorzaly, 1996).

Adults enjoy working in a garden to formulate a certain order, working to achieve beauty that they can enjoy and contemplate (Eck, 1993). In the late 1800's, the Europeans introduced the United States to community gardens (Bassett, 1981), and by the late 1960's to the early 1970's gardens were appreciated for their psychological and social benefits. Gardening, in particular community gardening, has been found to contribute to the quality of life experienced by gardeners in areas such as self-esteem, social, and physiological benefits (Waliczek et al., 1996).

### *Benefits of plants to people in interior environments*

#### *A. Effects of plants in offices*

Many individuals and businesses enhance the central design of their homes or offices with living interior plants (Ulrich, 1991). Research has suggested that interior living plants may offer some psychological and restorative values, such as reduced tension (Ulrich, 1991), better coping mechanisms (Lohr & Pearson- Mims, 2000), and increased concentration and attention (Taylor et al., 2001). Research has shown that interior plants can reduce eye irritation and stress, motivate, improve concentration, and even reduce air impurities (Vitiello, 2001). When questioned, 84% of the workforce liked plants and recognized their benefit (Vitiello, 2001). Companies made use of the appreciation of plants by bringing those aesthetic benefits indoors for their visiting clients to enjoy (Vitiello, 2001). However, companies often did not place plants in the staff work area due to space, personal preference, or funding (Vitiello, 2001).

Plants' effects regarding the endurance of an individual were especially evident in an experiment to measure the difference in people's response to physical discomfort when plants were and were not present. It was discovered that a greater number of subjects would keep their hand submerged for 5 minutes in ice water when plants were present when compared to when they were not (Lohr & Pearson-Mims, 2000). Subjects were tested with colorful objects on which to focus, but still withdrew more frequently during the 5 minute submersion than when plants were present (Lohr & Pearson-Mims, 2000).

The benefits of interior plants have been shown to positively impact stress and productivity. Reaction time on the computer improved by 12% and a lower systolic blood pressure was measured when plants were placed in a computer lab, along with people's reports of experiencing a greater attentiveness (Lohr et al., 1996).

Plants appeared to have a positive effect on stress and productivity (Lohr et al., 1996) and headaches and fatigue, hoarseness, and even dry facial skin were reported with less incidence when plants were introduced to the office (Fjeld et al., 1998). In one study (Russell & Uzzell, 1999), participants were tested in an office with either no plants or with many plants. Skin conductivity, blood pressure and heart rate were tested by attaching sensors to participants' skin. Recordings in the first 10 minutes established a stress level base line. Next, the participant was asked to add 78 numbers while noise distractions were played intermittently, followed by a 10 minute rest. Skin conductivity measurements showed a reduction in stress for those with plants present, though blood pressure and heart rate measurements showed minimal differences between groups.

Recovery from stress was shown to be greater for those who had plants present during testing (Russell & Uzzell, 1999).

Research has shown that interior plants have a positive impact on work-related symptoms of irritated eyes, headaches, concentration on the computer, productivity and motivation, reduced stress, and cleaner air, reducing the ailments that sometimes cause absenteeism (Vitiello, 2001). On one survey of office employees and facilities managers, only 10% of respondents thought that their offices could be improved with plants, yet 60% of office workers liked having plants around their desk. That is a higher percentage than the 50% who rated the necessity of good technology as a priority (Vitiello, 2001).

#### *B. Effects of nature views in prisons*

The effects of environmental characteristics on inmate health needs were examined at the State Prison of Southern Michigan. These environmental characteristics included concrete cells and cell blocks and their locations, and those areas both within and outside of the prison which could be viewed from the cell. With this, healthcare needs of inmates were examined by comparing sick calls between those who had a view of the enclosed prison yard from their cell window and those who could passively view forests and nearby farmlands. Results of the study found there were less sick calls from those who viewed the natural settings when compared to those who viewed the prison yard from their cell window (Moore, 1982). Prisoners who could view forests and farmlands outside prison walls while in their cell had lower frequencies of symptoms related to stress, such as digestive upsets and headaches, when compared to those prisoners whose window viewed buildings, prison walls, or other prisoners' cells (Moore, 1982; West, 1985).

Vocational education programs have been used as a means of rehabilitation for U.S. women inmates with limited success (Chapman, 1980; Feinman, 1986; Morash et al., 1994; Pollock-Byrne, 1990; Ryan, 1984; Simon, 1975). Research has suggested that the inmate's attitudes, beliefs, and values needed to be addressed as well (Wiley, 1986). A program in vocational horticulture was instituted at a federal prison for women to investigate how such a program could affect the incarcerated women's self-development, including their life satisfaction, self-esteem, and internal-external locus of control. The Master Gardener program, on which this program was based, is both a horticultural therapy program and a vocational horticulture program and met each weekday for 7 hours a day. Group A consisted of 36 inmates who had chosen to enroll in the program. The 26 members in Group B were not enrolled in the horticultural program, but most had either participated or were participating in other vocational programs. Life satisfaction and self-esteem scores significantly increased for both groups, demonstrating that horticulture can be used as a means of increasing life-satisfaction and self-esteem in the rehabilitation process (Migura et al., 1997).

### *C. Effects of nature views in medical facilities*

As stated earlier, not all natural views induce a calming or healing effect on subjects nor are they necessarily preferred views. For instance, thick vegetation that obstructs another view when safety is a concern (Hull & Harvey 1989; Schroeder & Anderson, 1984) or brown landscape and cacti may not be preferred (Kennedy, 1989). An investigation of the effects of natural scenes used as visual stimulation was conducted at a hospital in Sweden (Ulrich & Lunden, 1990). After having open-heart surgery, 166 patients were assigned randomly to the visual stimulation of either open water, a

somewhat enclosed forest, an abstract design, or to the control condition of no picture or a white panel. Though a forest is a nature scene, it did not significantly calm the anxious patients when compared to the control patients. Patients with an abstract scene exhibited higher anxiety than those in the control group. Results suggested that the group with the water scene were the least anxious of all post-operative groups studied.

Viewing nature has been found to have a positive effect on relieving stress and sustaining attention (Ulrich, 1991). Heart rates were taken on anxious patients in a dental fears clinic. Heart rates and self-ratings suggested less stress was felt by patients during the days that they viewed a natural spatial landscape on a large mural hung in the waiting room, when compared to heart rates of patients on the days when there was simply a blank wall (Heerwagen, 1990).

Different pictures were mounted to the ceiling in view of patients who were acutely stressed and lying in a “presurgical holding room.” When exposed to pictures of water and other calm nature scenes for three to six minutes, systolic blood pressure levels measured 10 to 15 points lower when compared to patients who either had no view of a picture, or who viewed a picture that was aesthetically pleasing but of an active outdoor scene (such as someone sailboarding) (Coss, 1990).

A ward in a Swedish hospital displayed prints and paintings with many styles and varied subject matter. Psychiatric patients in this hospital were interviewed and gave positive responses toward that art that focused on natural views, such as flowers in a vase, but did not like the abstract prints and paintings that were unintelligible or ambiguous (Ulrich, 1986a). Fifteen years of records were analyzed and revealed strong negative responses from patients that were directed to the painting and prints. Patients

had complained to staff and some had even acted out by taking the picture down off the wall and breaking the frame. This is important since these were non-aggressive, non-violent patients in an un-locked ward. All seven attacks targeted the abstract pictures. No attacks on pictures of nature were reported throughout the 15 years studied (Ulrich, 1986a).

Other demonstrations of such effects were found in studies which have shown that passive interactions with nature have restorative mental and physical effects on humans (Ulrich & Parsons, 1992). For example, patients in Pennsylvania had gall bladder surgery and were recovering in the hospital (Ulrich, 1984). Patients were matched who were most closely alike in variables such as tobacco use, age, and previous hospitalization. Patients were assigned to rooms randomly, except that one member of the pair was given a room with a view of deciduous trees, while the other had only a brown brick wall to view. Those with the view of nature, the stand of trees, spent less time in the hospital after surgery, and nurses recorded less negative comments about them, such as a need for encouragement or that they were upset. Minor complications from the effects of surgery, such as headaches, showed up less for those who had a natural view, and they required the weaker analgesics that were taken orally (for example, acetaminophen), whereas those with a view of the wall needed the stronger painkilling injections (Ulrich, 1984).

Supporting these findings in another study, patients who had experienced an accident or illness that left them severely disabled and were likely stressed from the event were questioned. Among the highly preferred window view categories for hospital views was the category of views that were mainly of a natural content (Verderber, 1986). Of further interest is a blood donation facility where it was discovered that systolic blood

pressure and heart rate of those clients in a waiting room were higher when the television was on as opposed to when it was turned off. The waiting room contained well-maintained plants and a large mural of a forest (Ulrich, 1991).

The use of plants in a hospital atrium was studied. In a hospital atrium it was discovered that there appeared to be no negative effects with the presence of plants within the atrium building. The use of the waiting area increased by 4.1%, and the use of the snack bar area increased by 2.7% when plants were present (Russell & Uzzell, 1999). Subjects' assessment of the atrium was that it was more relaxed and less stressful in the presence of plants. Further, both genders preferred to sit where plants could be viewed. The mean anxiety measures were lower when plants were present and the plants did not make subjects feel that their presence was confining or congested. No negative effects of the plants were found (Russell & Uzzell, 1999).

Interaction with plants has a natural healing ability. When an individual is in touch with nature, mental and physical well-being is enhanced. Horticultural therapy makes use of this in a variety of ways. When patients are battling intense psychological trauma, for example, they can be helped with a simple interaction with plants (Addington, 2005). Focusing on the scent of an herb can stimulate the senses, helping a person to think about what is happening at the present moment, and helping them to relax since they are not focused on problems they are facing (Addington, 2005).

#### *D. Effects of plants in schools*

In children with attention deficit disorder, it was found that the greener their play areas, such as in places with trees or grass, the milder their symptoms were manifested (Taylor et al., 2001). Parents' observations supported those findings (Taylor et al., 2001). Living in an area with nature was not related to the severity of symptoms. However, effects from areas of play showed significant differences in symptoms between play areas that were windowless or void of green spaces, and those that were green with nature, with the more severe ADD symptoms in children whose environment was windowless and void of green spaces (Taylor et al., 2001).

In San Francisco, a sample of university students were studied to see where they go to relieve stress and depression. The majority of them, 75%, said they went to outdoor places such as an environmentally natural location or somewhere urban, but with natural features such as a wooded park or a place with a natural landscape view (Francis & Cooper-Marcus, 1991). In another study of American university students, students were mildly stressed as they faced an upcoming final exam (Ulrich, 1979). Once they had viewed color slides of relatively ordinary rural areas with green vegetation or unblighted urban scenes that lacked natural elements, their stress recovery was assessed with a self-rated questionnaire. Results showed that ordinary rural views held students' attention better and they were more psychologically restored. This was demonstrated by an increase in positive feelings and a decrease in negative feelings (Ulrich, 1979). Then, with the addition of urban views containing clearly viewed vegetation, those urban views with vegetation resulted in greater recovery when compared to urban views without nature (Honeyman, 1987).

Unstressed university students in Sweden were self-rated in a study where they viewed natural settings and settings that lacked nature (Ulrich, 1981). It was found that their attention was held better and their emotional state more positive when participating in a lengthy viewing of natural scenes, when compared to when they viewed settings that lacked nature. In that study, electrical brain activity was recorded (EEG) and found that students were also more relaxed while viewing those landscapes with nature (Ulrich, 1981). This was supported with another study that found unstressed individuals felt more positive when changing from urban views without vegetation to views that contained vegetation (Sheets & Manzer, 1991).

Plants stimulate all of our senses. They supply: colors for sight; sounds such as wind in the grasses, or the rattle of a Love-in-a-mist seed-head; scents such as those of flowers or herbs; textures for touch like the soft Lamb's ear or spiky Globe Thistle; and a variety of tastes, such as those from spices and berries (Addington, 2005). Stress may be reduced when a person surrounds oneself with plants (i.e. Russell & Uzzell, 1999). When an individual is stressed, views of nature can positively alter that person's emotional state (Ulrich, 1981).

## CHAPTER III

### METHODOLOGY

The purpose of studying the impact of interior houseplants in university classrooms on overall student grade, overall student perceptions of the course and of the instructor was to determine if these variables could be positively impacted from the presence of plants in the classroom.

#### *Plants*

An assortment of plants was used in each classroom, with the logistics of the room in mind. Larger plants included *Chrysalidocarpus lutescens* (Areca Palm), *Ficus elastica* (Rubber Tree), and *Dracaena marginata* (Dragon Plant). Hanging plants included *Chlorophytum comosum* (Spider Plant) and *Hedera helix* (English Ivy). An assortment of foliage of various sizes and textures such as the *Spathiphyllum clevelandii* (Peace Lily), the small *Kalanchoe blossfeldiana* (Kalanchoe), *Philodendron cordatum* (Heart-Leaf Philodendron), and *Chrysalidocarpus lutescens* (Areca Palm) were used interchangeably. Focus was given to the front of the classroom in placing plants, though an attempt was made to place other plants in appropriate spots around the classroom, where possible.

#### *Classrooms, Storage, and Delivery*

Classrooms were in two buildings on the Texas State University-San Marcos campus. Room number 114 on the first floor in Evans Hall was the Sociology classroom

taught by Dr. Susan Day. Students entered at the top back of the auditorium through one of two doors that opened to a stairway on either side. Though it was a modern and relatively new auditorium with seating for over 100 and the interior was in good condition, it contained no windows and the two tone sterile, light walls contained no art or scenery, with the exception of a large but inconspicuous “1” painted on the right and left walls. Available locations for plants were limited to the bottom of each stairway. The available portion of the back wall was out of view during instruction.

Three to four larger plants, such as *Chrysalidocarpus lutescens* (Areca Palm), the *Dracaena marginata* (Dragon Plant) and the *Ficus elastica* (Rubber Tree) were used in front of the Evans Hall auditorium in order to be seen during instruction. They were placed at the foot of either stairway and were directly in front of those entering the auditorium. Plants were generally taller species, bushy or tree-like, and large enough to be seen from the rear of the classroom. When not in use, Evans Auditorium plants were locked in a storage closet, located on the second floor. In storage, they usually received no light except for time spent in transport.

Room 202 in the Psychology Building was the most ideal of the three rooms for placing plants. Space was available throughout much of the room, particularly in the area where most instruction takes place. The far wall was lined with windows that viewed trees from the second floor, and had attractive teal drapes with matching seating for 80 or more students. Although not as new as Evans Auditorium, it was, nevertheless, in good repair and a sunny, healthy location for both humans and plants.

Students entered room 202 through a door that faced the windows on the side near the back of the room. A center aisle to the right led to the main instruction area where

there was ample room. Generally, a large plant such as the *Spathiphyllum clevelandii* (Peace Lily) was placed on the floor in front of a smaller plant on a stand in the right and left front corners of the room. A hanging plant generally hung from the front left, near the window, with a plant such as a small *Kalanchoe blossfeldiana* (Kalanchoe) on the windowsill nearby, or on the windowsill in the back of the room. Various smaller plants, such as a small *Cycas revoluta* (Sago Palm) were placed from time to time on the floor to the right or the left of the door as students entered.

Room 316 in the Psychology Building was the most problematic in placing plants. Desks, many of them older, were crowded into the classroom of more than 60 students, along with other furniture and equipment. Heavy maroon drapes, at least one ripped and hanging, hung from the far wall that was covered with windows. The drapes partially blocked much of the natural light and blocked views to the outside where a large tree was growing. A door at the front and a door at the back of the room allowed access from one side, so that people entered facing the windows.

Plant arrangements in room 316 changed throughout the semester in an attempt to find the most attractive positionings in the tight space. One to three hanging plants were placed across the front of the room. A large plant was often placed in a corner in the front of the room, when the corner was not filled with equipment or furniture. A *Philodendron cordatum* (Heart-Leaf Philodendron) that had been trained upright usually sat on the file cabinet in the front of the room, next to a television. Additionally, a plant was sometimes also placed in the back of the room to be seen as students entered.

Plants for the Psychology Building were stored in a student office that was kept locked and was located across the hall from room 202. This made transporting plants

uncomplicated and allowed for a large assortment of plants to be used. Transporting to room 316, however, involved multiple hands or multiple trips up the nearby elevator, then down the hall past curious onlookers.

In all three cases, an attempt was made to deliver plants anonymously. The two classes in room 202 did not meet in sequence. However, room 316 and room 114 did meet in sequence. Students would linger after class, and others would arrive early and wait to enter, making any attempt to move about unnoticed impossible.

Student workers were employed to help with delivery. A general answer helpers used for questions about the reason why plants were being transported was to say that they were compliments of the Department of Agriculture. Helpers were instructed not to reveal the study to students involved in the study.

#### *Population*

The student sample used in this study came from Texas State University-San Marcos students taking specific Psychology or Sociology courses. Instructors were invited to participate in the study if they taught the same course in the same room with the same material to two separate groups of students. The sample used included the classes of those three professors who met the criteria and agreed to participate in the study. In appreciation and as an incentive for their assistance, the instructors were offered a free weekly floral design that was delivered to them or to the local destination of their choosing.

#### *Instrumentation*

An assent form was distributed and collected that allowed for students to volunteer anonymous information for the research (Appendix A). Demographic data

including class rank, gender and ethnicity were gathered (Appendix B). Course grade measured course achievement. The Texas State end-of-semester course evaluation survey was used to collect information on student satisfaction with the course and with the instructor (Appendix B). Professors coded each student name with a number so that grades and evaluations remained anonymous.

### *Data Collection and Analysis*

At the end of the semester, a survey was distributed to control and experimental group students. Students were offered the incentive of a packet of seeds, candy, or a snack bar for their cooperation in the study and for completing the survey. The survey instrumentation was distributed by researchers. The professor assigned a number to replace the name of each student to protect anonymity. For example, a professor distributed within the class a sheet containing the name and number information. Instead of writing names on the survey, each student wrote their assigned number from the sheet provided by the professor onto the research survey. Each professor provided researchers with the corresponding number matched with the final grade for each student.

### *Personal Interview*

A brief interview was conducted with each participating professor to assess if plant material affected the way they felt while conducting class, as well as their perception of the reaction and behavior of the class toward the presence of plants.

### *Scoring and Data Analysis*

The section of the instrument that measured student perceptions of the course and instructor was scored by allocating 5 points for positive answers, and one point for negative answers given by each student. Five points were given for the most positive response, four for positive, three for a neutral response, two for a negative response, and one point was given for the most negative response. Therefore, with 20 questions in total, each student earned a score that ranged from 20 to 100. Individual scores were tabulated and entered into the overall spreadsheet. The data collected was analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows Release 11.5™ (Chicago, IL). Statistical procedures included frequencies and ANOVA tests to determine differences between overall scores, individual statements and demographic influences.

## **CHAPTER IV**

### **RESULTS**

The main objective of this research was to investigate the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor. Descriptive statistics and data analyses are contained in this chapter concerning results from grade reports and a course and instructor evaluation instrument distributed to students of Introductory Psychology, Social Psychology, and Introductory Sociology courses. Grade reports and the course and instructor evaluations were received from 385 students from three courses that took place in three classrooms. Treatment and control groups were compared in areas of overall grade, overall course and instructor evaluation scores and the individual statement responses for the course and instructor evaluation instrument including statements in the areas of "Learning," "Enthusiasm," "Organization," "Individual Rapport," "Examinations," "Assignments," as well as "Students and Course Characteristics." Demographic information was collected from students for comparisons of the treatment and control groups.

The specific objectives of this study were to:

1. Compare final course grades of students in classrooms that had plant material during instruction to final course grades of students in classrooms with no plant material present.

2. Compare overall course and instructor satisfaction scores between students in classrooms that had plant material present within the classroom during instruction to students that had no plant material present within the classroom during instruction.
3. Compare specific classrooms of students to determine if any particular classroom of students appeared to benefit more in terms of course grade or perceptions of the course and instructor from the presence of plant material in the classroom.
4. Observe whether any particular demographic group appeared to benefit more in terms of course grade or perceptions of the course and instructor from the presence of plant material in the classroom.
5. Observe whether instructors felt plant materials in the classroom were beneficial or detrimental in any way.

#### *Overall Comparisons of Treatment and Control Groups*

##### *Demographic Information for Treatment and Control Groups*

The overall sample of 385 students included 48.1% or 185 of respondents from the control group, and 51.9% or 200 respondents from the treatment group. Demographic background of control and treatment groups were compared and found to be statistically similar for class ranking ( $P=0.097$ ), gender ( $P=0.373$ ), and ethnicity ( $P=0.606$ ) and grade point average (GPA;  $P=0.730$ ). The overall sample included 137 males: 67 from the treatment group and 70 from the control group. The overall sample included 246 females: 132 from the treatment group and 114 from the control group (Table 1). Most students were undergraduate Freshmen or Sophomores (67.8%; Table 1). There were 69 Freshmen

in the treatment group and 53 Freshmen in the control group. Most students were Caucasian (69.1%), with 143 Caucasians from the treatment group and 123 Caucasians from the control group. Hispanic students made up the next largest ethnic population (17.7%), with 31 Hispanics in the treatment group and 37 Hispanics in the control group (Table 1).

Table 1. Descriptive statistics of the overall sample of treatment and control groups by gender, class ranking, and ethnicity in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Sample size (%)</b>
<b>Gender</b>		
<b>Treatment</b>	200	51.9
Males	67	33.5
Females	132	66.0
Not indicated	1	0.5
<b>Control</b>	185	48.1
Males	70	37.8
Females	114	61.6
Not indicated	1	0.5
<b>Class ranking</b>		
<b>Treatment</b>	200	51.95
Freshmen	69	34.5
Sophomore	72	36.0
Junior	40	20.0
Senior	16	8.0
Other	2	1.0
Not indicated	1	0.5
<b>Control</b>	185	48.05
Freshmen	53	28.6
Sophomore	67	36.2
Junior	36	19.5
Senior	26	14.1
Other	2	1.1
Not indicated	1	0.5
<b>Ethnicity</b>		
<b>Treatment</b>	200	100.0
African-American	12	6.0
Asians	3	1.5
Caucasian	143	71.5
Hispanic	31	15.5

“Other” ethnicities	7	3.5
Not indicated	4	2.0
<b>Control</b>	<b>185</b>	<b>100.0</b>
African-American	9	4.9
Asians	5	2.7
Caucasian	123	66.5
Hispanic	37	20.0
Native American	1	0.05
“Other” ethnicities	5	2.7
Not indicated	5	2.7
<b>Total population</b>	<b>385</b>	<b>100.0</b>

### *Findings Related to Objective 1*

The first objective of the study was to compare final course grades of students in classrooms that had plant material during instruction to final course grades of students in classrooms with no plant material present.

#### *Descriptive Statistics*

Course performance was analyzed by comparing instructor issued grades using a traditional four-point scale. An analysis of variance compared the treatment and control groups’ mean grades and no statistically significant differences were found in comparisons ( $P=0.192$ ; Table 2). Therefore, plants did not appear to distract students, nor benefit them during instruction. Although research shows that plants may help to improve concentration (Taylor et al., 2001; Vitiello, 2001), which would, in turn, improve grades, these findings did not appear to support that research.

Table 2. Analysis of variance comparisons of overall treatment and control groups' instructor issued end-of-semester grade in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Actual grade for course						
Treatment	135	2.65	1.017	1	1.706	0.192
Control	140	2.51	0.985			

<sup>z</sup>Grades were issued on a traditional four-point scale by instructor.

### *Findings Related to Objective 2*

The second objective of the study was to compare overall course and instructor evaluation scores between students in classrooms that had plant material present within the classroom during instruction to students that had no plant material present within the classroom during instruction.

#### *Data Analysis*

An analysis of variance compared the treatment and the control groups' overall scores concerning perceptions of the course and the instructor and found no statistically significant differences ( $P=0.065$ ). However, the treatment group's mean score was 1.52 points higher than the control group's mean scores (Table 3). The range of scores was much narrower for the treatment group with the minimum and maximum scores being 59 and 100, compared to the control group minimum and maximum scores of 29 and 100.

Table 3. Analysis of variance comparisons of overall treatment and control groups' course and instructor evaluation scores in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Overall scores						
Treatment	200	82.13	8.063	1	3.428	0.065
Control	185	80.61	10.120			

<sup>z</sup> Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

Because overall course and instructor evaluation scores showed some interesting trends in the control and treatment groups, individual statements on the evaluation instrument were analyzed further using an analysis of variance test. There were 20 statements in the "Student Survey on Course Environment," and 14 in the "Students and Course Characteristics" section which gathered course and demographic information (Appendix B). Of the 20 statements from the "Student Survey on Course Environment," five individual statements were found to be statistically significant. In comparisons of the treatment and the control group responses on individual statements, there were statistically significant differences ( $P=0.014$ ) in treatment group versus control group responses to the statement, "My interest in the subject has increased as a consequence of this course." More students in the treatment group (8.5%) responded as agreeing or strongly agreeing to the statement, when compared to the control group of students. Nearly 11% (10.8%) of the control group disagreed or strongly disagreed with the statement, compared to 2.5% negative responses from the treatment group (Table 4).

Additionally, statistically significant differences ( $P=0.038$ ) were found concerning the "Learning" category statement, "I have learned and understood the subject materials in this course." The treatment group more often agreed or strongly agreed

(6.5%) when compared to control group responses. In the control group, 3.9% indicated “disagree” or “strongly disagree” compared to 2.0% in the treatment group who indicated only “disagree” (Table 4).

Research findings in areas of office work and health (Fjeld et al., 1998; Lohr et al., 1996; Ulrich, 2002) have shown that plants can improve perceptions of the work environment. To find if plants may have influenced student perceptions of their course and instructor, an ANOVA was conducted and found statistically significant differences in the “Enthusiasm” category in comparisons of the treatment and control groups. On the statement, “Instructor seemed interested in teaching the course,” the treatment group had 4% more responses as “agree” or “strongly agree” in comparison to the control group’s responses of “agree” or “strongly agree” on the same statement ( $P=0.015$ ). Only one person (0.5%) of the 200 responses indicated a negative “disagree” in the treatment group, while three persons (1.6%) of the 185 control group responses indicated they disagreed, two of those being a “strongly disagree” (Table 4). In the statements concerning “Organization,” the statement “Instructor’s explanations were clear” showed a statistically significant difference ( $P=0.010$ ) in comparisons of the treatment to the control group.

An ANOVA test of responses to “Instructor spoke clearly” found statistically significant differences in scores ( $P=0.008$ ), with 4% more “agree” and “strongly agree” responses within the treatment group. No negative responses were scored with the treatment group, and 3.2% responses of “disagree” or “strongly disagree” were in the control group (Table 4). Past studies have found the presence of plants produces a calming effect on subjects (Lohr & Pearson-Mims, 2000; Taylor et al., 2001). This effect

may have led to better feelings in some statistically significant areas including areas of interest of the subject.

From the “Students and Course Characteristics” survey, an analysis of variance test comparing statements concerning levels of interest at the start of the course versus the end of the course found no individual statistically significant differences in the levels of interest students perceived they had in the subject before the course began ( $P=0.093$ ). However, when overall present level of interest in the subject was compared, there were statistically significant differences ( $P=0.020$ ). Almost 9% more students in the treatment group indicated “agree” or “strongly agree” with the statement when compared to the control group (58.5% responses of “agree” or “strongly agree” in the treatment group versus 50.3% in the control group). Those who responded with “low” or “very low” comprised 17.3% in the control group, and only 8.0% in the treatment group (Table 4). Given that students were comparable in their interest when entering the course, it may be that plants added a positive dimension to the course not experienced by the control group, since research shows a positive effect on stress (Lohr et al., 1996; Russell & Uzzell, 1999;), productivity (Lohr et al., 1996), and better coping mechanisms (Lohr & Pearson-Mims, 2000) when plants are present. Since universities as well as states have an interest in student recidivism (Groen & White, 2001), it would be worthwhile to understand the effects of plants in these circumstances.

Table 4. Analysis of variance comparing individual statement response means of students in the overall treatment and control groups' course and instructor evaluation scores in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
<b>Learning</b>						
I found the course challenging and stimulating.						
Treatment	200	4.04	0.562	1	2.778	0.096
Control	185	3.93	0.676			
I have learned something I consider valuable.						
Treatment	200	4.29	0.554	1	1.197	0.094
Control	185	4.18	0.741			
My interest in the subject has increased as a consequence of this course.						
Treatment	200	4.10	0.780	1	6.154	0.014*
Control	185	3.87	0.992			
I have learned and understood the subject materials in this course.						
Treatment	200	4.18	0.610	1	4.318	0.038*
Control	184	4.04	0.723			
<b>Enthusiasm</b>						
Instructor's style of presentations held my interest during most of the class time.						
Treatment	200	4.13	0.858	1	3.583	0.059
Control	185	3.96	0.881			
Instructor seemed interested in teaching the course.						
Treatment	200	4.64	0.531	1	5.929	0.015*
Control	185	4.49	0.700			
<b>Organization</b>						
Instructor's explanations were clear.						

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Treatment	200	4.35	0.640	1	6.647	0.010*
Control	185	4.15	0.900			
The assignments were carefully explained.						
Treatment	199	4.29	0.684	1	2.556	0.111
Control	185	4.17	0.773			
Instructor spoke clearly.						
Treatment	200	4.51	0.558	1	7.024	0.008*
Control	185	4.34	0.728			
Instructor spoke at a comfortable speed.						
Treatment	200	4.39	0.685	1	1.027	0.312
Control	185	4.31	0.699			
<b>Individual Rapport</b>						
Instructor made me feel welcome in seeking help/advice in or outside of class.						
Treatment	200	4.21	0.810	1	0.430	0.512
Control	185	4.15	0.793			
Instructor was adequately accessible to me during office hours or after class.						
Treatment	200	3.94	0.818	1	0.899	0.344
Control	185	3.86	0.848			
Instructor was helpful when I contacted her outside of class.						
Treatment	192	3.76	0.855	1	0.393	0.531
Control	185	3.81	0.867			
<b>Examinations</b>						
Feedback on examinations was useful to me.						
Treatment	197	3.78	0.838	1	0.000	0.992
Control	184	3.78	0.866			
Feedback on graded materials was useful to me.						
Treatment	198	3.74	0.806	1	0.343	0.558

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Control	183	3.79	0.858			
<b>Methods on evaluating student work were fair.</b>						
Treatment	198	4.21	0.639	1	0.058	0.809
Control	184	4.19	0.726			
<b>Examinations tested course content as emphasized by the instructor.</b>						
Treatment	198	4.30	0.681	1	0.797	0.373
Control	185	4.23	0.755			
<b>Examinations reflected course content covered.</b>						
Treatment	199	4.29	0.707	1	0.004	0.947
Control	185	4.29	0.765			
<b>Assignments</b>						
<b>Required readings were useful to me.</b>						
Treatment	200	3.69	0.882	1	1.030	0.311
Control	185	3.59	0.963			
<b>Required texts were useful to me.</b>						
Treatment	200	3.68	0.950	1	0.743	0.389
Control	184	3.59	1.041			
<b>Student and Course Characteristics</b>						
<b>Level of interest in the subject prior to this course.</b>						
Treatment	200	2.98	0.961	1	2.834	0.093
Control	184	2.81	1.020			
<b>Level of interest at this time.</b>						
Treatment	200	3.68	0.890	1	5.483	0.020*
Control	185	3.45	1.047			

<sup>z</sup>Statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Individual Course Comparisons*

#### *Findings Related to Objective 3*

The third objective of the study was to compare specific courses/classrooms of students to determine if any particular classroom appeared to benefit more in terms of course grade and overall course and instructor evaluation scores from the presence of plant material in the classroom.

#### *Treatment and Control Group Comparisons for Introductory Psychology*

##### *Data analysis*

Course grade and scores for the course and instructor evaluation instrument of treatment and control groups were compared for students in the Introductory Psychology course using an analysis of variance test. With a total sample of 94 students in the Introductory Psychology course, no statistically significant differences were found in comparisons of course grades ( $P=0.480$ ), nor for comparisons of overall course and instructor evaluation scores ( $P=0.964$ ) of treatment and control groups (Table 5). The Introductory Psychology course met on the second floor in a sunny classroom with ample room for interior plants, windows and a view of trees. Window views of green leaves on trees outside this second floor classroom may have altered effects of interior plants on course grades and on course and instructor perceptions, making the influence of the plants in the classroom less pronounced. Research has shown health benefits (Moore, 1982; West, 1985), preferences of nature views (Verderber, 1986) and positive effects of window views of nature on attention deficit disorders (Taylor et al., 2001). These positive effects may have influenced students without the added benefits plants may have had within the classroom.

### *Treatment and Control Group Comparisons for Social Psychology*

#### *Data analysis*

Course grades and course and instructor evaluation scores of treatment and control groups were compared for the Social Psychology course using an analysis of variance test. The overall sample for Social Psychology consisted of 45 students from the overall treatment group and 44 students from the overall control group, with a total sample of 89. The classroom was located on the third floor, had unused furniture and little available floor space, and windows along one wall with a view of the tops of trees with green leaves. A statistically significant difference ( $P=0.005$ ) was found between treatment and control groups' course grades (Table 5). Grade distribution for the course revealed 21.9% more responses of "A" in the treatment group when compared to the control group, and 8.3% more responses of "B" in treatment group than in the control group, and 16.5% more responses of "C" in the control group when compared to the treatment.

No statistically significant differences ( $P=0.705$ ) were found in the overall course and instructor evaluation scores between the treatment and control groups (Table 5) in the third floor classroom with windows and a view of trees. However, the professor of the Social Psychology classes stated she felt attendance was better, class participation was better, and class average on most tests was higher in the class with plants. These findings support research which found that interior living plants may reduce tension (Ulrich, 1991), and increase concentration and attention (Taylor et al., 2001) since grades were higher in the treatment group. Window views in the Social Psychology room were often blocked by dark drapes. Also, drapes were in some disrepair during part of the semester.

There was not a statistically significant difference overall between treatment and control groups in the Introductory Psychology classroom where there was a bright, second floor view of the green leaves of trees. The green view of the tops of trees was not as lush and bright from this third floor as the views were from the second floor on the other side of the building in the Introductory Psychology classroom. Therefore, it is possible indoor plants may have had a slightly greater effect on course grades in the third floor classroom than in the second floor classroom.

Table 5. Analysis of variance comparisons of course grades and course and instructor evaluation scores of treatment and control groups for Introductory Psychology, Social Psychology, and Introductory Sociology in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>yz</sup>	SD	df	F	P
<b>Introductory Psychology</b>						
Course grades						
Treatment	56	3.09 <sup>y</sup>	0.668	1	0.503	0.480
Control	37	3.19 <sup>y</sup>	0.660			
Course and instructor evaluation scores						
Treatment	57	84.07 <sup>z</sup>	7.272	1	0.002	0.964
Control	37	84.11 <sup>z</sup>	12.274			
<b>Social Psychology</b>						
Course grades						
Treatment	44	3.14 <sup>y</sup>	0.795	1	8.353	0.005*
Control	39	2.62 <sup>y</sup>	0.847			
Course and instructor evaluation scores						
Treatment	45	82.71	7.809	1	0.144	0.705
Control	44	82.91 <sup>z</sup>	7.603			
<b>Introductory Sociology</b>						
Course grades						
Treatment	91	2.42 <sup>y</sup>	1.034	1	0.102	0.750
Control	101	2.47 <sup>y</sup>	1.035			

Participant group	Sample size (no.)	Mean <sup>y,z</sup>	SD	df	F	P
Course and instructor evaluation scores						
Treatment	97	80.78 <sup>z</sup>	8.502	1	3.914	0.049*
Control	104	78.25 <sup>z</sup>	9.574			

<sup>y</sup>Grades were issued on a traditional four-point scale by instructor.

<sup>z</sup>Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Treatment and Control Group Comparisons for Introductory Sociology*

#### *Data analysis*

The overall sample for Introductory Sociology consisted of 97 students from the overall treatment group and 104 students from the overall control group, with a total sample of 201. An ANOVA was conducted comparing course grades and course and instructor evaluation scores of students within the Introductory Sociology class. No differences were found in course grade ( $P=0.750$ ).

A statistically significant difference was found in the course and instructor evaluation scores comparisons ( $P=0.049$ ; Table 5) of control and treatment groups of students participating in the Introductory Sociology course that took place in the large, windowless auditorium. The treatment group's mean score (80.78) was 2.53 points higher than the control group's mean score (78.25). The range of scores was narrower for the treatment group with the minimum and maximum scores being 59 and 98, compared to the control group minimum and maximum scores of 48 and 99. Plants did not appear to influence course grade for the Introductory Sociology windowless class ( $P=0.750$ ; Table 5).

Because of the initial differences observed, individual statement responses were compared. Eight of 20 individual statement responses in the categories of “Learning,” “Enthusiasm,” and “Organization” showed statistically significant differences (Table 6). Statistically significant differences ( $P=0.014$ ) were found between treatment and control group scores of student responses to the statement, “I found the course challenging and stimulating” (Table 6). Nearly 10% more students in the treatment group responded with “agree” or “strongly agree” to the statement (86.6%) when compared to students in the control group (76.9%). Statistically significant differences ( $P=0.027$ ) were found in comparisons of treatment and control group responses on the statement, “I have learned something I consider valuable” (Table 6). Six percent more students in the treatment group responded with “agree” or “strongly agree” (90.7%) when compared to the control group (84.6%). On the statement regarding course influence on increased interest in the subject (“My interest in the subject has increased as a consequence of this course”), a statistically significant difference ( $P=0.017$ ) was found, where 79.4% of the treatment group indicated “strongly agree” or “agree” with the statement compared to 66.4% of the control group (Table 6) responding in the same way. A statistically significant difference ( $P=0.045$ ) was also found on the statement, “I have learned and understood the subject materials in this course” (Table 6). Nearly 94% (93.8%) of students in the treatment group responded with “agree” or “strongly agree” to this statement compared to 83.7% of the control group students.

These findings are compatible with research that found plants improve the classroom aesthetically (Hart, 1999), and that 43% of young students felt the presence of plants creates a more comfortable atmosphere in the classroom (Dinsmore, 2003). These

findings also support research that found students rated an effective teaching environment as “a comfortable and supportive learning environment” (Lawson & Askill-Williams, 2001, p. 8) and that motivation of students comes from “how” a student is taught, not “what” (Mullen, 2003).

In comparisons of overall course and instructor evaluation scores of students in the Introductory Sociology course, statistically significant differences were found on statements relating to instructor enthusiasm. On the statement, “Instructor’s style of presentations held my interest during most of the class time,” the treatment group responded more favorably ( $P=0.035$ ) with 81.5% responding with “agree” or “strongly agree” compared to 71.2% positive responses in the control group (Table 6).

The statement, “Instructor seemed interested in teaching the course” also had statistically significant differences ( $P=0.003$ ) in comparisons of the treatment and control group (Table 6). Almost 98% of the treatment group responded with “agree” or “strongly agree” to the statement compared to a 92.3% of similar responses by those in the control group.

Statistically significant differences were found ( $P=0.001$ ) on the statement “Instructor’s explanations were clear” with a difference of 8% more responses of “agree” or “strongly agree” by the treatment group when compared to control group responses on the same statement. In response to “The assignments were carefully explained,” a statistically significant difference ( $P=0.013$ ) was found with 4.9% more responses of “agree” or “strongly agree” scored by the treatment group compared to the control group (Table 6). In response to the statement “Instructor spoke clearly,” a statistically significant difference ( $P=0.011$ ) was found, with 3.6% more responses of “agree” or

“strongly agree” from the treatment group when compared to the control group (Table 6). It is of interest that there were no negative responses from the treatment group regarding instructor’s clarity of speech, in contrast to the 3.8% of negative responses from the control group.

Though there was no statistically significant difference ( $P=0.184$ ) in the level of interest in the subject prior to the course, there was a statistically significant difference ( $P=0.025$ ) on the statement “Level of interest in the subject at this time,” with 9.1% more students in the treatment group than in the control group (49.5% of the treatment group and 40.4% of the control group) responding as “high” or “very high” (Table 6).

Research has shown that the presence of plants may reduce negative feelings (Ulrich, 1979), and increase attention (Taylor et al., 2001; Ulrich, 1981) which may enhance the environment during instruction, possibly affecting scores in interest of the course. This stands in contrast to classrooms with green window views as those classrooms did not have statistically significant differences in course and instructor evaluation scores between treatment and control groups. Results appear to demonstrate that student course satisfaction may be more greatly affected by the presence of plants in a windowless environment than in a classroom with a green view.

Table 6. Analysis of variance comparisons of treatment and control groups’ individual statement responses from the course and instructor evaluation instrument for students in the Introductory Sociology course in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
<b>Learning</b>						
I found the course challenging and stimulating.						

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
Treatment	97	4.09	0.631	1	6.128	0.014*
Control	104	3.87	0.669			
I have learned something I consider valuable.						
Treatment	97	4.25	0.613	1	4.961	0.027*
Control	104	4.04	0.709			
My interest in the subject has increased as a consequence of this course.						
Treatment	97	4.07	0.820	1	5.759	0.017*
Control	104	3.75	1.059			
I have learned and understood the subject materials in this course.						
Treatment	97	4.18	0.595	1	4.075	0.045*
Control	103	3.98	0.754			
<b>Enthusiasm</b>						
Instructor style of presentations held my interest during most of the class time.						
Treatment	97	4.07	0.927	1	4.486	0.035*
Control	104	3.80	0.907			
Instructor seemed interested in teaching the course.						
Treatment	97	4.62	0.567	1	8.778	0.003*
Control	104	4.35	0.721			
<b>Organization</b>						
Instructor's explanations were clear.						
Treatment	97	4.27	0.685	1	10.366	0.001*
Control	104	3.88	0.969			
The assignments were carefully explained.						
Treatment	96	4.22	0.714	1	6.272	0.013*
Control	104	3.96	0.736			

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Instructor spoke clearly.						
Treatment	97	4.49	0.580	1	6.561	0.011*
Control	104	4.26	0.710			
Instructor spoke at a comfortable speed.						
Treatment	97	4.43	0.691	1	3.134	0.078
Control	104	4.26	0.697			
<b>Individual Rapport</b>						
Instructor made me feel welcome in seeking help/advice in or outside of class.						
Treatment	97	3.95	0.882	1	0.095	0.758
Control	104	3.91	0.726			
Instructor was adequately accessible to me during office hours or after class.						
Treatment	97	3.75	0.804	1	0.688	0.408
Control	104	3.66	0.719			
Instructor was helpful when I contacted her outside of class.						
Treatment	95	3.53	0.810	1	0.634	0.427
Control	104	3.62	0.767			
<b>Examinations</b>						
Feedback on examinations was useful to me.						
Treatment	96	3.81	0.944	1	0.121	0.729
Control	104	3.86	0.818			
Feedback on graded materials was useful to me.						
Treatment	96	3.71	0.857	1	1.160	0.283
Control	104	3.84	0.826			
Methods on evaluating student work were fair.						
Treatment	96	4.11	0.647	1	0.012	0.912

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Control	104	4.13	0.678			
Examinations tested course content as emphasized by the instructor.						
Treatment	95	4.29	0.599	1	0.464	0.496
Control	104	4.23	0.714			
Examinations reflected course content covered.						
Treatment	96	4.33	0.610	1	0.063	0.802
Control	104	4.36	0.652			
<b>Assignments</b>						
Required readings were useful to me.						
Treatment	97	3.56	0.924	1	2.853	0.093
Control	104	3.33	0.999			
Required texts were useful to me.						
Treatment	97	3.41	0.933	1	1.247	0.266
Control	103	3.25	1.082			
<b>Students and Course Characteristics</b>						
Level of interest in the subject prior to this course.						
Treatment	97	2.65	0.890	1	1.780	0.184
Control	103	2.48	0.948			
Level of interest in the subject at this time.						
Treatment	97	3.52	0.937	1	5.103	0.025*
Control	104	3.19	1.080			

<sup>z</sup>Statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Overall Class Ranking Comparisons*

#### *Findings related to Objective 4*

The fourth objective of the study was to observe whether any particular demographic group appeared to benefit more than others in the variables of interest from the presence of plant material in the classroom.

Analysis of variance tests compared treatment versus control groups within each individual class ranking and found no statistically significant differences in course grades of Freshmen ( $P=0.313$ ), Sophomore ( $P=0.972$ ), and Senior-level ( $P=0.177$ ) students (Table 7). No statistically significant differences in course and instructor evaluation scores were found for those who indicated their year in school to be Freshmen ( $P=0.325$ ), Sophomore ( $P=0.477$ ), or Senior ( $P=0.233$ ) (Table 7). Statistically significant differences did occur for course grade ( $P=0.038$ ) and course and instructor evaluation scores ( $P=0.017$ ) between the treatment and control groups for those who indicated their year in school to be the Junior -level (Table 7).

#### *Comparisons of Freshmen Overall*

##### *Data analysis*

The overall Freshmen sample consisted of 52 from the overall control group and 69 from the overall treatment group for a total of 121 students. Analysis of variance comparisons of overall course grades ( $P=0.313$ ) and overall course and instructor evaluation scores ( $P=0.325$ ) did not reflect statistically significant differences between control and treatment groups within the Freshmen class (Table 7). Level of interest in the subject between treatment and control groups before taking the course was not

statistically significantly different ( $P=0.292$ ), but was statistically significantly different ( $P=0.040$ ) at the end of the course.

### *Comparisons of Sophomores Overall*

#### *Data analysis*

With 137 respondents, 72 from the treatment group and 65 from the control group, an analysis of variance showed no statistically significant differences in comparisons of Sophomore course grades ( $P=0.972$ ), nor course and instructor evaluation scores ( $P=0.477$ ) were recorded between control and treatment groups (Table 7).

Table 7. Analysis of variance comparisons of course grade and course and instructor evaluation scores of overall treatment and control groups for Freshmen, Sophomores, Juniors, and Seniors in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>yz</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
<b>Freshmen</b>						
Course grades						
Treatment	68	2.78 <sup>y</sup>	0.928	1	1.028	0.313
Control	53	2.60 <sup>y</sup>	0.968			
Course and instructor evaluation scores						
Treatment	69	82.20 <sup>z</sup>	7.516	1	0.976	0.325
Control	53	80.68 <sup>z</sup>	9.525			
<b>Sophomores</b>						
Course grades						
Treatment	70	2.73 <sup>y</sup>	0.962			
Control	65	2.72 <sup>y</sup>	0.839	1	0.001	0.972
Course and instructor evaluation scores						
Treatment	71	82.03 <sup>z</sup>	8.655	1	0.507	0.477
Control	67	83.09 <sup>z</sup>	8.845			
<b>Juniors</b>						
Course grades						
Treatment	36	3.06 <sup>y</sup>	0.860	1	4.468	0.038*
Control	34	2.59 <sup>y</sup>	0.988			
Course and instructor evaluation scores						
Treatment	40	83.65 <sup>z</sup>	8.267	1	5.949	0.017*
Control	36	77.72 <sup>z</sup>	12.669			

Participant group	Sample size (no.)	Mean <sup>yz</sup>	SD	df	F	P
<b>Seniors</b>						
Course grades						
Treatment	14	2.14 <sup>y</sup>	0.949	1	1.899	0.177
Control	22	2.68 <sup>y</sup>	1.249			
Course and instructor evaluation scores						
Treatment	16	80.94 <sup>z</sup>	8.442	1	1.468	0.233
Control	26	77.65 <sup>z</sup>	8.583			

<sup>y</sup>Grades were issued on a traditional four-point scale by instructor.

<sup>z</sup>Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Comparisons of Seniors Overall*

#### *Data analysis*

Forty-two participants from the overall treatment and control groups indicated they were Seniors. Sixteen Seniors' responses were from the treatment group, and 26 were from the control group. An analysis of variance comparison of Senior course grades ( $P=0.177$ ) and course and instructor evaluation scores ( $P=0.233$ ) showed no statistically significant differences between overall control and treatment group comparisons (Table 7).

### *Comparisons of Juniors Overall*

#### *Data analysis*

Seventy-six participants from the overall treatment and control groups indicated they were Juniors. Forty Juniors' responses were from the treatment group, and 36 were from the control group.

An analysis of variance revealed statistically significant differences in comparisons of course grade ( $P=0.038$ ) and in course and instructor evaluation score ( $P=0.017$ ) comparisons of Juniors (Table 7). Course grade was 0.47 points higher in the

treatment group versus control group grades. Treatment groups' course and evaluation scores were 5.93 points higher when compared to the control group for Juniors.

There were 10.6% more course grades of "A" in the treatment group (30%) when compared to the control group (19.4%). There were 9.4% more course grades of "B" in the treatment group (40%) compared to the control group (30.6%). There were 15.6% less course grades of "C" in the treatment group (15.0%) when compared to the control group (30.6%).

In comparisons of individual statement responses statistically significant differences occurred in scores for "Learning" (one response), Organization (one response), and Examinations (one response). Mean score comparisons between treatment and control groups for the responses to the statement "Level of interest in the subject prior to this course" were not statistically significant ( $P= 0.344$ ). However, responses to the statement "Level of interest at this time" did show a statistically significant difference ( $P=0.004$ ; Table 8).

Because the course grade and course and instructor evaluation scores showed differences, individual statement responses from the course and instructor evaluation instrument were considered. Five statistically significant responses were found in these comparisons of college level Juniors. "My interest in the subject has increased as a consequence of this course" scored a statistically significant difference ( $P=0.000$ ) with 29.2% more responses of "agree" or "strongly agree" from the treatment group when compared to control group responses (Table 8). There were 23.9% responses of "disagree" or "strongly disagree" in the control group, compared to 2.5% responses of "disagree" or "strongly disagree" in the treatment group on the same statement. More

Juniors in the treatment group felt that the “Instructor’s explanations were clear” ( $P=0.036$ ) when compared to the control group (Table 8). In the control group there were 86.1% positive responses of “agree” or “strongly agree” compared to 97.5% positive responses of “agree” or “strongly disagree” from the treatment group, a difference of 11.4%.

There were statistically significant differences ( $P=0.026$ ) in responses to the statement “Examinations tested course content as emphasized by the instructor” between the treatment and control groups (Table 8). One hundred percent of the treatment group agreed with the statement, but only 86.1% of the control group responded with “agree” or “disagree”. There were 8.4% responses of “disagree” or “strongly disagree” in the control group (Table 8).

On the statement “Level of interest in the subject prior to this course” there was no statistically significant difference ( $P=0.344$ ) between Juniors in the control group versus Juniors in the treatment group. However, for “Level of interest in the subject at this time” there were statistically significant differences ( $P=0.004$ ) between control (47.2%) and treatment groups (72.5%) in the Junior class (Table 8) with 25.3% more “high” or “very high” responses from the treatment group. Only 2.5% of students responded with a “low” response, and no students responded with “very low” in the treatment group, whereas 16.7% in the control group responded with “low”, and 8.3% of students responded with “very low.”

The reasons Juniors took the course varied greatly. Survey choices included “major required” “major elective,” “general studies required,” “minor/related field,” and “general interest only” ( $P=0.039$ ; Table 8). There were 55.6% in the control group that

indicated “Major Required” as a reason for taking the course, compared to only 35.0% of the treatment group. Those who were required to take the course may have entered the course with a higher level of interest in the subject, since it was their chosen major, than those who had not chosen the subject as their major, thereby affecting scores for level of interest.

Since cognitive task performance is hindered in the presence of negative stress (Glass & Singer, 1972; Hockey, 1983), and since research has shown that plants help to reduce stress (Coss, 1990; Ulrich, 1979), it may be that plants helped to reduce stress in the treatment group, thereby affecting course grades and course and instructor evaluation scores. Juniors are in a stage of the education process where they have developed a level of commitment to an institution greater than Freshmen and Sophomores (Bean, 1985) and therefore may have been affected differently from the presence of plants.

Table 8. Analysis of variance comparing individual statement response means of students in the overall treatment and control groups’ course and instructor evaluation scores for overall Juniors in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
<b>Learning</b>						
I found the course challenging and stimulating.						
Treatment	40	3.95	0.552	1	0.990	0.323
Control	36	3.81	0.710			
I have learned something I consider valuable.						
Treatment	40	4.20	0.564	1	1.946	0.167
Control	36	3.97	0.845			
My interest in the subject has increased as a consequence of this course.						

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Treatment	40	4.28	0.751	1	14.786	0.000*
Control	36	3.53	0.941			
I have learned and understood the subject materials in this course.						
Treatment	40	4.25	0.543	1	3.521	0.065
Control	36	3.92	0.967			
<b>Enthusiasm</b>						
Instructor's style of presentations held my interest during most of the class time.						
Treatment	40	4.18	0.903	1	0.500	0.482
Control	36	4.03	0.910			
Instructor seemed interested in teaching the course.						
Treatment	40	4.63	0.490	1	0.677	0.413
Control	36	4.50	0.811			
<b>Organization</b>						
Instructor's explanations were clear.						
Treatment	40	4.43	0.549	1	4.541	0.036*
Control	36	4.00	1.121			
The assignments were carefully explained.						
Treatment	40	4.38	0.586	1	1.917	0.170
Control	36	4.11	1.036			
Instructor spoke clearly.						
Treatment	40	4.55	0.552	1	3.265	0.075
Control	36	4.25	0.874			
Instructor spoke at a comfortable speed.						
Treatment	40	4.55	0.504	1	3.576	0.063
Control	36	4.22	0.959			
<b>Individual Rapport</b>						
Instructor made me feel welcome in seeking help/advice in or outside of class.						
Treatment	40	4.22	0.832	1	1.941	0.168
Control	36	3.94	0.924			

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Instructor was adequately accessible to me during office hours or after class.						
Treatment	40	3.98	0.832	1	1.539	0.219
Control	36	3.72	0.944			
Instructor was helpful when I contacted her outside of class.						
Treatment	36	4.00	0.894	1	1.033	0.313
Control	36	3.78	0.959			
<b>Examinations</b>						
Feedback on examinations was useful to me.						
Treatment	38	3.92	0.712	1	0.820	0.368
Control	36	3.75	0.906			
Feedback on graded materials was useful to me.						
Treatment	39	3.97	0.707	1	1.867	0.176
Control	35	3.71	0.926			
Methods on evaluating student work were fair.						
Treatment	40	4.22	0.577	1	2.193	0.143
Control	35	3.97	0.891			
Examinations tested course content as emphasized by the instructor.						
Treatment	40	4.40	0.496	1	5.145	0.026*
Control	36	4.00	0.986			
Examinations reflected course content covered.						
Treatment	40	4.43	0.594	1	3.518	0.065
Control	36	4.08	0.967			
<b>Assignments</b>						
Required readings were useful to me.						
Treatment	40	3.80	0.939	1	2.354	0.129
Control	36	3.44	1.081			
Required texts were useful to me.						

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
Treatment	40	3.78	1.050	1	3.567	0.063
Control	36	3.31	1.117			
<b>Student and Course Characteristics</b>						
Level of interest in the subject prior to this course.						
Treatment	40	3.13	0.911	1	0.907	0.344
Control	36	2.92	0.996			
Level of interest in the subject at this time.						
Treatment	40	3.90	0.744	1	8.928	0.004*
Control	36	3.25	1.131			
Reason for taking the course:						
Treatment	40	3.28	1.502	1	4.437	0.039*
Control	35	3.97	1.339			

<sup>z</sup>Statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Overall Gender Comparisons*

#### *Findings related to Objective 4*

The fourth objective of the study was to observe whether any particular demographic group appeared to benefit more than others in the variables of interest from the presence of plant material in the classroom. Gender differences are outlined below.

#### *Comparisons of Females Overall*

##### *Data analysis*

Analysis of variance tests compared the treatment and control groups of females. One hundred fourteen females in the control group and 132 females in the treatment group participated in the study, for a total of 246 females in overall treatment and control

groups. Course grade comparisons ( $P=0.326$ ) and course and instructor evaluation scores ( $P=0.345$ ) were not statistically significantly different in comparisons between females within the treatment and control groups (Table 9).

Table 9. An analysis of variance comparison of gender differences within treatment and control groups on course grade and course and instructor evaluation scores in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>yz</sup>	SD	df	F	P
<b>Females</b>						
Course grades						
Treatment	125	2.84 <sup>y</sup>	0.945	1	0.968	0.326
Control	110	2.72 <sup>y</sup>	0.949			
Course and instructor evaluation scores						
Treatment	132	83.11 <sup>z</sup>	7.665	1	0.895	0.345
Control	114	82.11 <sup>z</sup>	8.903			
<b>Males</b>						
Course grades						
Treatment	65	2.66 <sup>y</sup>	0.957	1	0.592	0.443
Control	66	2.53 <sup>y</sup>	0.996			
Course and instructor evaluation scores						
Treatment	66	80.64 <sup>z</sup>	8.796			
Control	70	77.99 <sup>z</sup>	11.328	1	2.304	0.131
<b>Control course grades</b>						
Female	110	2.72 <sup>y</sup>	0.949	1	1.557	0.214
Male	66	2.53 <sup>y</sup>	0.996			
<b>Control score</b>						
Female	114	82.11 <sup>z</sup>	8.903	1	7.552	0.007*
Male	70	77.99 <sup>z</sup>	11.328			
<b>Treatment course grade</b>						
Female	125	2.84 <sup>y</sup>	0.945	1	1.512	0.220
Male	65	2.66 <sup>y</sup>	0.957			
<b>Treatment score</b>						
Female	132	83.11 <sup>z</sup>	7.665	1	4.159	0.043*
Male	66	80.64 <sup>z</sup>	8.796			

<sup>y</sup>Grades were issued on a traditional four-point scale by instructor.

<sup>z</sup>Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Overall Comparisons of Males*

#### *Data analysis*

An analysis of variance test compared the treatment and control groups of males within the study. Seventy males in the control group and 67 males in the treatment group participated in the study, for a total of 137 males in overall treatment and control groups. Course grade ( $P=0.443$ ) and course and instructor evaluation score ( $P=0.131$ ) comparisons were not statistically different between males in treatment and control groups (Table 9).

#### *Male/Female Comparisons*

Neither males in comparisons of treatment and control groups, nor females in comparisons of treatment and control groups seemed to benefit differently from the presence of plant materials in the classroom in this analysis. No statistically significant differences in overall course grade for the males versus females treatment group comparisons ( $P=0.220$ ) or the males versus females control group comparisons ( $P=0.214$ ) were found. However, in comparisons of course and instructor evaluation scores between males and females only in the treatment group, statistically significant differences ( $P=0.043$ ) were detected. The mean for female course and instructor evaluation scores for the treatment group (83.11) was 2.47 points higher than the mean of scores for males in the treatment group (80.64). Further, in comparisons of course and instructor evaluation scores between males and females only in the control group statistically significant differences ( $P=0.007$ ) were also detected (Table 9). The mean for female course and instructor evaluation scores for the control group (82.11) was 4.12 points higher than the mean of scores for males in the control group (77.99).

Research has shown that though there were no differences in stress recovery between treatment and control groups of mildly stressed females or males from viewing red-flowering geraniums, females from the treatment group of highly stressed females recovered more quickly than highly stressed females in the control group (Kim & Mattson, 2002). Other studies have shown that the gift of flowers elicited positive moods to both men and women (Haviland-Jones, 2005). Results of this study do not indicate plants benefited nor hindered scores of treatment and control males and females.

#### *Overall Comparisons of "Reason for Taking the Course"*

##### *Findings Related to Objective 4*

The fourth objective of the study was to observe whether any particular demographic group appeared to benefit more than others in the variables of interest from the presence of plant material in the classroom. Comparisons of student's reasons for taking the course are discussed below.

##### *Comparisons of statements for overall "Major Required"*

###### *Data analysis*

An analysis of variance test compared the control and treatment groups of students responding on their different reasons for taking the course. Students responded in the categories of "Major Required," "Major Elective," "General Studies Required," "Minor Related Field," and "General Interest." The overall sample that indicated "Major Required" as their reason for taking the course consisted of 78 from the overall treatment group and 74 from the overall control group, with a total sample of 152. An analysis of variance compared treatment and control groups' mean scores for course grade ( $P=0.020$ ) and course and instructor evaluation ( $P=0.437$ ) for those whose reason for taking the

course was indicated as “Major Required.” A statistically significant difference ( $P=0.020$ ) was found in course grades between the treatment and control groups (Table 10). Actual grades issued by the instructor revealed 10.7% more grades of “A”, 11.1% more grades of “B”, and 21.1% fewer “C’s” in the treatment group compared to the control group. Since course grades were higher for the treatment group, plants appeared to have had a positive effect on those taking the course as a requirement for their major. Comparison of course and instructor evaluation scores between treatment and control groups showed no statistically significant differences ( $P=0.437$ ; Table 10). Research has shown that stress can inhibit maximum performance of cognitive tasks (Glass & Singer, 1972; Hockey, 1983), and that recovery from stress has been associated with an increase in cognitive performance (Glass & Singer, 1972; Hockey, 1983). Since research has shown plants aid in stress recovery (Hartig et al., 1991), as well improve concentration (Taylor et al., 2001), it may be that plants aided students in achieving higher grades.

Because of the initial differences observed between control and treatment groups, an analysis of variance compared treatment and control groups for individual statement responses on the course and instructor evaluation instrument in those whose reason for taking the course was indicated as “Major Required.” Responses to “My interest in the subject has increased as a consequence of this course” showed a statistically significant difference ( $P=0.046$ ) in those who indicated the course was a requirement for their major (Table 11). There was a difference of 11% in positive responses of “agree” or “strongly agree” between the control and the treatment group (control 52%, treatment 63%). Though 8.1% disagreed or strongly disagreed in the control group, 1.3% in the treatment group indicated they disagreed and no “strongly disagree” responses tallied.

Though there were no statistically significant differences ( $P=0.484$ ) between treatment and control groups regarding level of interest in the subject prior to the course, there was a statistically significant difference ( $P=0.036$ ) in present interest in the course (Table 11). No one in the treatment group responded with a “very low” to the question “Level of interest in the subject at this time,” and only 7.7% indicated “low” interest (Table 11). In the control group, there were 4.1% “very low” responses and 12.2% responding in the category “low,” a difference of 8.6%. A difference of 12.7% in “high” and “very high” responses was found between control and treatment groups, or 52.7% “high” and “very high” responses from the control group compared to 65.4% “high” and “very high” responses from the treatment group.

Table 10. An analysis of variance comparing overall treatment and control groups’ grades and overall course and instructor evaluation scores for the categories of “Reasons for taking the course” in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>y,z</sup>	SD	df	F	P
<b>“Major Required”</b>						
Course grades						
Treatment	75	2.92 <sup>y</sup>	0.941	1	5.558	0.020*
Control	72	2.56 <sup>y</sup>	0.933			
Course and instructor evaluation scores						
Treatment	77	82.40 <sup>z</sup>	9.006	1	0.607	0.437
Control	74	81.18 <sup>z</sup>	10.328			
<b>“Major Elective”</b>						
Course grades						
Treatment	22	2.45 <sup>y</sup>	0.963	1	0.111	0.741
Control	20	2.55 <sup>y</sup>	0.887			
Course and instructor evaluation scores						
Treatment	22	80.59 <sup>z</sup>	7.162	1	0.258	0.615
Control	20	79.25 <sup>z</sup>	9.862			

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
<b>“General Studies Required”</b>						
Course grades						
Treatment	56	2.64 <sup>y</sup>	0.980	1	1.096	0.297
Control	56	2.84 <sup>y</sup>	1.005			
Course and instructor evaluation scores						
Treatment	58	81.60 <sup>z</sup>	7.993	1	0.014	0.908
Control	58	81.41 <sup>z</sup>	9.496			
<b>“Minor Related Field”</b>						
Course grades						
Treatment	19	3.16 <sup>y</sup>	0.898	1	0.002	0.968
Control	7	3.14 <sup>y</sup>	0.690			
Course and instructor evaluation scores						
Treatment	20	82.70 <sup>z</sup>	6.876	1	0.653	0.426
Control	10	84.90 <sup>z</sup>	7.340			
<b>“General Interest”</b>						
Course grades						
Treatment	18	2.67 <sup>y</sup>	0.767	1	1.097	0.303
Control	17	2.35 <sup>y</sup>	0.996			
Course and instructor evaluation scores						
Treatment	20	84.45 <sup>z</sup>	7.571	1	9.748	0.004*
Control	18	75.44 <sup>z</sup>	10.141			

<sup>y</sup>Grades were issued on a traditional four-point scale by instructor.

<sup>z</sup>Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

Table 11. An analysis of variance comparison within treatment and control groups of those whose reason for taking the course was “Major Required” on course grade and course and instructor evaluation scores in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>yz</sup>	SD	df	F	P
My interest in the subject has increased as a consequence of this course.						
Treatment	78	4.03 <sup>z</sup>	0.581	1	4.062	0.046*
Control	74	3.84 <sup>z</sup>	0.951			
Level of interest in the subject prior to this course.						
Treatment	78	3.10 <sup>z</sup>	0.961	1	0.491	0.484
Control	74	2.99 <sup>z</sup>	1.079			
Level of interest in the subject at this time:						
Treatment	78	3.78 <sup>z</sup>	0.863	1	4.502	0.036*
Control	74	3.46 <sup>z</sup>	1.009			
Actual grade						
Treatment	75	2.92 <sup>y</sup>	0.941	1	5.558	0.020*
Control	72	2.56 <sup>y</sup>	0.933			

<sup>y</sup>Grades were issued on a traditional four-point scale by instructor.

<sup>z</sup>Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Comparisons of statements for overall “Major Elective”*

#### *Data analysis*

The overall sample that indicated “Major Elective” as their reason for taking the course consisted of 22 from the overall treatment group and 20 from the overall control group, with a total sample of 42. An analysis of variance compared the treatment and control groups’ course grades and course and instructor evaluation scores. Comparisons

of course grade ( $P=0.741$ ) and of course and instructor evaluation scores ( $P=0.615$ ) between treatment and control groups showed no statistically significant differences (Table 10). Results are an indication that students taking the course as a “Major Elective” were not positively or negatively affected by the presence of plants in the classroom.

*Comparisons of statements for overall “General Studies Required”*

*Data analysis*

The overall sample that indicated “General Studies Required” as their reason for taking the course consisted of 58 from the overall treatment group and 58 from the overall control group, with a total sample of 116. An analysis of variance comparing the treatment and control groups’ course grades ( $P=0.297$ ) and course and instructor evaluation scores ( $P=0.908$ ) showed no statistically significant difference (Table 10). Results are an indication that students taking the course as for “General Studies Required” were not positively or negatively affected by the presence of plants in the classroom.

*Comparisons of statements for overall “Minor Related Field”*

*Data analysis*

The overall sample that indicated “Minor Related Field” as their reason for taking the course consisted of 17 from the overall treatment group and 10 from the overall control group, with a total sample of 27. An analysis of variance comparison of course grades ( $P=0.968$ ) and of course and instructor evaluation scores ( $P=0.426$ ) showed no statistically significant difference between treatment and control groups (Table 10). Results are an indication that students taking the course as a “Minor Related Field” were not positively or negatively affected by the presence of plants in the classroom.

### *Comparisons of statements for overall “General Interest”*

#### *Data analysis*

The overall sample that indicated “General Interest” as their reason for taking the course consisted of 20 from the overall treatment group and 18 from the overall control group, with a total sample of 38. An analysis of variance was used to compare course grades and course and instructor evaluation scores between treatment and control groups. Comparisons of course grade between treatment and control groups ( $P=0.303$ ) showed no statistically significant differences (Table 10). However, there were statistically significant differences ( $P=0.004$ ) in comparisons of overall course and instructor evaluation scores between the treatment and control group for those who indicated “General Interest” as their reason for taking the course, with mean scores being 0.32 points higher for the treatment group (Table 10). Students who indicated they took the course for “General Interest” may have benefited from the presence of plants in the classroom in their perceptions of the course and the instructor, which is supported by research that found that interior living plants may offer some psychological and restorative values, such as reduced tension (Ulrich, 1991). Research has stated the importance of positive instructor perceptions in that those perceptions can increase the likelihood of increased student enrollment, which in turn can increase the frequency a course may be offered (Ferguson, 2000).

Examination of individual statement responses using analysis of variance tests revealed several statistically significant differences between the control and treatment group of the students taking the course for “General Interest”. “I found the course challenging and stimulating” was statistically significantly different ( $P=0.004$ ) with

72.2% of responses of “agree” and no “strongly agree” from the control group, and 100% of responses of “agree” or “strongly agree” from the treatment group (20% of those being “strongly agree”; Table 12).

The statement “I have learned something I consider valuable” was statistically significantly different in comparisons ( $P=0.004$ ) with 77.8% of responses of “agree” or “strongly agree” from the control group, and 100% of responses of “agree” or “strongly agree” from the treatment group, and 45% of those being “strongly agree” (Table 12).

“My interest in the subject has increased as a consequence of this course” was statistically significantly different in comparisons ( $P=0.000$ ) with 50% responses of “agree” or “strongly agree” from the control group, and 100% of responses of “agree” or “strongly agree” from the treatment group (Table 12).

Statistically significant differences were found ( $P=0.023$ ) on responses to the statement “Instructor’s style of presentations held my interest during most of the class time” (Table 12). Though 11% responded with “disagree” or “strongly disagree” in the control group and 16.7% were neutral, there were no negative responses and only 10% were neutral in the treatment group. There was a 90% response of “agree” or “strongly agree” from the treatment group, 72.2% responses of “agree” or “strongly agree” from the control group. This supports studies that show plants can help hold a person’s attention (Katcher et al., 1984; Taylor et al., 2001; Ulrich, 1979, 1981).

The statement “Instructor’s explanations were clear” showed a statistically significant difference in scores ( $P=0.024$ ) with an 11.2% negative response of “disagree” or “strongly disagree” from the control group, and no responses of “disagree” or “strongly disagree,” nor of “neutral” from the treatment group. One hundred percent of

the treatment group responded with “agree” or “strongly agree” to this statement, while 77.8% in the control group responded with “agree” or “strongly agree” (Table 12).

The statement, “Instructor was adequately accessible to me during office hours or after class” received a 61.1% response of “neutral” in the control group, with a statistically significant difference ( $P=0.003$ ) in responses between the treatment and the control group. No responses of “disagree” or “strongly disagree” were indicated for either control or the treatment group. The treatment group showed an 80.0% positive response, 50.0% of which were “strongly agree” and 30.0% of which was “agree.” Only 11.1% of the control group indicated “strongly agree” and 27.8% responded “agree,” for a total of 38.9% positive responses. This was a difference of 41.1% in positive responses between the control and the treatment groups (Table 12).

A statistically significant difference ( $P=0.001$ ) was found in comparisons of responses on the statement, “Required readings were useful to me” as 33.4% responded with “disagree” or “strongly disagree” in the control group, compared to no responses of “disagree” or “strongly disagree” in the treatment group. Seventy percent of the treatment group responded with “agree” or “strongly agree”, while 33.3% of the control group responded with “agree” and no responses of “strongly agree” (Table 12).

Analysis of the statement, “Required texts were useful to me” found statistically significant differences ( $P=0.043$ ) in response with a 10% difference in responses of “agree” or “strongly agree” between the control and treatment groups. No “strongly agree” responses occurred in the control group, while 20% of the treatment group strongly agreed (Table 12).

While no statistically significant differences ( $P=0.562$ ) between groups were found for the question “Level of interest in the subject prior to this course,” statistically significant differences did appear in responses to “Level of interest in the subject at this time” ( $P=0.001$ ) with a difference of 48.3% more responses of “high” and “very high” scores from the treatment group than from the control group (Table 12). No “very high” responses were recorded from the control group, while 15% “very high” responses were indicated within the treatment group. No “very low” responses were recorded within the treatment group, and one “very low” response (5.6%) was indicated in the control group.

These “Reasons for Taking the Course” results are interesting because they showed that the only group with no requirement stated for taking the course was responding differently on the course and instructor evaluation tool. Results show a statistically significant difference in scores between those in a class with the presence of interior plants and those in a class with no interior plants present. These findings support research that has shown a preferred environment includes plants (Ulrich, 1981), and that workers like plants in the workplace and companies use plants for aesthetic enjoyment of their clients (Vitiello, 2001). Research has also shown that plants can trigger recuperative physiological and emotional responses (Ulrich & Parsons, 1992), bringing out more positive feelings in a person (Ulrich, 1990). These findings support research in that the treatment group saw the course as more stimulating and had a greater increase in interest in the subject than those who were not instructed in the presence of interior plants. It may be that since the “General Interest” group is the only group with no mandated reason for taking the course, their perceptions of course and instructor could benefit from the

presence of plants in ways not possible by groups that were mandated in some way to take the course.

Table 12. Analysis of variance comparisons of individual statement responses from the treatment and control groups' course and instructor evaluation instrument for those who indicated the course was taken for "General Interest" in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
<b>Learning</b>						
I found the course challenging and stimulating.						
Treatment	20	4.20	0.410	1	9.442	0.004*
Control	18	3.50	0.924			
I have learned something I consider valuable.						
Treatment	20	4.45	0.510	1	9.596	0.004*
Control	18	3.78	0.808			
My interest in the subject has increased as a consequence of this course.						
Treatment	20	4.55	0.510	1	16.887	0.000*
Control	18	3.39	1.145			
<b>Enthusiasm</b>						
Instructor style of presentations held my interest during most of the class time.						
Treatment	20	4.30	0.657	1	5.653	0.023*
Control	18	3.67	0.970			
<b>Organization</b>						
Instructor's explanations were clear.						
Treatment	20	4.45	0.510	1	5.531	0.024*
Control	18	3.83	1.043			
Instructor spoke clearly.						

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>z</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
Treatment	20	4.60	0.503	1	4.086	0.051
Control	18	4.22	0.647			
<b>Individual Rapport</b>						
Instructor made me feel welcome in seeking help/advice in or outside of class.						
Treatment	20	4.50	0.688	1	4.060	0.051
Control	18	4.00	0.840			
Instructor was adequately accessible to me during office hours or after class.						
Treatment	20	4.30	0.801	1	10.545	0.003*
Control	18	3.50	0.707			
<b>Assignments</b>						
Required readings were useful to me.						
Treatment	20	3.85	0.671	1	11.904	0.001*
Control	18	2.94	0.938			
Required texts were useful to me.						
Treatment	20	3.75	0.851	1	4.415	0.043*
Control	18	3.11	1.023			
<b>Students and Course Characteristics</b>						
Level of interest in the subject prior to this course.						
Treatment	20	2.90	0.852	1	0.343	0.562
Control	18	2.72	1.018			
Level of interest in the subject at this time:						
Treatment	20	3.75	0.786	1	12.880	0.001*
Control	18	2.83	0.786			

<sup>z</sup>Statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

*Overall Ethnicities Comparisons*

*Findings Related to Objective 4*

The fourth objective of the study was to observe whether any particular demographic group appeared to benefit more than others in the variables of interest from the presence of plant material in the classroom.

Data analysis results from an analysis of variance comparing treatment and control groups of students of different ethnicities found no statistically significant differences in course grades or in course and instructor evaluation scores for any individual ethnic group (Table 13). No individual ethnicity appeared to benefit more from the presence of plants in the classroom when compared to other ethnicities. Findings demonstrate that interior plants do not have a statistically significantly different effect between ethnicities in the effect of interior plants in the university classroom.

Table 13. Analysis of variance comparisons of course and instructor evaluation scores of overall treatment and control groups of students from different ethnic backgrounds in the study of the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

<b>Participant group</b>	<b>Sample size (no.)</b>	<b>Mean<sup>yz</sup></b>	<b>SD</b>	<b>df</b>	<b>F</b>	<b>P</b>
<b>African-Americans</b>						
Course grades						
Treatment	12	2.67 <sup>y</sup>	1.303	1	0.407	0.531
Control	9	2.33 <sup>y</sup>	1.000			
Course and instructor evaluation scores						
Treatment	12	82.17 <sup>z</sup>	6.351	1	0.000	0.985
Control	9	82.11 <sup>z</sup>	6.566			
<b>Asians</b>						
Course grades						
Treatment	3	2.67 <sup>y</sup>	0.577	1	0.750	0.420
Control	5	2.00 <sup>y</sup>	1.225			
Course and instructor evaluation scores						
Treatment	3	83.00 <sup>z</sup>	1.000	1	0.427	0.538
Control	5	78.20 <sup>z</sup>	12.296			

Participant group	Sample size (no.)	Mean <sup>z</sup>	SD	df	F	P
<b>Caucasians</b>						
Course grades						
Treatment	137	2.87 <sup>y</sup>	0.898	1	2.127	0.146
Control	119	2.70 <sup>y</sup>	0.979			
Course and instructor evaluation scores						
Treatment	142	81.49 <sup>z</sup>	8.166	1	2.303	0.130
Control	123	79.75 <sup>z</sup>	10.525			
<b>Hispanics</b>						
Course grades						
Treatment	29	2.48 <sup>y</sup>	1.022	1	0.517	0.475
Control	33	2.67 <sup>y</sup>	0.990			
Course and instructor evaluation scores						
Treatment	31	85.52 <sup>z</sup>	7.865	1	1.297	0.259
Control	37	83.30 <sup>z</sup>	8.113			
<b>“Other” ethnicities</b>						
Course grades						
Treatment	6	2.50 <sup>y</sup>	1.225	1	0.028	0.870
Control	5	2.60 <sup>y</sup>	0.548			
Course and instructor evaluation scores						
Treatment	7	85.00 <sup>z</sup>	10.033	1	0.026	0.876
Control	5	84.20 <sup>z</sup>	5.630			

<sup>y</sup>Grades were issued on a traditional four-point scale by instructor.

<sup>z</sup>Scores ranged from 20-100. Twenty statements were rated on a 1 to 5 scale with 5 being the most positive response and 1 being the most negative response.

\*Statistically significant at the 0.05 level.

### *Observations of Instructors*

#### *Findings Related to Objective 5*

The fifth objective of the study was to observe whether instructors felt the presence of plant materials in the classroom were beneficial or detrimental in any way. A verbal interview was held with the professor of Introductory Psychology. Written interviews were received from the professors of the Social Psychology and Introductory Sociology classes.

*Discussion*

The professor of the Introductory Psychology course stated in an informal interview that she very much enjoyed the presence of plants in the classroom and felt the presence of plants might, unconsciously, have an effect on her presentation to the classroom.

Written interviews with the instructors of the Social Psychology course and the Introductory Sociology course stated that they did not notice plants during instruction, though both instructors indicated they liked plants. The Introductory Sociology professor stated that class participation was higher in the treatment classroom, but absences did not seem to be affected. Other research states that plants triggered positive emotions (Isen, 1990) which may have encouraged discussion.

The Social Psychology professor stated she felt attendance was better in the class with plants, though she did not know if it was due to the plants, or perhaps to the later time of day. If some degree of unpleasantness is associated with attending class, then this supports research where subjects endured an unpleasant situation of a hand submerged in ice more often when plants were present (Lohr & Pearson-Mims, 2000). The instructor also felt class participation was better in the class with plants, though she named a number of variables unrelated to plants that might have affected that participation. She noted that class average on most tests was higher in the class with plants, again adding that other variables not related to plants could have affected scores. However, this observation supports research findings that plants can positively effect a person's emotional state (Ulrich, 1981), which benefits cognitive functioning necessary for memory recall (Isen, 1990).

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

#### *Purpose of the Study*

The main objective of this research was to investigate the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor. Specific objectives of this study were to 1) compare final course grades of students in classrooms that had plant material during instruction to final course grades of students in classrooms with no plant material present, 2) compare overall instructor and course satisfaction scores between students in classrooms that had plant material present within the classroom during instruction to students that had no plant material present within the classroom during instruction, 3) compare specific classrooms of students to determine if students within any particular course/classroom appeared to benefit more from the presence of plant material in terms of course grade or course and instructor satisfaction 4) observe whether any particular demographic group appeared to benefit more than others from the presence of plants in terms of the variables of interest, 5) observe whether instructors felt plant materials in the classroom were beneficial or detrimental in any way.

### *Summary of the Review of Literature*

A correlation has been found through research between recidivism rates of students and the quality of a university (Brewer et al., 1999). Quality educators are attracted to quality schools, and quality educators provide a quality education (Groen & White, 2003). Top students are then more likely to be attracted to top universities than to other universities (Groen & White, 2003). Since national budget systems are linked to the choices students make in higher education (Wiers-Jenssen et al., 2002), states have an interest in attracting and retaining quality students with high ability (Groen & White, 2003).

It has been demonstrated that the state of emotion a person is experiencing can affect memory and problem solving (Isen, 1990). Positive feelings are associated with greater creativity (Isen, 1985). Conversely, cognitive task performance can be inhibited when a person is stressed. Research has shown that cognitive task performance is improved with stress recovery (Glass & Singer, 1972; Hockey, 1983). Studies have shown that viewing nature can improve the emotional state of a stressed person, whereas urban views were found to negatively affect well-being (Ulrich, 1981).

Research has found several important interior environmental preferences and perceptions to be important universally including temperature (Stoops, 2001), vision, and smell (Ulrich, 1981). Plants can positively affect environmental perceptions. It has been shown that the presence of plants can increase humidity in a dry room and reduce dust (Lohr & Pearson-Mims, 1996). Interior plants and nature views have been shown to have positive effects on well-being in medical facilities (Heerwagen, 1990; Ulrich, 1986a;

Ulrich, 1984). Window views of nature from the interior of a prison have been shown to be beneficial to inmate well-being (Moore, 1982; West, 1985).

Research has shown benefits with the presence of nature in interior work areas (Hartig et al., 1991; Vitiello, 2001). Interior plants have been found to have a positive effect on the ability to cope (Lohr & Pearson-Mims, 2000), and research has indicated that university students may experience psychologically positive benefits in the presence of plants or of natural views (Ulrich, 1979; Ulrich, 1981). The psychological state of students who were about to take an exam was more positive when they viewed slides of green, but ordinary, rural areas. Even in unstressed students, attention was held better and their emotional state was more positive when viewing nature scenes (Ulrich, 1981).

In general, all types of people can find value in including the beauty of plants in everyday life (Rappaport, 1994). Research is available on the benefits of plants and nature in health care facilities, prisons, offices, and on the student. However, studies on the benefits of plant material and nature on students mainly focus on green play areas for children or views of nature in pictures or in outdoor settings. Though research has found that plants benefit the classroom aesthetically, provide oxygen, and absorb toxins (Hart, 1999), little research has been done on other benefits of plants, particularly with the daily presence of plants in the classroom. The main objective of this research was to investigate the impact of interior houseplants in university classrooms on course performance and on perceptions of the course and instructor.

## *Methodology*

### *Sample group*

The student sample used in this study came from Texas State University – San Marcos students taking specific Psychology or Sociology courses during the spring 2005 semester. Instructors were invited to participate in the study if they taught the same course in the same room with the same material to two separate groups of students. The sample used included classes of three female professors who met the criteria and agreed to participate in the study. Three hundred eighty-five students participated from each of the three courses of two sections. One hundred eighty-five students responded from the control group and were instructed without the presence of interior plants, and 200 students responded from the treatment group and were instructed throughout the semester in the presence of interior plants. The control group participated in the first class session of the day for each of the three courses. Interior tropical plants were then brought in for the second session of the day for the three courses, which was the treatment group. Each set of treatment and control classes was taught by the same professor teaching the same subject in the same room. In appreciation and as an incentive for their assistance, the instructors were offered a free weekly floral design that was delivered to them or to the local destination of their choosing. Students were offered their choice of candy, a granola bar, or seed packet in appreciation for their completion of the evaluation survey.

### *Instrumentation*

An assent form was distributed and collected that allowed for students to volunteer anonymous information for the research (Appendix A). Demographic data gathered included class rank, gender and ethnicity (Appendix B). Course grade on a 4.0

scale measured course achievement. The Texas State University end-of-semester course and instructor evaluation survey was used to collect information on student satisfaction with the course and with the instructor (Appendix B).

### *Conclusions*

This study shows that the presence of plants can accompany a positive emotional state in the form of increased interest in the subject. Statistically significant differences were found in treatment and control group comparisons of grades of the Social Psychology classroom, Juniors, and those who indicated “Major Required” as their reason for taking the course. Statistically significant differences were found in course and instructor evaluation scores in treatment and control group comparisons of Juniors, the windowless Sociology classroom, and those who indicated “General Interest” as their reason for taking the course. A statistically significant greater present interest in the subject was scored by the treatment groups of the overall scores, the Sociology course, Freshmen, Juniors, and those who indicated “Major Required” and “General Interest” as their reason for taking the course. Increase in course interest of “Major Required” students was also statistically significantly greater in the treatment group when compared to the control group.

This study found that plants may improve perceptions of the course and instructor, particularly of students otherwise learning in a stark windowless environment. Level of interest in the subject at this time in the treatment group of the windowless environment was statistically significantly greater. Positive perceptions of course and instructor are important when considering the interest of universities in retaining students

and of governments who use those universities to attract high ability students (Groen & White, 2003).

Conclusions in support of research and results presented in previous chapters are summarized as follows:

#### *Objective 1*

The first objective was to compare final course grades of students in classrooms that had plant material during instruction to final course grades of students in classrooms with no plant material present.

An analysis of variance comparison found no statistically significant differences in comparisons of student final course grades ( $P=0.192$ ). Treatment and control group grades were comparatively similar initially. Results indicated that plants were not distracting to instruction, nor beneficial to students.

#### *Objective 2*

The second objective was to compare overall instructor and course satisfaction scores between students in classrooms that had plant material present within the classroom during instruction to students that had no plant material present within the classroom during instruction.

Analysis of variance comparisons found no statistically significant differences between treatment and control groups' overall course and instructor evaluation scores ( $P=0.065$ ). Although comparisons of perceptions of the course and instructor did not show a statistically significant difference, the treatment group scored higher and showed a statistically significant difference in comparisons of individual statement responses in the categories of "Learning," "Enthusiasm," and "Organization". Also, responses in the

“Students and Course Characteristics” survey showed no statistically significant difference ( $P=0.093$ ) in level of interest in the subject when entering the course, but the treatment group’s interest showed a statistically significant positive difference in the subject ( $P=0.020$ ) at the end of the course.

Plants may have benefited students by adding to positive perceptions, as shown here in increased interest in the course and in satisfaction with the course on individual statements. Since research has shown that plants can enhance positive feelings (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991), and universities as well as states have an interest in student recidivism (Groen & White, 2001), it would be worthwhile to understand the effects of plants in these statistically significant areas of interest.

### *Objective 3*

The third objective of the study was to compare specific classrooms of students to determine if any particular classroom appeared to benefit more from the presence of plant material in the classroom.

### *Introductory Psychology*

Results from analysis of variance comparisons indicated no statistically significant differences in overall course grade ( $P=0.480$ ) or in course and instructor evaluation ( $P=0.964$ ) scores between treatment and control groups in individual classrooms of Introductory Psychology. A question on “Students and Course Characteristics” instrument gave students the opportunity to indicate if they felt plants had influenced their learning environment. In the treatment group, though more than 20 comments stated they felt the learning environment was not affected by the presence of plants, many individual positive comments were made such as that plants made the room

“comfortable” (10 comments), “homelike” or “at home” (3 responses), “relaxed” or “more relaxing” (3 responses), and many other singular references to plants such as “keep you alive and interested.” These and other comments such as that plants “made it easier,” and that they made the environment “warmer,” and “calming” support research that plants help concentration and attention (Taylor et al., 2001) and increase the ability to cope (Lohr & Pearson-Mims, 2000). The room was bright, had color in the seating and matching drapes, and windows along the length of one wall with a southern view. It may be that the color in the room and window views of green leaves on trees altered the effects of interior plants, in that students already had a green view of nature. Studies of the classroom environment have shown that our human senses are influenced by the built environment, and that color is an important factor in the construction of a positive environment (Rydeen, 2002).

### *Social Psychology*

Results from analysis of variance comparisons indicated a statistically significant difference in overall course grades ( $P=0.005$ ) between treatment and control groups in the Social Psychology course. The mean of the course grade for the treatment group (3.14) was 0.52 points higher than the mean of the control group (2.62). No course grades of “D” and 24.4% course grades of “C” were received in the treatment group, whereas 45.4% of the control group received a “C” or a “D”. No statistically significant difference was found in comparisons of course and instructor evaluation scores ( $P=0.705$ ) between treatment and control groups for Social Psychology. A question on “Students and Course Characteristics” instrument gave students the opportunity to indicate if they felt plants had influenced their learning environment. In the treatment group, though at least 15

comments stated they felt the learning environment was not or may not have been affected by the presence of plants, many individual positive comments were made in reference to plants such as “brighter” and “calmer.” Two references were made to color and nine references to comfort. Other comments suggested that: the plants “add to a great learning environment”; the plants make the learning environment feel “warmer”; five comments referred to “home”; plants made the environment “less sterile” and “less jail-like”; and that they “enjoyed looking at them while pondering.”

These results support other research that states that vegetation can hold a person’s attention (Katcher et al., 1984; Ulrich, 1979, 1981). One comment was that plants made the environment feel “less authoritarian”, which is compatible with research findings that democratic professors are more likeable (Larocca, 2003). The latter statement regarding “pondering” is supported by speculation from both the 19<sup>th</sup> and 20<sup>th</sup> century that the mind can be active yet not be stressed while looking at plants (Kaplan & Kaplan 1989; Kaplan & Talbot, 1983; Olmsted, 1865).

Results showed that plants were not a detriment to instruction and course performance. This classroom was cramped and lacked color other than dark drapes on the windows. The windows spanned one wall with a third-floor view of the tops of trees. It may be that the window views of green leaves on the tops of trees altered the effects of interior plants in results of scores. Since research has shown a strong preference for window views of a natural content (Moore, 1982; Verderber, 1986), a nulling effect may have occurred since green vegetation was in view through the windows for both control and treatment groups.

### *Introductory Sociology*

Analysis of variance comparison results indicated that there was no statistically significant difference ( $P=0.750$ ) in course grade between treatment and control groups in the Introductory Sociology classes. There was, however, a statistically significant difference in comparisons of responses to course and instructor evaluation scores of the treatment group and the control group ( $P=0.049$ ), with more positive responses coming from the treatment group.

Because of the initial differences in overall evaluation scores, individual statement responses were analyzed. Several statements were found to have statistically significant differences between groups in the survey categories of “Learning” (four responses), “Enthusiasm” (two responses), and “Organization” (three responses). The treatment group scored significantly higher than the control group in each of these 9 responses. Also, treatment and control groups were not statistically different ( $P=0.184$ ) when entering the class on their level of interest in the subject. However, the treatment group was statistically significantly more interested in the subject at the end of the semester ( $P=0.025$ ), with 9.1% more treatment group responses of “high” or “very high” when compared to the control group.

The Sociology class had no windows, was modern and in good repair, but stark. It is designed to seat 121 people. A question on “Students and Course Characteristics” instrument gave students the opportunity to indicate if they felt plants had influenced their learning environment. In the treatment group, though more than 45 comments stated they felt the learning environment was not or may not have been affected by the presence of plants, it is not known where these students sat in the auditorium or if plants were in

clear view for these students. Many positive comments were included. Four comments showed that students felt that the plants made the learning environment less boring or were looked at during lecture. This supported research findings of sustained attention (Ulrich, 1991) in interiors with plants. Individual comments also included that students felt “less caged in,” that the trees helped their grade, and that plants “took the edge off.” Two comments regarding comfort support research findings by Lohr & Pearson-Mims (2000) that discomfort is tolerated longer in the presence of plants. One other student said the plants were “warmly welcomed,” and one said they were “wonderful.”

Since research has demonstrated that the presence of plants may reduce negative feelings (Ulrich, 1979) and increase attention (Taylor et al., 2001; Ulrich, 1981), the environment may have been enhanced during instruction with the presence of plants, which may have affected scores for interest in the course. Plants appeared to have contributed to the comfort, attention and concentration of students in the stark, windowless auditorium more than in the Psychology classes which had windows and a view of trees with green leaves. This supports other research of increased attention and concentration in the presence of plants (Lohr & Pearson-Mims, 2000; Taylor et al., 2001).

#### *Objective 4*

The fourth objective of the study was to observe whether any particular demographic group appeared to benefit more than others in the variables of interest from the presence of plant material in the classroom.

### *Class ranking*

#### *Freshmen*

Analysis of variance comparisons of course grade showed no statistically significant differences ( $P=0.313$ ) between treatment and control groups of the Freshmen class. Course and instructor evaluation scores did not reflect a statistically significant difference ( $P=0.325$ ) between control and treatment groups within the Freshmen class. In comparisons of scores between treatment and control groups on statement responses to “Level of interest in the subject prior to this course” there were no statistically significant differences between treatment and control groups ( $P= 0.292$ ). However, responses to “Level of interest at this time” scored a statistically significant difference of  $P=0.040$ . The mean treatment group score (3.84) was 0.35 points higher than the mean score of the control group (3.49).

#### *Sophomores*

Analysis of variance comparisons showed no statistically significant differences occurred in course grade ( $P=0.972$ ) or in course and instructor evaluation scores ( $P=0.477$ ) between Sophomore treatment and control groups. Of Freshman, Sophomore, and Junior class rankings, Sophomores are the most likely to transfer (Bean, 1985). Since plants were not shown to increase interest in the subject or to benefit course and instructor evaluations for Sophomores, findings do not give evidence that plants would effect recidivism rates of Sophomores.

*Seniors*

Analysis of variance comparisons found no statistically significant differences in course grades ( $P=0.177$ ) or in course and instructor evaluation scores ( $P=0.233$ ) between treatment and control groups of Seniors.

*Juniors*

Analysis of variance comparisons found a statistically significant difference of course grades ( $P=0.038$ ) between treatment and control groups of Juniors. The treatment group received 20% more grades of “A” and “B” than did the control group. A statistically significant difference also occurred in Juniors’ course and instructor evaluation scores ( $P=0.017$ ). The treatment group’s mean score was 5.93 points higher for the treatment group when compared to the control group. Mean score comparisons between treatment and control groups for the responses to the statement “Level of interest in the subject prior to this course” were not statistically significant ( $P= 0.344$ ). However, responses to the statement “Level of interest at this time” did show a statistically significant difference ( $P=0.004$ ). The treatment group’s mean score was 0.65 points higher when compared to the control group score. Results indicated that plants may have had a positive effect on Juniors’ course grade and on their perceptions of the course and instructor. Further, it appears that plants may have affected outcomes of increased interest in the subject for Juniors in the treatment group. The level of commitment to an institution grows stronger the longer a student is in a school (Bean, 1985), which may have somehow spurred an appreciation of or benefit from plants with Juniors that was not experienced by other classes. This positive experience may not only encourage Juniors,

but also make it possible for them to communicate to potential future Juniors that the experience was a positive one.

### *Gender*

#### *Female*

Analysis of variance comparisons found no statistically significant differences ( $P=0.326$ ) in comparisons of course grades or in overall course and instructor evaluation scores between treatment and control groups of those who indicated they were female ( $P=0.345$ ).

#### *Male*

Analysis of variance comparisons found no statistically significant differences ( $P=0.443$ ) in comparisons of course grades between treatment and control groups of males or in overall course and instructor evaluation scores ( $P=0.131$ ).

#### *Male/Female Comparisons.*

Analysis of variance found no statistically significant differences in overall course grade for the males versus females treatment group comparisons ( $P=0.220$ ) or the males versus females control group comparisons ( $P=0.214$ ). Statistically significant differences ( $P=0.043$ ) in comparisons of course and instructor evaluation scores between males and females only in the treatment group were detected (Table 9). The mean for female course and instructor evaluation scores for the treatment group (83.11) was 2.47 points higher than the mean of scores for males in the treatment group (80.64)

Comparisons of course and instructor evaluation scores between males and females only in the control group also detected statistically significant differences ( $P=0.007$ ; Table 9). The mean for female course and instructor evaluation scores for the

control group (82.11) was 4.12 points higher than the mean of scores for males in the control group (77.99). This supports research that found gender bias where female students rated female instructors more highly than did their male colleagues (Centra & Guabatz, 2000).

#### *Reason for taking the course*

##### *Major Required*

Analysis of variance comparisons found a statistically significant difference ( $P=0.020$ ) in overall course grades of those who indicated “Major Required” as their reason for taking the course. Comparison of mean scores revealed the treatment group score was 0.36 points higher than the control group score. No statistically significant differences ( $P=0.437$ ) in overall course and instructor evaluation score comparisons occurred between treatment and control groups of those who indicated “Major Required” as their reason for taking the course. However, responses to “My interest in the subject has increased as a consequence of this course” scored a statistically significant difference ( $P=0.046$ ), with the treatment group responding agreeing or strongly agreeing 11% more than the control group.

No statistically significant differences ( $P=0.484$ ) between treatment and control groups regarding level of interest in the subject prior to the course were found. There was a statistically significant difference ( $P=0.036$ ) in present interest in the course when comparing control and treatment groups, the mean being 0.32 points higher for the treatment group than the control group. Results indicated plants may have had an effect on grades and level of interest in the course for those who indicated “Major Required” as their reason for taking the course. These findings correspond with research that suggests

that a preferred environment includes plants (Ulrich, 1981), and that workers like plants in the workplace (Vitiello, 2001). Though higher grades are a desired outcome in the effect of plants, students with higher grades also perceive that it is easier to transfer (Bean, 1985,) making positive perceptions of course and instructor important factors in retention rates with high ability students.

#### *Major Elective*

Analysis of variance comparisons found no statistically significant differences ( $P=0.741$ ) in overall course grade or in overall course and instructor evaluation scores ( $P=0.615$ ) between treatment and control groups of those who indicated “Major Elective” as their reason for taking the course. Results indicated that plants did not appear to either benefit, nor hinder course grade or course and instructor evaluation scores for those who indicated “Major Elective” as their reason for taking the course.

#### *General Studies Required*

Analysis of variance comparisons found no statistically significant differences in overall course grade ( $P=0.297$ ) and overall course and instructor evaluation scores ( $P=0.908$ ) between treatment and control groups of those who indicated “General Studies Required” as their reason for taking the course. Results indicated that plants did not appear to either benefit, nor hinder course grade or course and instructor evaluation scores for those who indicated “General Studies Required” as their reason for taking the course.

#### *Minor Related Field*

Analysis of variance comparisons found no statistically significant differences in overall course grade ( $P=0.968$ ) or in overall course and instructor evaluation scores

( $P=0.426$ ) between treatment and control groups of those who indicated “Minor Related Field” as their reason for taking the course. Results indicated that plants did not appear to either benefit, nor hinder course grade or course and instructor evaluation scores for those who indicated “Minor Related Field” as their reason for taking the course.

### *General Interest*

Analysis of variance comparisons found there were no statistically significant differences in overall course grade ( $P=0.303$ ) between treatment and control groups for those who indicated “General Interest” as their reason for taking the course. However, a statistically significant difference in course and instructor evaluation scores comparisons between treatment and control groups ( $P=0.004$ ) was found. The mean score of the treatment group was 9.01 points higher than the mean score of the control group. Further study revealed several statistically significant differences in scores of individual statement responses. Three responses in the “Learning” category, one in the “Enthusiasm” category, two in the “Organization” category, two in the “Individual Rapport” category, and two in the “Assignments” category scored statistically significant differences. Also, scores for “Level of interest in the subject prior to the course” were not statistically different ( $P=0.562$ ). However, scores between treatment and control groups in response to “Level of interest in the subject at this time” revealed the treatment group responses were significantly statistically more positive ( $P=0.001$ ). Results indicated interior plants may have affected course and instructor evaluation scores and level of interest in the subject for those who indicated “General Interest” as their reason for taking the course.

The “General Interest” group is the only group with no mandated reason for taking the course. Even though grades in the “General Interest” group did not appear to benefit significantly from the presence of plants, this group is the only group that scored a statistically significant difference between treatment and control groups in their perceptions of the course and the instructor, and therefore may have benefited from the presence of plants in ways not possible by groups that were mandated in some way to take the course. This supports research that has shown that plants can trigger recuperative physiological and emotional responses (Ulrich & Parsons, 1992), and bring out positive feelings in a person (Ulrich, 1990), since the students who were instructed in the presence of interior plants saw the course as more stimulating and interesting than those who were instructed without the presence of interior plants. This is an important finding when considering ways to increase interest and retention in any given branch of learning. These findings support research that has shown a preferred environment includes plants (Ulrich, 1981), and that workers like plants in the workplace and companies use plants for aesthetic enjoyment of their clients (Vitiello, 2001).

#### *Ethnicity*

Analysis of variance comparisons found no statistically significant differences between course grade or total course and instructor evaluation scores between treatment and control groups of students of different ethnicities. Results indicated that plants in the classroom did not appear to benefit any students of a particular ethnic background more than students of other ethnic backgrounds in terms of course grade or perceptions of course and instructor in comparisons of treatment and control groups.

### *Objective 5*

The fifth objective of the study was to observe whether instructors felt the presence of plant materials in the classroom were beneficial or detrimental in any way.

The Introductory Psychology classes had the fewest statistically significant differences of the three courses, but the instructor was very positive about the plants. During a verbal discussion with a researcher she speculated that her positive view of the presence of plants may have had a subconscious positive effect on her instruction.

Comments from students to the Social Psychology and Introductory Sociology instructors conveyed mostly curiosity. On only one day, in Social Psychology, plants were inadvertently not placed in the treatment class. The professor reported that a student lightheartedly commented that they would not be able to learn that day for lack of plants. All professors enjoyed plants in general, but two professors did not feel they noticed plants during instruction. The Social Psychology professor commented that there was more class participation and interaction from students in the treatment session.

### *Programmatic Implications*

1. The overall results from this study indicated that, in general, interior plants do not negatively affect the overall course performance of students.
2. Results from this study indicated plants appear to have an influence in individual areas of interest in student satisfaction with course and instructor in “Learning”, “Enthusiasm” (of instructor), “Organization”, “Individual Rapport”, “Examinations”, and “Assignments,” as well as on increased general interest in the subject.

3. Results from this study demonstrated that the positive effect of plants on overall university student perceptions of the course environment is more evident in a stark, windowless environment.
4. Plants appeared to have a positive influence on grades and level of interest in the subject for students who indicated “Major Required” as their reason for taking the course.
5. Plants appeared to have a positive influence on course and instructor evaluation scores and level of interest in the subject for students who indicated “General Interest” as their reason for taking the course.
6. Plants do not appear to benefit any particular demographic group more than others.

*Recommendations for Additional Research*

1. It is recommended that more studies be conducted comparing treatment and control groups in afternoon classes and in classes that are not consecutive, so that plants may be moved inconspicuously.
2. It is recommended that more studies be conducted using two classes of the same course that meet at the same time on different days with the same professor in the same classroom.
3. It is recommended that more studies be conducted using the first class of the day as the treatment group.
4. It is recommended that more studies be conducted using course classrooms of subjects not included in this study.
5. It is recommended that more studies be conducted using windowless environments, such as is found in the Education Building at Texas State University, to see if results of this study may be replicated.

6. It is recommended that studies be conducted comparing the effects of silk plants versus live plants.
7. It is recommended that studies be conducted with plants placed in high, medium, and low areas in the same room if the room is large.
8. It is recommended that more studies be conducted to explore effects of plants on individual grade levels of freshmen, sophomores, juniors, seniors, and of graduate students.
9. It is recommended that more studies be conducted to explore the effects of plants on fatigued students, i.e. students who have worked long hours, commuted long distances, attend one long class per week, or suffered an illness.

## APPENDIX A

## Student Survey on Course Environment

### Informed Consent

#### **To The Student:**

Your class has been selected to participate in a special project. In order for others to learn more about you and what influences your perceptions of your learning environment, a short survey (10 minutes) has been specially developed for use in this research. Your participation in filling out this questionnaire is completely voluntary and there is no penalty for non-participation. Your name will not be included on the questionnaire. You will remain anonymous. The information will be used to inform others on possible future benefits of changes in classroom environment to overall student learning.

Please read each question carefully and answer truthfully. You may have already answered a similar survey for university use. However, this version is used only for this research study. If you have any questions during the completion of the questionnaire, please raise your hand and they will be answered. For results or further questions or concerns, you may feel free to contact the researcher Jennifer S. Doxey at (512) 245-1845, or Dr. Tina Marie Cade at (512) 245-3324.

Once you have completed the questionnaire, please raise your hand so it may be collected. A copy of this consent form is available upon request. Thank you for assisting us in our research.

I have read and understand the explanation provided to me.  
I have had all my questions answered to my satisfaction, and  
I voluntarily agree to participate in this study.

Student's name \_\_\_\_\_

Date \_\_\_\_\_

## APPENDIX B

[Class and section here] STUDENT SURVEY ON COURSE ENVIRONMENT

Please locate and write your ASSIGNED NUMBER here \_\_\_\_\_  
(No names, please.)

Answer the following questions by circling the answer that best describes your feelings for each question. Do not mark a response to questions which are not relevant or not applicable to the course/instruction.

1. Learning

1. I found the course challenging and stimulating.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

2. I have learned something I consider valuable.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

3. My interest in the subject has increased as a consequence of this course.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

4. I have learned and understood the subject materials in this course.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

2. Enthusiasm

5. Instructor's style of presentations held my interest during most of the class time.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

6. Instructor seemed interested in teaching the course.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

3. Organization

7. Instructor's explanations were clear.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

8. The assignments were carefully explained.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

9. Instructor spoke clearly.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

10. Instructor spoke at a comfortable speed.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

4. Individual Rapport

11. Instructor made me feel welcome in seeking help/advice in or outside of class.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

12. Instructor was adequately accessible to me during office hours or after class.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

13. Instructor was helpful when I contacted her outside of class.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

5. Examinations

14. Feedback on examinations was useful to me.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

15. Feedback on graded materials was useful to me.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

16. Methods on evaluating student work were fair.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

17. Examinations tested course content as emphasized by the instructor.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

18. Examinations reflected course content covered.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

6. Assignments

19. Required readings were useful to me.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

20. Required texts were useful to me.

*Strongly agree*      *Agree*      *Neutral*  
*Disagree*              *Strongly disagree*

STUDENTS AND COURSE CHARACTERISTICS

Answer the next eleven questions using the scale that follows each question. Circle your choice for each question. LEAVE THE QUESTION BLANK IF NO RESPONSE APPLIES.

21. What grade in the course did you expect to earn when you enrolled in the class?

*A B C D F I'm not sure*

22. Course difficulty, relative to other courses, was:

*very easy easy medium hard very hard*

23. Course workload, relative to other courses, was:

*very light light medium heavy very heavy*

24. Course pace was:

*too slow about right too fast*

25. Hours per week required for the course workload outside of class:

*0-2 3-4 5-7 8-12 over 12*

26. Level of interest in the subject prior to this course:

*very low low medium high very high*

27. Level of interest in the subject at this time:

*very low low medium high very high*

28. Expected final grade in this course:

*A B C D F I'm not sure*

29. Reason for taking the course: (Select the one which is the best)

*major required major elective General Studies required  
minor/related field general interest only*

30. Year in school:

*Freshman*      *Sophomore*      *Junior*      *Senior*  
*Graduate*                      *Other*

31. I am:

*male*                      *female*

32. I consider myself to be:

*African American*      *Asian*      *Caucasian*      *Hispanic*  
*Native American*                      *other*

Please comment appropriately to the following questions:

33. I noticed the presence of plants during instruction.

*True*                      *False*

34. If true, did you feel they influenced your learning environment? How?

## REFERENCES

- Addington, A. (2005). Healing plants: horticultural therapy uses the healing abilities of interacting with plants. Retrieved October 20<sup>th</sup>, 2005 from <http://www.ledger-enquirer.com>
- Ambady, N., & Rosenthal, R. (1993). Half a minute: predicting teacher evaluations from thin slices of nonverbal behavior and physical attractiveness. *Journal of Personality and Social Psychology*, 64(3), 431-441.
- The American heritage dictionary of the English language* (4<sup>th</sup> ed.). (2000). Houghton Mifflin Company. Retrieved from <http://www.bartleby.com/61/90/S0099000.html>
- Anderson, L. M., & Schroeder, H. W. (1983). Applications of wildland scenic assessment methods to the urban landscape. *Landscape Planning*, 10, 219-237.
- Asakawa, S. (1984). The effects of greenery on the feelings of residents towards neighborhoods. *Journal of the Faculty of Agriculture, Hokkaido University*, 62, 83-97.
- Bassett, T. (1981). Reaping on the margins, a century of community gardening in America. *Landscape*, 25(2), 1-8.
- Basso, M. R., Schefft, B. K., Ris, M. D., & Dember, W. N. (1996). Mood and global-local visual processing. *Journal of the International Neuropsychological Society*, 2, 249-255.
- Bean, J. P. (1985). Interaction effects based on class level in an explanatory model of college student dropout syndrome. *American Educational Research Journal*, 22(1), 35-64.
- Berkman, L. F., & Syme, S. (1979). Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *American Journal of Epidemiology*, 109, 186-204.
- Brewer, D. J., Eide, E., & Ehrenberg, R. G. (1999). Does it pay to attend an elite private college? Cross cohort evidence on the effects of college type on earnings. *Journal of Human Resources*, 34, 104-123.

- Butin, D. (2000a). Classrooms. *National Clearinghouse for Educational Facilities*, 5 pp. Department of Education, Washington, DC.
- Butin, D. (2000b). Student commons. *National Clearinghouse for Educational Facilities*, 4 pp. Department of Education, Washington, DC.
- Cammack, C., Waliczek, T. M., & Zajicek, J. M. (2002). The Green Brigade: effects of a community-based horticultural program on the self-development characteristics of juvenile offenders. *HortTechnology* 12, 82-86.
- Centra, J. A., & Gaubatz, N. B. (2000). Is there gender bias in student evaluations of teaching? *The Journal of Higher Education*, 71(1),17-33.
- Chapman, J. (1980). *Economic realities and the female offender*. Lexington Books, Lexington, KY.
- Chokor, B. A., & Mene, S. A. (1992). An assessment of preference for landscapes in the developing world: Case study of Warri, Nigeria, and environs. *Journal of Environmental Management*, 34, 237-256.
- Coss, R. G. (1990). *Picture perception and patient stress: a study of anxiety reduction and postoperative stability*. Unpublished paper, University of California at Davis.
- Daniel, T. C., & Boster, R. S. (1976). *Measuring landscape esthetics: The scenic beauty estimation method*. USDA Forest Service Research Paper RM-167, 66 pp., Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colo.
- Daniel, T. C., & Vining, J. (1983). Methodological issues in the assessment of landscape quality. In I. Altman & J. F. Wohlwill (Eds.), *Human Behavior and Environment: Vol. 6. Behavior and the Natural Environment*, New York: Plenum.
- De Clercq, L. M. (1996). Student-teacher rapport in video-conferencing. *Masters Abstracts International*, 35(05), 1138.
- Derryberry, D., & Tucker, D. M. (1994). Motivating the focus of attention. In P. M. Neidenthal & S. Kitayama (Eds.), *The heart's eye: emotional influences in perception and attention* (pp. 167-196). San Diego, CA: Academic Press.
- Dinsmore, T. S. (2003). *Classroom Management*. Marygrove College, Michigan. (ERIC Document Reproduction Service No. ED478771)
- Eck, J. (1993). Element of Design. *Horticulture*, 26-28.
- Edith Cowan University, (2005). *ECU annual report 2004*. Retrieved August 29, 2005 from <http://www.ecu.edu.au/pr/ar04/kpi.htm#2>

- Feinman, C. (1986). *Women in the criminal justice system*. 2<sup>nd</sup> ed. Praeger Publication, New York.
- Ferguson, L. A., & Panirselvam, G. P. (2000). *Measuring satisfaction of M.B.A. students in the classroom*. Annual Meeting of the Academy of Business Education.
- Filak, V. F., & Sheldon, K. M. (2003). Student psychological need satisfaction and college teacher-course evaluations. *Educational Psychology, 23*(3), 235-247.
- Fjeld, T., Veierstedb, B., Sandvike, L., Riisec, G., & Levyd, F. (1998). The effect of indoor foliage plants on health and discomfort symptoms among office workers. *Indoor and Built Environment, 7*, 204-209.
- Fjeld, T. Do plants in offices promote health? *Plants for People*. Retrieved on March 8, 2005 from <http://www.plants-for-people.org>
- Frances, S., & Gruber, M. B. (1981). Student evaluations of psychology instructors [Abstract]. *Annual Convention of the American Psychological Association*. 11 pp.
- Francis, C., & Cooper-Marcus, C. (1991). "Places People Take Their Problems." In J. Urbina-Soria, P. Ortega-Andeane, & R. Bechtel (Eds.), *Proceedings of the 22<sup>nd</sup> Annual conference of the Environmental Design Research Association*. Oklahoma City: EDRA.
- Glass, D. C., & Singer, J. E. (1972). *Urban Stress: Experiments on Noise and Social Stressors*. New York: Academic Press.
- Gowan, R. T. L. (1987). Plant effluvia. Changing notions of the effects of plant exhalations on human health in the eighteenth and nineteenth centuries. *Journal of Garden History 7*(2), 176-185.
- Greenwald, A. G., & Gillmore, G. M. (1997). Grading leniency is a removable contaminant of student ratings. *American Psychologists, 52*, 1209-1217.
- Groen, J. A., & White, M. J. (2003). In-state versus out-of-state students: the divergence of interest between public universities and state governments. *National Bureau of Economic Research Working Paper Series*, 1-38.
- Groen, J. A., & White, M. J. (2001). *In-state versus out-of-state students: the divergence of interest between public universities and state governments*. University of California, San Diego, and RAND Corporation.
- Hart, L. (1999). *Human brain and human learning*. Washington: Books for Educators, Inc.

- Hartig, T., Mang, M., & Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environment and Behavior*, 23(1), 3-26.
- Hassan, B. N., & Mattson, R. H. (1993). Family income and experience influence community garden success. *Journal of Therapeutic Horticulture* 7, 13-18.
- Haviland-Jones, J. *Flower power turns 40: Research proves what the flower children knew 40 years ago*. Retrieved on November 11, 2005 from <http://www.aboutflowers.com/flowers.com/flowerpower.htm>
- Heerwagen, J. (1990). The psychological aspects of windows and window design. In K. H. Anthony, J. Choi, & B. Orland (Eds.), *Proceedings of 21<sup>st</sup> annual conference of the Environmental Design Research Association* (pp. 269-280). Oklahoma City: EDRA.
- Hockey, R. (ed., 1983). *Stress and Fatigue in Human Performance*. New York: John Wiley.
- Honeyman, M. (1987). *Vegetation and stress: a comparison study of varying amounts of vegetation in countryside and urban scenes*. Unpublished Master's Thesis. Department of Landscape Architecture, Kansas State University, Manhattan, Kansas.
- Hongxun, Y. (1982). *The Classical Gardens of China*. Translated by W.H. Min. New York: Van Nostrand Reinhold.
- Hull, R. B., & Harvey, A. (1989). Explaining the emotion people experience in suburban parks. *Environment and Behavior*, 21, 323-345.
- Hull, R. B., & Revell, G. R. B. (1989). Cross-cultural comparison of landscape scenic beauty evaluations: A case study in Bali. *Journal of Environmental Psychology*, 9, 177-191.
- Isen, A. M. (1985). The asymmetry of happiness and sadness in effects on memory in normal college students. *Journal of Experimental Psychology: General*, 114, 388-391.
- Isen, A. M. (1990). The influence of positive and negative affect on cognitive organization: Some implications for development. In N.L. Stein, B. Leventhal, & T. Trabasso (Eds.). *Psychological and Biological Approaches to Emotion* (pp. 75-94). Hillsdale, N.J.: Lawrence Erlbaum Associates, Inc.
- Jessee, P., Strickland, M.P., Leeper, J.D., & Hudson, C. J. (1987). The effect of nature-based experiences on children's adjustment to the hospital: a comparative study. *Hosp Top.*, 66(4), 37-41.

- Jung, I., Choi, S., Lim, C., & Leem, J. (2002). Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction. *Routledge, part of the Taylor & Francis Group*, 39(2), 153-162.
- Kaplan, R. (1973). Some psychological benefits of gardening. *Environment and Behavior*, 5, 145-162.
- Kaplan, R. (1983). The role of nature in the urban context. In I. Altman & J. Wohlwill (Eds.), *Behavior and the Natural Environment* (pp. 127-161). New York: Plenum.
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature*. Cambridge University Press, New York: Cambridge, p. 164-174.
- Kaplan, S., & Talbot, J. F. (1983). Psychological benefits of a wilderness experience. In I. Altman & J. F. Wohlwill (Eds.), *Human Behavior and Environment Vol. 6, Behavior and the Natural Environment* (pp. 163-203). New York: Plenum Press.
- Katcher, A., Segal, H., & Beck, A. (1984). Comparison of contemplation and hypnosis for the reduction of anxiety and discomfort during dental surgery. *American Journal of Clinical Hypnosis*, 27, 14-21.
- Kennedy, C. B. (1989). Vegetation in Tucson: Factors influencing residents' perceptions and preferences. Unpublished doctoral dissertation, Department of Geography and Regional Development, University of Arizona, Tucson.
- Kim, E., & Mattson, R. H. (2002). Stress recovery effects of viewing red-flowering geraniums. *Journal of Therapeutic Horticulture*, 13, 4-12.
- Knopf, R. C. (1987). Human behavior, cognition and affect in the natural environment. In D. Stokols & I. Altman (Eds.), *Handbook of Environmental Psychology* (p. 783-825). New York: John Wiley.
- Konoshima, H. (1995). Participation of school children in agricultural activities at school farms in Shiga Prefecture. *Acta Horticulturae*, 391, 217-222.
- Lambe, R. A., & Smardon, R. C. (1986). Commercial highway landscape reclamation: A participatory approach. *Landscape Planning*, 12, 353-385.
- Larocca, M. A. (2003). *Perception of leadership qualities in higher education: Impact of professor gender, professor leader style, situation, and participant gender*. University of South Florida. (UMI No. 3082978)
- Lawson, M. J., & Askill-Williams, H. (2001). *What facilitates learning in my university classes? The students' account*. Annual Conference of the Higher Education Research and Development Society of Australia, University of Newcastle, 2-11.

- Lerle, C. G. (1997). O segredo de um jardineiro. *Reader's Digest Seleccoes*, 77-78.
- Lewis, C. (1978). Comment: Healing in the urban environment. *American Psychological Association Journal*, 7, 330-338.
- Lewis, C. (1996). *Green nature/human nature*. University of Illinois Press, Chicago.
- Lohr, V.I., & Pearson-Mims, C.H. (2000). Physical discomfort may be reduced in the presence of interior plants. *HortTechnology*, 10(1), 53-58.
- Lohr, V. I., Pearson-Mims, C. H., & Goodwin, G. K. (1996). Interior plants may improve worker productivity and reduce stress in a windowless environment. *Journal of Environmental Horticulture*, 14(2), 97-100.
- Migura, M. M., Whittlesey, L. A., & Zajicek, J. M. (1997). Effects of a vocational horticulture program on the self-development of female inmates. *HortTechnology*, 7(3), 299-304.
- Moore, E. O. (1982). A prison environment's effect on health care service demands. *Journal of Environmental Systems*, 11(1), 17-34.
- Morash, M., Haarr, R. N., & Rucker, L. (1994). A comparison of programming for women and men in U.S. prisons in the 1980's. *Crime and Delinquency*, 40(2), 197-221.
- Mullen, G. E. (2003). A model of college instructors' demandingness and responsiveness and effects on students' achievement outcomes. (Doctoral dissertation, Texas Tech University, 2003). Dissertation Abstracts International, 64/06, 1972.
- Nasar, J. L. (1983). Adult viewers' preferences in residential scenes: A study of the relationship of environmental attributes to preference. *Environment and Behavior*, 15, 589-614.
- Nasar, J. L. (1988). *Environmental Aesthetics: Theory, Research, and Applications*. New York: Cambridge University Press.
- Ogorzaly, M. C. (1996). A qualitative study of an innovative program to support children's learning of botanical conceptions. Doctoral dissertation, The University of Texas at Austin, 1996. Dissertation Abstracts International, 57/06, 2423.
- Olmsted, F. L. (1865). Preliminary report upon the Yosemite and Big Tree Grove. Report to the Congress of the State of California. Reprinted in V. P. Ranney, G. J. Rauluk, & C. F. Hoffman (Eds.), *The Papers of Frederick Law Olmsted, vol. V: The California Frontier, 1863-1865*. 1990. Baltimore: Johns Hopkins University Press.

- Osterberg, D. 1993/1986. Fortolkende sosiologi [Interpretative sociology], Oslo, Pax.
- Parsons, R. (1991). The potential influences of environmental perception on human health. *Journal of Environmental Psychology, 11*, 1-23.
- Patel, I. C. (1991). Gardening's socioeconomic impacts: community gardening in an urban setting. *Journal of Extension 29*, 7-8.
- Patrick, H., Turner, J. C., Meyer, D. K., & Midgley, C. (2002). *Teacher practices associated with creating classroom environments and early adolescents' avoidance behaviors*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Pollock-Byrne, J. M. (1990). *Women, prison, and crime*. Brooks/Cole Publishing Company, Pacific Grove.
- Rappaport, J.W. 1994. Benefits Beyond Botany.
- Ribe, R. G. (1989). The aesthetics of forestry: What has empirical preference research taught us? *Environmental Management, 13*, 55-74.
- Robertson, A. S., McInnes, M., Glass, D., Dalton, G., Burge, P. S. (1989). Building sickness: are symptoms related to the office lighting? *The Annals of Occupational Hygiene, 33*(1), 47-59.
- Russell, H., & Uzzell, D. (1999). Green plants for the feel good factor. *Interiorscape Magazine*. Retrieved March 8, 2005 from <http://www.interiorscape.com/rentokil/>
- Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal, 38*(2), 437-60.
- Ryan, T. E. (1984). *Adult female offenders and institutional programs: A state of the art analysis*. Natl. Inst. Correct., Washington D.C.
- Rydeen, J. (2002). A positive environment. *American School and University, 75*(2), 36-39.
- Saroyan, A., & Amundsen, C. (2001). Evaluating university teaching: time to take stock. *Assessment and Evaluation in Higher Education, 26*, 341-353.
- Schroeder, H. W. (1989). Environment, behavior, and design research on urban forests. In E. H. Zube, & G. T. Moore (Eds.), *Advances in Environment, Behavior, and Design Vol. 2* (pp. 87-117). New York: Plenum.
- Schroeder, H. W., & Anderson, L. M. (1984). Perception of personal safety in urban recreation sites. *Journal of Leisure Research, 16*, 177-194.

- Schroeder, H. W., & Cannon, W. N., Jr. (1983). The esthetic contribution of trees to residential streets in Ohio towns. *Journal of Arboriculture*, 9, 237-243.
- Shafer, E. L., & Tooby, M. (1973). Landscape preferences: an international replication. *Journal of Leisure Research*, 5, 60-65.
- Sheets, V. L., & Manzer, C. D. (1991). Affect, cognition, and urban vegetation: some effects of adding trees along city streets. *Environment and Behavior*, 23, 285-304.
- Shepard, P. (1967). *Man in the landscape: A historic view of the esthetics of nature*. Alfred A. Knopf, New York.
- Simon, R. J. (1975). *Women and Crime*. Lexington Books, Lexington, KY.
- Smardon, R. C. (1988). Perception and aesthetics of the urban environment: Review of the role of vegetation. *Landscape and Urban Planning*, 15, 85-106.
- Stoops, J. L. (2001). The physical environment and occupant thermal perceptions in office buildings: An evaluation of sampled data from five European countries. PhD thesis Chalmers University of Technology, Dissertation Abstracts International 62/02, 294.
- Taylor, A. F., Kuo, F. E., & Sullivan, W. C. (2001). Coping with ADD: The surprising connection to green play settings. *Environment and Behavior*, 33(1), 54-77.
- Think, M. K. (2003). *University of San Francisco classroom and office standards and prototypes*. Retrieved April 2, 2005, from [http://www.usfca.edu/planning\\_budget/space\\_planning\\_committee/pdf/standards.pdf](http://www.usfca.edu/planning_budget/space_planning_committee/pdf/standards.pdf)
- Ulrich, R. S. (1977). Visual landscape preference: a model and application. *Man-Environment Systems*, 7, 279-293.
- Ulrich, R. S. (1979). Visual landscapes and psychological well-being. *Landscape Research*, 4(1), 17-23.
- Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. *Environment and Behavior*, 13(5), 523-556.
- Ulrich, R. S. (1983). Aesthetic and affective response to natural environment, In I. Altman and J. F. Wohlwill (Eds). *Human behavior and environment*, vol. 6: *Behavior and the Natural environment* (pp. 85-125). New York: Plenum.
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224, 420-421.

- Ulrich, R. S. (1986a). *Effects of hospital environments on patient well-being* (Research Report 9). Trondheim, Norway: University of Trondheim, Department of Psychiatry and Behavioral Medicine.
- Ulrich, R. S. (1986b). Human responses to vegetation and landscapes. *Landscape and Urban Planning*, 13, 29-44.
- Ulrich, R. S. (1990). The role of trees in human well-being and health. In P. D. Rodbell (Ed.), *Proceedings of the Fourth Urban Forestry Conference* (pp. 25-30). American Forestry Association, Washington, D.C.
- Ulrich, R. S. (1991). Effects of Interior Design on Wellness: Theory and Recent Scientific Research. *Journal of Health Care Interior Design*, 3, 97-109.
- Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. In S. R. Kellert & E. O. Wilson (Eds.), *The Biophilia Hypothesis* (Chapter 3). Washington, DC: Island Press/Shearwater Books.
- Ulrich, R. S., & Addoms, D. L. (1981). Psychological and recreational benefits of a neighborhood park. *Journal of Leisure Research*, 13, 43-65.
- Ulrich, R. S., Dimberg, U., & Driver, B.L. (1991). Psychological indicators of leisure benefits. In B. L. Driver, P. J. Brown, & G.L. Peterson (Eds.), *Benefits of Leisure*. State College, Pa.: Venture.
- Ulrich, R. S., & Lunden, O. (1990). *Effects of nature and abstract pictures on patients recovering from open heart surgery*. Paper presented at the International Congress of Behavioral Medicine, Uppsala, Sweden.
- Ulrich, R. S., & Parsons, R. (1992). Influences of passive experiences with plants on individual well-being and health. In D. Relf (Ed.), *The role of horticulture in human well-being and social development* (pp. 93-105). Portland, OR: Timber Press.
- Ulrich, R. S., & Simons, R. F. (1986). Recovery from stress during exposure to everyday outdoor environments. In J. Wineman, R. Barnes, & C. Zimrig (Eds.), *The costs of not knowing: proceedings of the seventeenth annual conference of the environmental design research association*. Washington, D.C: Environmental Design Research Association.
- Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M.A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology* 11, 201-230.
- Verderber, S. (1986). Dimensions of person-window transactions in the hospital environment. *Environment and Behavior*, 18, 450-466.

- Vitiello, A. (2001). Specifying interior planting can be subjective. *Plants for People*, Germany. Retrieved on March 8, 2005 from <http://www.plants-for-people.org>
- Waliczek, T. M., Mattson, R. H., & Zajicek, J. M. (1996). Benefits of community gardening on quality-of-life issues. *Journal of Environmental Horticulture*, 14(4), 204-209.
- Wellman, J. D., & Buhyoff, G. J. (1980). Effects of regional familiarity on landscape preferences. *Journal of Environmental Management*, 11, 105-110.
- West, M. J. (1985). *Landscape views and stress response in the prison environment*. Unpublished master's thesis, Department of Landscape Architecture, University of Washington, Seattle.
- Wiers-Jenssen, J., Stensaker, B., & Groggaard, J. B. (2002). Student satisfaction: towards an empirical deconstruction of the concept. *Quality in Higher Education*, 8(2), 183-195.
- Wiley, L. J. (1986). *The effect of teaching style on the development of moral judgment in prison inmates*. Unpublished doctoral dissertation, Texas A&M University, College Station.
- Yi, Y. K. (1992). *Affect and cognition in aesthetic experiences of landscapes*. Unpublished doctoral dissertation, Texas A&M University, College Station.
- Zube, E. H., Brush, R. O., & Fabos, J. G. (Eds.), (1975). *Landscape Assessment: Values, Perceptions, and Resources*. Stroudsburg, Pa.: Dowden, Hutchinson, and Ross.
- Zube, E. H., Pitt, D. G., & Evans, G. W. (1983). *A lifespan developmental study of landscape assessment*. *Journal of Environmental Psychology*, 3, 115-128.

## VITA

Jennifer Sue Doxey was born Jennifer Sue Wakefield in Biddeford, Maine, the daughter of Grace Alice Wakefield and Roland Walter Wakefield. After graduating from Bonny Eagle High School, Buxton, Maine, in 1974, she attended Eastern Nazarene College in Quincy, Massachusetts where she received the degree of Bachelor of Arts in 1980. During the years following she was involved with a variety of educational and teaching experiences including home-schooling of her three children, Portuguese language study in Portugal, and training of nationals in Mozambique. It was during the latter that her concern for and curiosity about agricultural needs in developing nations was spurred, so that in January, 2001 she enrolled in Southwest Texas State University (now Texas State University-San Marcos) as a post-baccalaureate student.

This thesis was typed by Jennifer Sue Doxey.