A STUDY OF THE RELATIONSHIP BETWEEN AN INDIVIDUAL'S HUMAN ENVIRONMENT AND SPATIAL VISUALIZATION SKILLS AND SUCCESS IN THE PROFESSION OF INTERIOR DESIGN AND SPATIAL VISUALIZATION SKILLS

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

Design has been described as the interface in the relationship between man and his environment or as the optimum combination of man with his environment. This definition brings to light the fact that each individual becomes a designer each day as he decides what to do with his time. Design may take place, therefore, simply by neglect as when willful consideration is not given to the day's activities. Good design, however, may be considered to be the use of tools to create better solutions to life and its problems with respect for aesthetics, technology, life, and efficiency (Hanks, Belliston, and Edwards, 1978).

Indeed, design is as old as civilization and the desire to create a pleasant environment. In the twentieth century, however, environments are becoming increasingly artificial and almost exclusively within the control of those who design and build them. In light of this, since the setting for human life influences its quality in a powerful way, good design is more important now than ever.

Environmental design can be used as an inclusive term to encompass all who share the responsibility for generating a physical setting in which human life can be healthy and rewarding. Among those with enviromental responsibility, the developing profession of interior design must

be considered. Often viewed as a specialized branch of architecture, the interior design field is devoted to the more specific aesthetic, functional, and psychological questions of the interior, and to the individual character of the spaces.

Relatively new as a serious profession, as distinguished from interior decoration, interior design does not have a strongly established educational tradition or a large amount of scientific research available. Until the late 1940's, there was little formal education offered in the field and the only courses available were basically concerned with interior decoration. The years following World War II brought a sudden demand for well-trained designers and curriculum revisions were begun toward strong professional training.

Training is now available in three-year certificate or diploma programs in professional schools of interior design, and in four-year college or university programs in interior design. The curriculum usually includes principles of design, history of art, freehand and mechanical drawing or architectural drafting, painting, architecture as it relates to interiors, design of furniture and exhibits, study of materials, and knowledge of contemporary and historical furnishings. In addition, courses in business and management are often offered.

In 1971, a Foundation for Interior Design Education and Research (FIDER) was formed by the professional societies along with the Interior Design Educators Council. The purpose of FIDER was to establish and administer a voluntary plan for the special accreditation of interior design programs offered at institutions of higher learning throughout the United States, its possessions, and Canada.

Membership in professional organizations such as the American

Society of Interior Design (ASID) and the Institute of Business Designers (IBD) is now recognized as a mark of achievement in this profession. Membership usually requires work experience and education as well as the completion of a written and design problem examination. The ten-hour National Council for Interior Design Qualifications (NCIDQ) exam covers space allocation and furniture selection and arrangement, as well as lighting and electrical plans, and is required for ASID membership.

In spite of the emerging demands for formal education and examination, it is important to remember that interior design is above all a creative field. This leads interior design educators to the consideration of creativity itself, especially within the educational framework. Creativity has been defined as the ability to find new solutions to a problem or new modes of expression, the bringing into existance of something new to the individual (Edwards, 1979). Therefore, creative people are able to see new relationships in commonplace phenomenon and create new inventions and objects from commonplace materials.

The creative process is one of the most active studies in the field of psychology with research taking varied approaches. For example, there are those who attempt to describe in words the gross features of the creative act as seen from outside the creative person. Others correlate apparent creativity scores with other almost randomly selected characteristics of the individual, his background, or his surroundings (Walkup, 1967). Recognizing the role of the brain in creativity, the left hemisphere of the brain has been proven to be more creative and perceptive and to be dominant in some individuals (Edwards, 1976, 1978; McGee, 1979). A fourth approach has been to isolate and identify the

most important primary factors or aptitude traits in creative behavior of a specific type such as interior design. If correct, this view of creativity suggests many research areas and potential changes in education for interior design.

Taking this approach, hypotheses have been advanced that creative persons appear to have developed the ability to visualize in the area in which they are creative (Karlens, 1969; Walkup, 1967). Furthermore, successful creating seems to depend on the degree to which these mental images can be manipulated and the skills with which the individual can sense the properties of these new combinations of things.

The ability to judge the relationships of objects in space, to judge shapes and sizes, to manipulate them mentally, and to visualize the effects of putting them together or turning them over or around is generally referred to as spatial visualization. Spatial visualization may be seen as a subability of the psychological spatial factor along with spatial orientation. Spatial orientation includes the comprehension of the arrangement of elements within a visual stimulus pattern, the aptitude to remain unconfused by the changing orientation in which the spatial configuration may be presented, and an ability to determine spatial orientation with respect to one's body (McGee, 1979).

With spatial visualization indicated as a component of creativity, interior design educators hoping to foster creativity in their students must look to the influences upon spatial visualization ability such as course work, work experience, cultural exposure, and confidence levels. Questions are brought to mind such as the effect of training or experience on spatial visualization test scores, the correlation of spatial visualization skills, professional achievement in interior design and

therefore, the predictive ability of spatial visualization test scores.

The present study investigates the relationship between an individual's human environment and spatial visualization and between success in the interior design profession and spatial visualization.

Problem Statement

Interior design as an element of environmental design plays an increasingly important role in a society whose environment is largely artificial and thus controlled to a great extent by those who design and build it. Creativity is a major component of a design profession and has been the topic of many studies (Guilford, 1959; Karlins, Schuerhoff, and Kaplan, 1969; Durio, 1975; Walkup, 1967). Spatial visualization has been seen as a factor in creativity (Taylor, 1969; Walkup, 1967). Interior design is an emerging and ever changing discipline as evidenced by Friedmann, Pile, and Wilson (1982). However, this researcher found few studies that investigated the relationship between spatial visualization, an individual's human environment, and interior design professional success.

If indeed there is a relationship between an individual's environment, spatial visualization skill, and success in the interior design profession, it is of definite benefit to the design profession to examine such a relationship so that the educational system can better train and teach an individual to improve their spatial visualization skills.

Purpose

The purpose of this study is to determine if human environment, including training and experience, has an effect on spatial

visualization capabilities and if spatial visualization correlates with success in the interior design profession.

Objectives

1. To determine each individual's demographic background through the use of the OSU Human Environment Questionnaire.

2. To determine each individual's biographic background through the use of the OSU Human Environment Questionnaire.

3. To determine the characteristics of each individual's human environment through the use of the OSU Human Environment Questionnaire.

4. To determine each individual's three-dimensional perceptual level through the Space Relations Test of the Differential Aptitude Test (DAT).

5. To compare the responses of the students in HIDCS 2313 with the responses of the professionals in the Oklahoma ASID chapter to the OSU Human Environment Questionnaire.

6. To compare the scores of the students in HIDCS 2313 with the scores of the professionals in the Oklahoma ASID chapter on the Space Relations Test of the Differential Aptitude Test.

7. To compare the scores of the students in HIDCS 4264 with the scores of the students in HIDCS 2313 on the Space Relations Test of the Differential Aptitude Test.

8. To compare the scores of the students in HIDCS 4264 with the scores of the students in HIDCS 2313 on the OSU Human Environment Questionnaire.

9. To compare the responses of the students in HIDCS 4264 with the responses of the professionals in the Oklahoma ASID chapter to the

OSU Human Environment Questionnaire.

10. To compare the scores of the students in HIDCS 4264 with the scores of the professionals in the Oklahoma ASID chapter on the Space Relations Test of the Differential Aptitude Test.

11. To determine if there is any correlation between an individual's human environment and spatial visualization as indicated by test scores.

12. To determine if there is any correlation between an individual's spatial visualization skill and success in interior design as indicated by test scores and membership in ASID.

Hypotheses

Hypotheses are derived from the objectives and were analyzed in terms of comparing scores of the design students with the scores of the design professionals.

1. There is a significant correlation between the amount of design related coursework which an individual has completed and spatial visualization skill.

2. There is a significant correlation between the amount of design related work experience an individual has completed and spatial visualization skill.

3. There is a significant correlation between the amount of travel experience an individual has completed and spatial visualization skill.

4. There is significant correlation between the urban and rural residence and spatial visualization skill.

5. There is a significant correlation between confidency level

and spatial visualization skill.

6. There is significant correlation between sex and spatial visualization skill.

7. There is a significant correlation between spatial visualization skill and professional success in interior design as evidenced by membership in the American Society of Interior Designers (ASID).

Assumptions

1. That the students in the Housing for Contemporary Living (HIDCS 2313) were not previously exposed to advance design courses.

2. That the professionals were deemed successful by their membership in the American Society of Interior Designers (ASID).

3. That the researcher has developed a valid scale in which to measure the responses to the OSU Human Environment Questionnaire and the Space Relations Test of the Differential Aptitude Test (DAT).

Definition of Terms

Design - for the purpose of this study, design will be defined as the process of finding a solution in a particular set of circumstances (Hanks, Belliston, and Edwards, 1978).

Interior Designer - for the purpose of this study, interior designer will be defined as one who is qualified by education and experience to identify, research, and creatively solve problems relative to the function and quality of man's proximate environment (ASID, 1980).

Successful Interior Design Professional - for the purpose of this study, a successful interior designer will be defined as one who has

been accepted for full professional membership in an organization such as the American Society of Interior Designers, having met membership, experience, and education requirements.

Creativity - for the purpose of this study, creativity will be defined as the ability to find new solutions to problems or new modes of expression; the bringing into existance of something new to the individual (Edwards, 1976).

Spatial Visualization - for the purpose of this study, spatial visualization shall be defined as the ability to mentally rotate, manipulate, and twist two and three dimensional stimulus objects (McGee, 1979).

Human Environment - for the purpose of the study, human environment will be defined according to Sells (1963) as reported by Milieus (1954);

1. background characteristics such as age, sex, and socio-economic status, and skill characteristics such as ability, experience, and training;
2. external reference characteristics, e.g., biologically defined factors such as height, weight, physique, race and physical abnormalities or injuries;
3. factors related to geographic position and/or socio-economic status, such as rural or urban residence, income, occupational classification, amount of savings, number of dependents, and education;
4. family and primary or marriage group factors, such as legal status, status in family, and number of children; and
5. group membership factors, including number of group memberships, types of groups and social status of groups (p. 13).

American Society of Interior Designers - for the purpose of this study, the American Society of Interior Designers (ASID) shall be defined as a professional organization of interior designers formed in 1975 through the consolidation of the American Institute of Designers and the National Society of Interior Designers and having education,

experience, and examination as its membership requirements (Siegel, 1982).

Aptitude - for the purpose of this study, aptitude shall be defined as a natural tendency or talent; readiness in learning (Webster, 1966).

CHAPTER II

REVIEW OF LITERATURE

Introduction

There has been extensive research on various factors that have direct influence on the purpose of the study. Therefore, the following categories have been established for this review in order that the reader can develop an understanding of these factors:

design as a process,

education and professionalism in interior design,

characteristics contributing to interior design success,

spatial visualization as an aspect of creativity,

assessment of spatial visualization, and

influences on spatial visualization skill.

Design as a Process

Design may be considered to be the process of finding a solution in a particular set of circumstances. A good design, then will optimize the situation by finding the very best solution within the given limitations which have been confronted (Hanks, Belliston, and Edwards, 1978).

Hanks goes a step further to see design as the interface in the relationship between man and his environment. It is, therefore, man living in cooperation with, and using correctly and beautifully those things of nature which surround everyone and make this world the place

that it is now. Design is respect for aesthetics, technology, life, and efficiency (Hanks, Belliston, Edwards, 1978).

Bevlin (1970) also looks to nature for the fundamentals of design which include a plan for order, expression of material, laws of growth and order, fulfillment of purpose, and individuality. These characteristics are to be found in any good design, with individuality as the most important of the characteristics for the creative artist since it is his own identity that makes his work unique. Therefore, it is here that the importance of creativity comes into play.

However, design is important not only to the artist as a form of expression, but it is a responsibility of all individuals. Design is unconsciously created simply by the orderly way in which the tasks of everyday life are approached (Bevlin, 1970; Evans and Dumesnil, 1982; Hanks, Belliston, Edwards, 1978).

This design activity of every person is not a casual and simple process. On the highest level, designing is a conscious and knowledgable manipulation of the art elements to produce an expressive statement. It is purposeful creation in which emotion, knowledge, imagination, and intellect are all operative. It involves the cerebral and psychological processes necessary for decision making. If an individual can define his problem and have some awareness of the effect he wishes to achieve, the act of design is facilitated. Design begins when the perceptive person views his world and does not like what he sees (Evans and Dumesnil, 1982).

Therefore, the design process is really a process of creative problem solving (Hanks, Belliston, and Edwards, 1978; Parry, 1982). It is a process of constructive, active, and usually creative behavior. The design problem solving process usually takes the designer through the

following steps which Hanks refers to as energy states.

1. Recognizing the problem.
2. Analyzing the problem.
3. Definition of the problem.
4. Ideation, alternative solutions to the problem.
5. Selection of the best alternative.
6. Implementing the solution.
7. Evaluating to determine the effectiveness of the design.

Within this problem solving framework, expression is achieved through organizing the elements of space, form, line, texture, ornament, and color. Over the centuries designers in putting these elements together have evolved certain principles including balance, rhythm, emphasis, harmony, variety and unity, proportion, and scale (Faulkner and Faulkner, 1975).

Beitler and Lockhart (1969) suggest four approaches to design through which decisions made in the design process are emphasized. The historical approach involves the gain of inspiration from awareness of characteristic historical details, philosophy of expression, and ways of living in previous generations. The designer may gain inspiration from areas of science through the environmental approach. Third, uninhibited experimentation may be conducted with materials, tools, and processes. Finally a designer may examine the methods and ways which that individual works best, be they spontaneous or deliberate. Most designers use a combination of these approaches to direct their problem solving.

Education and Professionalism in Interior Design

Man's desire to create a pleasant environment is probably as old

as our civilization, but interior design as a profession is a relatively new field, especially in the United States. Until not too many years ago, interior design was primarily concerned with the home and every furniture salesman and drapery hanger was a "decorator". During the past two decades the term "decorator" has fallen into disrepute and a new profession has emerged. Profession having been defined as a vocation or occupation requiring advanced training in some liberal art or science, and usually involving mental rather than manual work (Webster, 1966).

Interior designer, then, refers to a professional whose functions and qualifications have been defined as:

> A professional designer is one who is qualified by education and experience to identify, research, and creatively solve problems relative to the function and quality of man's proximate environment.
>
> His competency includes fundamental design, design analysis, space planning and programming, the design of all interior spaces and an understanding of other and related aspects of envionmental design.
>
> His technical development includes knowledge of structure with emphasis on interior construction, knowledge of building systems, equipment, components, and ability in communication skills.
>
> His education and experience have developed an awareness of an analytical understanding of the needs of man which can be fulfilled by the design of his surroundings.
>
> His design sensitivity, creative and conceptual abilities combined with technical proficiency effect a breadth and depth of design solutions that will serve the needs of man today and in the future (ASID, 1980, p. 1).

The term designer, however, was hardly in use at all about five decades ago and did not formally supercede the word decorator until the midfifties. At that time the two leading professional American organizations representing the profession incorporated the term designer as part of their names. The elder, founded in 1931, acknowledged the obsolescence of decorator in 1961 when it changed its name from the American Institute of Decorators to the American Institue of Designers.

The younger organization used the term from the outset, calling itself the National Society of Interior Desingers (NSID) since its founding in 1957. On January 1, 1975, the American Society of Interior Designers (ASID) was formed through the consolidation of these two organizations and it is now the largest organization representing professional interior designers. Another emerging organization is the Institute of Business Designers (IBD) dedicated solely to the professional designer whose major field is commercial and institutional interiors (Siegel, 1982).

To strengthen the profession and to ascertain that the public is served competently is one of the goals of the professional societies. Both the IBD and ASID, together with several other groups including the Canadian society have formed the National Council for Interior Design Qualifications. At this time, every professional society whose members are interior designers makes it mandatory for new members to pass the examination given by NCIDQ. In most cases candidates are required to have completed a four year interior design program or its equivalent and have two years of professional experience in the field (Friedman, Pile, and Wilson, 1982).

Until the late 1940's there was little formal education offered in the field and the only courses available were basically concerned with interior decoration. The years following World War II saw a sudden demand for well-trained designers and a number of leading schools started serious curriculum revisions towards strongly professional training in interior design (Friedman, Pile, and Wilson, 1982).

The Interior Design Educators Council, Inc. (IDEC) was founded in 1962 and is dedicated to the development and improvement of interior

design education and the professional level of interior design practice. IDEC's program concentrates on the establishment and strengthening of lines of communication among educators, educational institutions, and organizations concerned with interior design (Stolper, 1983).

A study conducted by IDEC in 1968 revealed that programs leading to a baccalaureate degree with a major in interior design existed in 70 schools. The report also revealed that many semiprofessional schools exist and that a number of universities offer some interior design courses without a complete professional education. The IDEC curriculum study contained a strong recommendation for a program of accreditation of schools, as well as accrediting procedure for individuals who wish to join one of the major professional societies. The Foundation for Interior Design Education Research (FIDER) was formed with the professional societies together with IDEC in 1971 for the purpose of establishing and administering a voluntary plan for the special accreditation of interior design education offered at institutions of higher learning in the United States, its possessions, and Canada (Friedman, Pile, and Wilson, 1982).

The establishment of standards of criteria by which to judge interior design education programs is a very difficult task, requiring expertise in the field, perserverance, and the ability to mediate the many different points of view to be found in an individualistic and creative field such as this one. These standards are developed and written with considerable input from educators and professionals. The programs accredited by FIDER, according to Rogers, Brent, Veitch, and Hill (1983) are:

1. Graduate programs of interior design.
2. Baccalaureate degree programs of no less than three years duration.
3. Certification or diploma programs of no less than three years duration.
4. Certificate or Associate Degree programs of at least two years duration with emphasis on either pre-professional or technical training for interior design aides (p. 33).

According to Rogers (1983), standards have been developed for each program type and are important yardsticks for the evaluation and measure of each program's curriculum, instruction, administration, and impact. The standards and accreditation process insure that the information in the school's bulletin is accurate.

The curricula of accredited schools are evaluated in relation to the percentages of the curricula devoted to the specific FIDER educational categories of:

1. Basic and Creative Arts
2. Interior Design
3. Technical Knowledge
4. History of Art and Design
5. Liberal Arts, Sciences, and Humanities

The Rogers study found that the three year school with a concentration on the communication skills and technical courses, devotes a higher percentage of its program to the traditional design content areas than did the four year schools. Both in percentages of time in the program and in actual semester hours, the four year schools show strength in the liberal arts category. For the most part, the two year schools resemble the three year schools, emphasizing the design and technical courses and deemphasizing the liberal arts courses. The two year schools spend more semester hours in field training or internships

than in any of the other categories. The one five year architectural school in the sample devoted its additional year to traditional design courses rather than to liberal arts courses. The completed study shows strong and individualistic programs, clearly influenced by the disciplines in which they are based (Rogers, Brent, Veitch, and Hill, 1983).

The existence of these programs, (FIDER, IDEC, ASID, and IBD) is evidence of the mounting strength of the profession of interior design. A profession which must be taken seriously because its application affects objects and structures, the people who use them, and the environment as a whole (Faulkner and Faulkner, 1975). Indeed, viewing interior space as no more than a field for decoration in styles generated to forward commercial ends is to disavow the human need to work and live in spaces that derive from more serious intentions (Friedmann, Piles, and Wilson, 1982).

Characteristics Contributing to Interior Design Success

In order to evaluate a person's vocational prospects, two types of information about the individual are needed: the psychological facts which describe aptitudes, skills, interests, and personality traits and the social facts which describe the environment in which the person lives, the influences which are affecting the individual, and the resources which the individual has available (Super and Crites, 1949). While research has been done to show interests common to interior designers, no standard testing battery is available for such evaluation concerning interior design.

Therefore, if persons with different abilities enter different

professions, (Eisenberg and McGinty, 1977) who then is this interior designer, what factors or characteristics lead to the successful achievement of professionalism in the emerging field of interior design?

Considering interior design as an integral aspect of architecture (Friedmann, Pile, and Wilson, 1982), one might first consider interior design to be, as architecture must be, the overlapping of artistic and scientific creativity. If designs are to give delight, the architect must be an artist; if their designs are technologically sound and efficiently planned, they must be something of a scientist as well as a businessman, lawyer, advertiser, author, psychiatrist, educator, and psychologist (Mackinnon, 1962). The architect is seen as a creative person (Mackinnon; 1962, 1965).

Eisenberg and McGinty found architects as well as engineers to require the ability to visualize and reason in three dimensions. They found that technically oriented individuals view their environment differently than nontechnically oriented individuals.

Artistic talent is also crucial for interior designers. People in the field need strong color sense, an eye for detail, a sense of balance and proportion, and an ability to think in three dimensions. Because styles and tastes in art and fashion change quickly, people in this field need to be versatile and alert to new ideas and trends. A successful designer must also be well organized and good at handling details. Ability to work well with people is very important, for the designer must be able to deal effectively with clients, suppliers, and craft workers such as carpenters, electricians, and plumbers (Chronicle Guidance, 1980).

Like any true profession, a combination of talent, desire, and business acumen is required to be successful. The successful designer

in addition to taste and knowledge, must possess physical endurance, mental ability, and flexibility to cope with a diversity to work, and also deal tactfully with clients with varying degrees of education, income, and background (ASID, 1980). Interior designers must have patience and perseverance, since they will have setbacks (Chronicle Guidance, 1979).

Tulsa Junior College's Career Exploration course varifies this as its computer printout describes interior design as a profession having pressure, competition, job insecurity, and a hectic lifestyle. This course presents interior designers as subject to frustration, involved with extensive paperwork and travel, and required to adjust their work to the tastes and the needs of their clients. More than the average amount of variety, independence, and prestige is available to the interior designer according to the TJC source.

These three characteristics of the profession may, therefore, lead us to look at the individual professional. Variety is the opposite of routine, predictability, or repetition. If one values variety highly, he probably likes novelty and surprises and enjoys facing new problems, events, places, and people. If people respect an individual, look up to him, listen to his opinion, or seek his help in community affairs, he is said to have prestige. Independence as an occupational characteristic is seen as the freedom to make decisions and work without supervision or direction from others (TJC, 1981).

Campbell found the characteristics of creative people to be mental agility, convergent thinking, divergent thinking, conceptual flexibility, originality, preference for complexity over simplicity, stimulating backgrounds, multiple skills, capacity for hard work, independent

judgement, resilience, good communication, interest in concepts, intellectually curious, playful, spontaneous, and avoiding early self-criticism of ideas.

Therefore, since parallels may be drawn between qualities of the profession and the characteristics of creative people, one might conclude that one of the most vital characteristics for success in interior design is creativity.

Spatial Visualization As An Aspect of Creativity in Design

In the last twenty years, the study of creativity has become one of the most active in the field of psychology but little research has been directed toward creativity in the interior design profession. Efforts to explain creative behavior by means of a single concept have been thwarted by inconsistent and conflicting experimental finding (Kalins, Schuerhoffm, and Kaplan, 1969).

Perhaps it was this pattern of results which led J. P. Guilford and his associates toward the factor analytic approach to creativity (Guilford, 1959). To these researchers, there are many traits of creativity with some creative attributes contributing more directly to creative performance than others. Strength in some abilities and weakness in others, therefore, leads to specialization in specific areas of creative performance. Karlins, Schuerhoff, and Kaplan (1969) sought to determine the nature of the relationship of certain aptitude and non-aptitude traits and abilities to a specific type of creative behavior: architectural behavior. They found that rated architectural crativity as assessed by professors familiar with the architectural work of

graduating seniors in architecture did not correlate with standard measures of academic aptitude and achievement but was related to the quality of the students' independent design projects and to their performances on a spatial factor test.

Little research is available investigating the relationship between spatial visualization and creativity, but Durio (1975) finds spatial abilities to be a factor in creativity. Durio used spatial relations tests as an indication of imagery ability which she in turn presents as a factor in creativity. Imagery being defined as internal figural representations involved in all decoding, encoding, and cognitive construction processes of figural or spatial content.

McGee (1979) also suggests that visualization is fundamental to imagery. Again with spatial visualization being defined as the ability to mentally rotate, manipulate, and twist two and three dimensional objects.

Goodman and Marquart (1978) stated that few studies investigate the relationship between creativity and perceptual processes. They appear to be intrinsically related, however.

The missing ingredient in the study of creativity according to Walkup (1967) is visualizing. He found that creative individuals appear to have a high degree of perfection concerning an unusual ability to visualize mentally in the areas in which they are creative. Successful creating seems to depend on the degree to which these mental images can be manipulated and the skill with which the individual can sense the properties of these new configurations and combinations of things. While Walkup's interest was primarily with scientific creativity, he went further to suggest application in architecture and other fields where

physical things are involved. He suggested further research (such as that undertaken here) concerning effective education in visualization.

Hanks, Belliston, and Edwards (1978) suggest that the Einstein story should lead educators to include lessons in visual thinking. Albert Einstein believed that thought consisted primarily of images and rarely of words, at least in his own case. They also support visual thinking as practice in better problem solving.

In addition, Taylor suggests that the application of functional visualization can result in creative solutions to broadly defined problems. Functional visualization is to be thought of as a system by which a series of evolving pictures is translated into a complete design (Taylor, 1969).

The tendency to produce unusual visual perspective was also investigated by Torrance (1972) as a predictor of creative achievement. He found that creative people are able to see new relationships in commonplace phenomenon. Mackinnon (1962, 1965) selected architects to represent such creative people.

Assessment of Spatial Visualization

The ability to judge the relations of objects in space, to judge shapes and sizes, to manipulate them mentally, and to visualize the effects of putting them together or of turning them over or around is generally referred to as spatial visualization. It is an aptitude which has been long considered important in such clearly similar activities as machine-shop work, carpentry, and mechanical drawing, in which the worker must judge shape and size and translate two dimensional drawings into three dimensional objects. Spatial visualization has also been

considered likely to be important in certain other occupations, the principle activities of which are not quite so clearly similar, such as engineering and art.

Work in the measurement of spatial judgement began as one aspect of the measurement of intelligence rather than as an attempt to measure a special ability of significance to certain occupations. It resulted in the measurement of a trait which is related to mental ability in childhood but relatively independent of it in adulthood. Spatial judgement develops at approximately the same rate as other mental abilities and therefore provides a fair measure of mental age in childhood, but being a special aptitude the degree of spatial judgement posed in adolescence or adulthood is not a good indicator of any other mental ability possessed by the individual (Super and Crites, 1962).

McGee (1979) supports the existence of two distinct spatial abilities, spatial visualization and spatial orientation. Spatial visualization is reported as the ability to mentally rotate, minipulate, and twist two and three dimensional objects. Spatial orientation ability includes the comprehension of the arrangements of elements within a visual stimulus pattern, the aptitude to remain unconfused by the changing orientations in which a spatial configuration may be presented, and an ability to determine spatial orientation with respect to one's own body.

Spatial visualization may be assessed through the use of specialized tests such as the Minnesota Spatial Relations Test, the Crawford Spatial Relations Test, and the O'Conner Wiggly Block Test. In addition to these special tests, spatial subtests of composite tests or test batteries such as the Blocks Tests of the MacQuarrie Test of Mechanical Ability,

the Surface Development Test of the Chicago Tests of Primary Mental Abilities, and the Space Relations Test of the Psychological Corporation's Differential Aptitude Tests may be used (Super and Crites, 1962).

The Space Relations Test of the Differential Aptitude Tests represents a combination of two previous approaches to the measurement of this ability. The ability to visualize a constructed object from a picture of a pattern has been used frequently in tests of structural visualization. Similarly, the ability to imagine how an object would appear if rotated in various ways has been used effectively in the measurement of space perception. The item type used combines the functions of these previous type items, since both factors are considered important in any useful definition of ability to think in spatial terms (Bennett, Seashore, and Wesman, 1959).

Bennett, Seashore, and Wesman (1959) explain that manipulation of objects in three dimensional space is used since there are relatively few occasions when perception of two dimensional space alone is important. The Space Relations Test is a measure of ability to deal with concrete materials through visualization. There are many vocations in which one is required to imagine how an object would appear if rotated a given way. This ability to manipulate things mentally, to create a structure in one's mind from a plan, is what the test is designed to evaluate. It is an ability needed in such fields as drafting, dress designing, architecture, art, dye-making, and decoration, or wherever there is a need to visualize objects in three dimensions.

Engen, Lamb, and Prediger (1982) found that the DAT is one of the four most popular standardized tests being used in secondary schools. The use of tests to predict success in school is a widely accepted

practice and McGee (1978) states that the practical use of visualization and orientation abilities is proven to have social significance. Four job categories are cited as those requiring spatial visualization ability at high levels; engineering, science, drafting, and designing.

Correlations with academic coursework have also been drawn. Sherman (1967) found spatial visualization scores to be predictive of geometry grades. Wormack (1979) found that spatial visualization had the largest effect in the relationship between physics achievement and test performance. Battista, Wheatley, and Talsma (1982) also found spatial visualization to correlate with achievement in geometry.

Influences On Spatial Visualiation Skill

Three types of spatial representation - spatial products, spatial thought, and spatial storage - are identified by Liben (1981), with spatial visualization falling under the category of spatial thought. Liben finds spatial representation as a whole to be influenced by characteristics of the individual, characteristics of the physical environment, and cultural and individual history.

Characteristics of Individuals

The characteristics of individuals relevant to spatial behavior and representation according to Liben (1981) may be grouped into three major categories: physical, cognitive, and socioemotional. Within the physical dimension, the most striking differences are those associated with age. The different physical characteristics of infants, children, adults, and the elderly necessarily affect activities in space and representation of space. Relevant physical characteristics also vary within chronological ages.

In the domain of cognitive characteristics, it is again possible to identify qualities that differ both across and within portions of the life span such as qualitative changes in logical thought processes and the storage of relevant knowledge (Liben, 1981). Goldberg and Meredith (1975) however, support the hypotheses that spatial ability can be measured in children that is the same spatial ability measured in adults, and that an individual's spatial ability remains relatively unchanged over time.

Finally, socioemotional factors play an important role. For example, individual's self-concepts about their spatial abilities may also be presumed to affect their performance on space related tasks, be they standardized tests of spatial aptitude, performance in geometry classes, map reading, or way finding (Liben, 1981). Lunneborg (1982) suggests differential participation in sports as a critical social influence affecting not only punative spatial performance but even within gender self-assessments of commonplace activities using spatial ability.

Characteristics of the Physical Environment

There are many aspects of the physical environment - its differentation, its organization, its contents - that may affect spatial activity and representation. The development of reliable, detailed, comprehensive scales to record these characteristics would facilitate the study of links between the physical environment and individual's spatial activities and representation (Liben, 1981). Majoribanks (1982) found that the environmental measure counted for more of the variance than did social status indicators or family structure variables but that the relationship with the environment was less definite with spatial

ability than other mental abilities. Orsini, Schrappa, and Grossi (1982) found those with urban environments to perform better on spatial skills than those with rural environments.

Cultural and Individual History

The culture has certain norms with respect to what are appropriate behaviors, values, and activities. These cultural values affect the social experiences as well as the physical environment (Liben, 1981). Potter (1982) found variations in spatial cognition to be the result of socially indiced differences in mobility, income, and space preference levels as he examined high and low status households.

Harris (1981) cites numerous examples of male superiority in spatial ability with the sex difference becoming more apparent as the children grow older. Harris finds experience to be a contributing factor but not sufficient to explain the differences totally since hormonal and neurological factors must also be considered. These considerations suggest that if there are sex differences in style or strategy of spatial analysis, their roots lie in early infancy and childhood. Whereas the girl's early lead in language development would dispose her to one intellectual path, perhaps the boy's different sensitivities would take him in a different direction. While girls are becoming increasing skillful in expressive language skills, boys are still focused on things and on spatial-perceptual activities. Having spent more time in early childhood on the analysis of the spatial features of their environments, perhaps boys continue along the spatial course even though they eventually equal females in most, if not all, aspects of language skill.

McGee (1979) reports that clinical and experimental neurological literature suggests conclusively that the right hemisphere is specialized for spatial processing and that males have greater right hemisphere specialization than females. According to McGee, further research is needed to determine the casual relationship between sex differences in hemisphere specialization and sex differences in spatial abilities. McGee states, as Harris (1981) has, that sex differences do not reliably appear until puberty, but goes on to suggest that spatial abilities are influenced almost as much by genetic factors as is verbal ability. The development of sex differences in spatial skills is likely according to McGee to be related to sex differences in the development of hemisphere specialization. McGee cites that until more direct methods of hormonal assay are employed on larger samples, the precise nature of the relationship between spatial abilities and hormonal balance will remain an open question.

In studies by Wattanawaha, Nongnuch, and Clements (1982), hypotheses that males tend to outperform females on questions requiring three dimensional thinking or mental manipulation were confirmed. These researchers found that the manner in which an answer has to be presented is also important. Sex differences were also supported in studies by Orsini, Schiappa, and Grossi (1982) where males performed better than females. Burnett, Lane, and Dratt (1979) support sex differences in spatial visualization ability and suggest that sex differences in spatial visualization ability might account for the sex differences in mathematical ability.

Effectiveness of educational development through normal curriculum offerings has also been questioned in spatial visualization. While

certain components of perceptual organization may be influenced by genetic endowment as previously noted, other factors in visual perception can be influenced by learning. In the absence of guidance, deficiencies in function of the complex process of spatial visualization suggest that girls can at least hold their own when provided with opportunity to learn about a particular area in which they are assumed to have less ability. Brinkmann (1966) also believes that functional skills can be improved.

Sherman (1967) explored sources of differential practice, activities involved in fostering spatial skills, finding very few girls in high school classes of mechanical drawing, analytical geometry, and shop. Spare time activities of tinkering with the car, sports, model building, driving the car, direction finding, and map reading are also sex typed and were cited as possible sources of differential practice.

McGee (1978) found performance gains due in part to the training session in addition to repetition, however, he recognized many unknowns involved in assuming what is relevant activity in increasing spatial abilities because it is difficult to know whether sexes received differential practice.

While high scores on the spatial visualization test may indicate an aptitude for engineering study, low scores do not necessarily indicate a lack of aptitude according to Blade and Watson (1955). Such scores may mean only a lack of related experience such as engineering drawing and descriptive geometry. Blade and Watson recommend more use of solid models, construction, and manipulation to increase scores.

Using the Purdue Spatial Visualization Test at the beginning and end of a course in geometry for preservice elementary teachers, Battista,

Wheatly, and Talsma (1982) found spatial visualization skills and achievements to correlate highly, with spatial visualization skills being improved significantly. Increased experience also produced less concrete and more abstract imagery with three dimensional models of the environment in a study by Foley and Cohen (1982).

Learning to see and overcoming our preconceived notions is the key to increasing perceptual skills according to Edwards (1979). Edwards believes that by learning to draw, a person is forced to train the eye to "see" and "perceive" objects as they truly are. Thus, abilities which often remain untapped in a predominantly verbal and analytical culture are utilized. By recognizing that every object that we see or perceive is not identical, we can train our eyes to see objects in detail and as they truly are. This can improve our perceptual skills by eliminating any pre-conceived notions or obstacles that will interfere with perceiving correctly (Edwards, 1979).

Summary Statement

Design may be seen as a problem solving process, the finding of a solution in a particular set of circumstances. In an increasingly artificial society, among those with environmental responsibility, interior design plays an important role in the life of every individual and is emerging as an influential profession. Professional societies, qualification testing, and academic training have been developed and are growing in prominence and significance as they support the interior design profession.

Success in the profession may be attributed to numerous attributes among which creativity may be found. Creativity traits may then be

considered including the ability to mentally rotate, manipulate, and twist two and three dimensional objects, known as spatial visualization.

Spatial visualization may be assessed through testing and is considered to be one of two distinct spatial abilities, the other being spatial orientation. Spatial visualization may be influenced by characteristics of the individual, characteristics of the physical environment, and cultural and individual history.

Thus, design, the interior design profession, and spatial visualization have been investigated. However, the researcher concludes that further study in the relationship of spatial visualization and creativity is needed and may well be applied to the creative field of interior design.

CHAPTER III

METHODOLOGY

The purpose of this chapter is to identify the methodological and statistical procedures used in this study. This chapter will discuss the research design of the study and will specifically address the sampling procedures, instrumentation, data gathering processes, and statistical analysis procedures.

Research Method

The research method considered to be appropriate for this study was descriptive research, since it is an attempt to describe and interpret relationships that exist between non-controllable variables (Best, 1981). According to Best, descriptive research can be defined as

> ...non-experimental, for they deal with the relationships between non-manipulated variables in natural rather than artificial settings. Since the events or conditions have already occured or exist, the researcher selects the relevant variables for analysis of their relationships (p. 106).

Populations and Sampling Procedures

Incoming Students: This population included all officially admitted Oklahoma State University students in the Department of Housing, Interior Design, and Consumer Studies who were enrolled in HIDCS 2313, Housing for Contemporary Living, for the Fall, 1983 semester. The sample of incoming interior design students was selected through purposive sampling.

Purposive sampling is a non-probability sampling method, that allows the researcher to select a sample that meets certain standards or criteria necessary for the validity of the study (Babbie, 1979).

The sample of incoming interior design students was selected based on the purpose of the study. Because of the limited number of members of the incoming interior design student population, the sample consisted of the entire population. The students enrolled in Housing for Contemporary Living (HIDCS 2313), were beginning design students, and previous design experience was very limited. Therefore, the majority of the students were on the same basic level of design competency. In other words, very few, if any, students would have had the advantage of having advanced design training or previously been administered the tests used in this study (instrumentation is discussed later in this chapter). These characteristics of limited design experience and no previous exposure to the instruments, were important so that each subject's human environment was being measured as the variable and not any advanced training in design or familiarity with testing procedures which may influence spatial visualization skill.

Senior interior design students: This population included all officially admitted, Oklahoma State University students, in the Department of Housing, Interior Design, and Consumer Studies, enrolled in HIDSC 4264, Studio II, for the Fall, 1983 semester. The sample of senior interior design students was selected through purposive sampling based in the purpose of the study. Because of the limited number of members of the senior interior design student population, the sample consisted of the entire population. The students enrolled in Studio II (HIDSC 4264) were senior interior design students, and had had previous interior

design experience both through coursework and internship work experience. Therefore, the majority of the students were on the same basic level of design competency.

Professional Interior Designers: The professional membership of the Oklahoma Chapter of the American Society of Interior Designers was also selected as a population. Its membership is composed of professional interior designers who have met membership standards concerning education, work experience, and examination or the equivalent thereof. The membership was used as the population of professional interior designers in this study since it is a professional organization representing the entire scope of the interior design profession.

Instrumentation

In order to test the hypotheses of the research and to achieve the purpose of the study, valid and reliable instrumentation must be utilized. For the purpose of this study, one questionnaire and one instrument were used.

The questionnaire selected was an adaptation of the Oklahoma State Biographical/Demographical Questionnaire by Louis Steinbrink Harris (1981). The purpose of this questionnaire (see Appendix A) was to gather information about an individual's human environment. Questions were designed specifically to gather information on age, education, travel experience, work experience, skill characteristics, and residency.

Testing each subject for spatial visualization skill was accomplished through the use of the Space Relations Test, Form T, of the Differential Aptitude Test by Bennett, Seashore, and Wesman (1959). This test measures the subject's ability to perceive three dimensional patterns

as the correct three dimensional solid. This test consisted of 60 multiple choice questions which tested spatial perception. The scoring procedures consisted of subtracting the amount of errors from the 60 possible points. For example, if a student missed ten questions, the score was then recorded as 50.

Method of Data Collection

The Human Environment Questionnaire and the Space Relations Test were administered to the subjects in the two student populations during the regularly scheduled class times during the Fall Semester of 1983. The professional population completed the questionnaire and the Space Relations Test during the fall meeting of the Oklahoma ASID Chapter in Tulsa, Oklahoma. The population was completed through the use of an individual mailing.

The questionnaire was distributed to each subject after this researcher verbally explained the purpose of the questionnaire and that no identity was associated with the questionnaire. The subjects were allowed to take as much time as needed to complete the questionnaire, however, most subjects completed the information in 15 to 20 minutes.

The Space Relations Test was a 25 minute, timed examination. This researcher verbally explained the purpose of this test and the instructions (including examples), before the actual testing began. After the 25 minutes expired, the tests were collected.

Data Transformation

Questionnaire data were converted into numerical codes representing each variable. This codebook became a document describing the location

and code assignments for each variable. All data for students and professionals were coded on Fortran coding transfer sheets. The transfer sheets were used for the direct key-punching of computer data cards after all data were verified by the researcher. The process of verifying punched data was a means of clearing and eliminating possible coding errors. This was accomplished through the placement of spaces at key locations between coded variables. This allowed for the checking of variable and column location.

Data Analysis

Four major statistical techniques were used to test the hypotheses of the study. These analytical procedures which included Analysis of Variance (ANOVA), Chi-Square Correlations, the Duncan Test, and T-Test were computed by the Statistical Analysis at the Computer Center of Oklahoma State University.

The data were analyzed in three separate groups, i.e., the incoming interior design students, the senior interior design students, and the professional interior designers. This was done so that comparisons could be made. Specific statistics were derived from the data by comparing variables from data collected from the Human Environment Questionnaire and the scores from the Space Relations Test. These comparisons were tested by the Chi-Square, T-Test, and Analysis of Variance statistical procedures. The alpha level of .05 was used as the level of significance. The Duncan Test was used to indicate where the significant differences occurred between the groups of subjects.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this chapter is to describe the findings of the data analyses. The findings of the research have been organized according to the hypotheses presented in Chapter I.

Sample Description

Fifty incoming interior design students (HIDCS 2313) participated in the study. Thirty-seven senior interior design students (HIDCS 4264) participated in the study. Fourteen professional interior designers (ASID) participated in the study. Further description of the sample is given in relation to the appropriate hypothesis.

Analyses by Research Hypotheses

As stated in Chapter III (p. 33 and p. 34), purposive sampling was utilized to meet the specific purpose of the study and the analysis of data tested the hypotheses in terms of comparing the space relations scores and environmental background information of the incoming interior design students, the senior interior design students, and the professional interior designers. Because of the sampling procedures and method of data analysis, it should be recognized that this study investigates trends between a subject's human environment and spatial visualization skill.

One of the assumptions of the use of Chi-Square Correlations is that the expected cell frequency does not equal zero. The statistical results of the study sometimes violated that assumption. Therefore, the results of the Chi-Square Coefficient should be used with caution (Loether and McTavish, 1974). The Duncan Test assumes equal cell sizes which do not always occur in this study. Therefore, the results of the Duncan Test should be used with caution.

Hypothesis 1

There is a significant correlation between the amount of design related coursework which an individual has completed and spatial visualization skill.

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. With the use of analysis of variance, subjects completing four types of courses as listed on question 7 of the questionnaire, were determined to have statistically significant differences in mean scores on the Space Relations Test. Technical drawing, psychology, sculpture, and design related coursework were included in this group. Groups having completed courses in art, free hand drawing, painting, architecture, industrial art, and mechanical operations did not have significant differences in mean scores according to analysis of variance.

The Duncan Test was conducted to determine where the significant differences occurred. The significant difference in mean score among students having completed technical drawing courses occurred between those who had no technical drawing coursework and those who had completed high school and/or undergraduate courses as illustrated in

Table I and Figure 1. There is a significant correlation between the amount of design related coursework which an individual has completed and spatial visualization skill. The significant difference in mean scores among students having completed design courses occurred between those who had completed no design related coursework and those who had completed higher levels of design related coursework.

Chi-Square Coefficients were determined by comparing each course level completed by a subject with the test score on the Space Relations Test. Art, technical drawing, free hand drawing, and design coursework have significant Chi-Square Coefficients at, or below the critical value of .05 level of significance. However, since over 20% of the cells have expected counts of less than 5 the table is so sparse that Chi-Square results must be used with caution.

Mean test scores are illustrated in Table I and Figure 1 for each type of coursework considered. Based on the results of the statistical analyses, the null hypothesis is rejected. There is a significant correlation between the amount of design related coursework which an individual has completed and spatial visualization skill.

Hypothesis 2

There is a significant correlation between the amount of design related work experience an individual has completed and spatial visualization skill.

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. With the T-Test, subjects having design work experience were determined to have statistically significant differences in mean scores on the Space Relations Test.

TABLE I

MEAN SPATIAL VISUALIZATION TEST SCORES BY COURSEWORK CATEGORIES
* P<.05

COURSEWORK	CATEGORIES						
	0 NONE	1 HIGH SCHOOL	2 JR COLLEGE/ UNDERGRADUATE	3 HIGH SCHOOL & JR COLLEGE/ UNDERGRADUATE	4 GRADUATE	5 HIGH SCHOOL & GRADUATE	6 GRADUATE & UNDERGRADUATE
ART	36.412	43.200	44.176	45.567			
*TECHNICAL DRAWING	38.205	46.471	47.025				
FREEHAND DRAWING	40.375	44.071	46.190	52.500			
PAINTING	41.574	42.679	50.125	51.333			
*SCULPTURE	42.207	40.000	54.000	59.000			
ARCHITECTURE	41.059	47.000	47.043		55.000		
*PSYCHOLOGY	36.176	36.765	46.270	47.333		55.000	
*DESIGN	33.182	37.000	46.627	40.118		55.000	46.000
INDUSTRIAL ARTS	42.706	44.364	46.800				
MECHANICAL OPERATIONS	42.185	54.200	50.000				

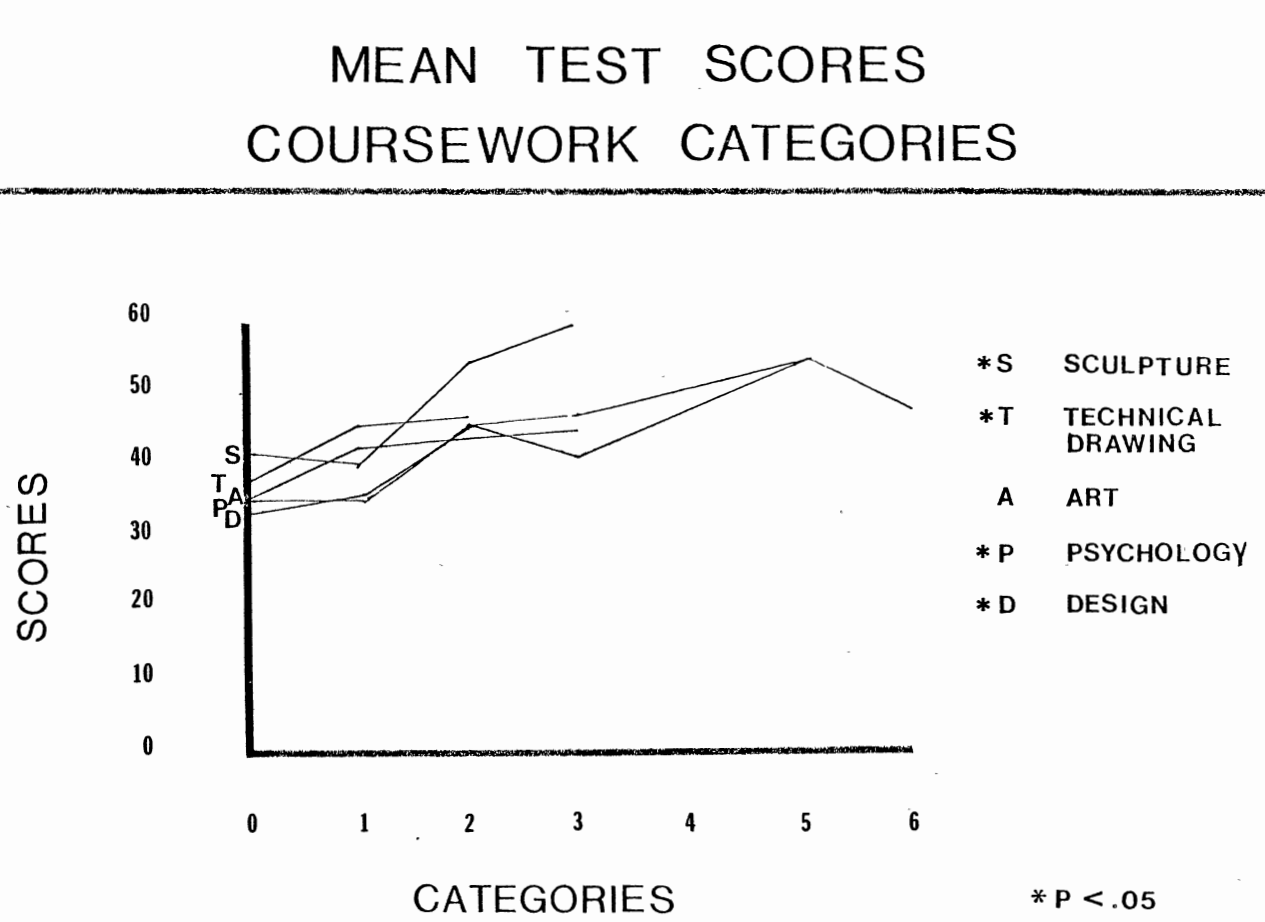

Figure 1. Mean Spatial Visualization Test Scores by Coursework Categories

Art, technical drawing, architecture, construction, psychology, and industrial arts work experience did not have statistically significant differences in mean scores on the Space Relations Test.

Chi-Square Coefficients were determined by comparing each type of work experience as listed on question 8 of the questionnaire with the test score on the Space Relations Test. Table II shows mean spatial visualization test scores for art, architecture, technical drawing, and design work experience which have significant Chi-Square Coefficients at or below the critical value of .05 level of significance. However, since in come cases, over 20% of the cells have expected counts of less than 5 the tables may be so sparse that the Chi-Square must be used with caution.

After considering statistical results, the null hypothesis is rejected. There is significant correlation between the amount of design related work experience an individual has completed and spatial visualization skill.

Hypothesis 3

There is significant correlation between the amount of travel experience an individual has completed and spatial visualization skill.

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. Question 12 of the questionnaire addressed the amount of travel according to the number of states in which each subject had spent two or more weeks. With the use of Analysis of Variance, no significant differences in mean scores on the Space Relations Test occurred based on such responses. The Duncan Test, however, indicated an apparent relationship between those

TABLE II

MEAN SPATIAL VISUALIZATION TEST SCORES BY WORK EXPERIENCE CATEGORIES
* <.05

WORK EXPERIENCE CATEGORY	WITHOUT WORK EXPERIENCE	WITH WORK EXPERIENCE
ART	42.12048193	47.55555556
ARCHITECTURE	42.87777778	44.81818182
TECHNICAL DRAWING	42.350	45.90476190
CONSTRUCTION	42.68965517	45.57142857
PSYCHOLOGY	43.23469388	38.33333333
*DESIGN	38.96226415	47.64583333
INDUSTRIAL ARTS	43.08	44.00

individuals traveling in more than 20 states and increased mean scores as opposed to those traveling in less than 10 states and lower scores. Since cell sizes were not equal, the Duncan Test should be used with caution since equal cell sizes were assumed for such testing.

Question 13 of the questionnaire addressed the number of countries in which a subject has spent two or more weeks. With the Analysis of Variance, no significant difference in mean spatial visualization scores occurred based on such responses.

Tables III and IV illustrate mean test scores and travel categories. Therefore, the null hypotheses is supported. There is not significant correlation between the amount of travel experience an individual has completed and spatial visualization skill.

TABLE III

MEAN SPATIAL VISUALIZATION TEST SCORES BY STATES TRAVELED

	CATEGORIES					
	0 0	2 1-3	2 4-6	3 7-10	4 11-20	5 >21
MEAN SCORE	47.538	43.294	41.385	36.000	52.250	51.500

Hypothesis 4

There is a significant correlation between urban and rural residence and spatial visualization skill.

TABLE IV

MEAN SPATIAL VISUALIZATION TEST SCORES
BY COUNTRIES TRAVELED

	CATEGORIES			
	0	1	2	3
MEAN SCORE	41.894	43.442		43.333

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. Question 15 of the questionnaire addressed the setting in which each subject's professional life had been spent. The use of the T-Test revealed no significant differences in mean test scores on the Space Relations Test between those having urban and those having rural professional settings.

Question 16 of the questionnare addressed the urban or rural residency of each subject's parents or guardians. The use of the T-Test revealed no significant difference in mean spatial visualization scores between those with urban residency and those with rural residency. The Chi-Square supported these findings although since over 20% of the cells have expected counts of less than 5, the table is so sparse that the Chi-Square results must be considered with caution.

Question 9 of the questionnaire considered whether the subjects have spent the majority of their lives in rural or urban settings. The use of the Chi-Square revealed no significant difference in mean spatial

visualization test scores between those with urban and those with rural residence. Since over 20% of the cells have expected counts of less than 5, the table is so sparse that the Chi-Square results must be considered with caution.

Question 14 of the questionnaire considered the subjects' residency before the age of 18 but Chi-Square Correlation did not indicate a significant difference. Since 20% of the cells have expected counts of <5, the table is so sparse that Chi-Square results must be considered with caution.

Tables V and VI illustrate the relationships of residence and mean spatial visualization test scores. After consideration of statistical findings, the null hypothesis is supported. There is not a significant correlation between urban and rural residence and spatial visualization skill.

TABLE V

MEAN SPATIAL VISUALIZATION TEST SCORES BY URBAN/RURAL RESIDENCE

	URBAN	RURAL
Father's Life Residence	42.36619718	45.7500
Mother's Life Residence	43.16923077	44.31428571
Professional Life Residence	44.87037037	37.16666667

TABLE VI

MEAN SPATIAL VISUALIZATION TEST SCORE BY TOTAL OKLAHOMA RESIDENCE

	OKLAHOMA RESIDENCE TOTALLY	OTHER RESIDENCE
MEAN SCORE	41.18918919	44.42857143

Hypothesis 5

There is a significant correlation between confidency level and spatial visualization skill.

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. Responses to questions 22 and 23 of the questionnaire were considered for statistical analysis. With the use of Analysis of Variance, significant difference in spatial visualization test scores occurred between subjects with varying levels of confidence in art. The Duncan Test was conducted to determine where the significant difference occurred. The significant difference in mean spatial visualization scores were found to occur between the mean scores of those who indicated a high level of confidence and those who indicated a lower level of confidence. However, since cell sizes were not equal, the Duncan Test must be considered with caution. The Chi-Square analysis supported these results but also must be considered with caution since

over 10% of the cells have expected counts of less than 5 and the table is sparse.

With the Analysis of Variance, significant difference in spatial visualization test scores occurred between subjects with varying levels of confidence in design. The Duncan Test was conducted to determine where the significance differences occurred. The significant difference in mean spatial visualization test scores was found to occur between the mean spatial visualization test scores of those who indicated a high level of confidence and those who indicated a lower level of confidence. However, since cell sizes were not equal, the Duncan Test results must be considered with caution. The Chi-Square analysis supported these results but also must be considered with caution since over 20% of the cells have expected counts of less than 5 and the table is sparse.

No significant difference in mean spatial visualization test scores occurred between subjects with varying levels of confidence in mathematics, English, working with people, working with things, typing, music, physical science, puzzle solving, and athletics. Analysis of Variance, the Duncan Test, and Chi-Square Analysis were used for statistical analysis.

Table VII and Figure 2 illustrate the relationship between mean spatial visualization test scores and confidence levels. The null hypothesis is rejected on the basis of these findings. There is a significant correlation between confidency level and spatial visualization skill.

Hypothesis 6

There is a significant correlation between sex and spatial visualization skill.

TABLE VII

MEAN SPATIAL VISUALIZATION TEST SCORES BY CONFIDENCE LEVELS
*Significant Difference Occurs

AREA OF CONFIDENCE	1 Not At All Confident	2 Not Very Confident	3 Confident	4 Somewhat Confident	5 Very Confident
Mathematics	48.400	41.259	41.806	42.421	48.231
*Art/Drawing Design	27.500	37.143	39.800	44.543	48.800
English/Writing	42.667	39.933	40.679	44.286	48.444
Working with People		44.000	43.643	42.138	43.833
Working with Things	48.000	40.000	40.250	43.821	44.073
Working with Numbers	50.286	40.188	39.182	46.296	46.875
Typing	47.700	42.591	42.226	42.750	43.250
Playing Musical Instrument	43.657	41.150	44.286	43.722	42.500
*Drawing/Designing	26.000	36.000	40.680	41.861	49.406
Physical Science	41.545	42.258	45.971	40.619	49.000
Working with Jigsaw Puzzle	39.833	39.714	42.667	46.000	42.600
Athletics (Sports)	40.375	45.722	42.742	43.000	43.500

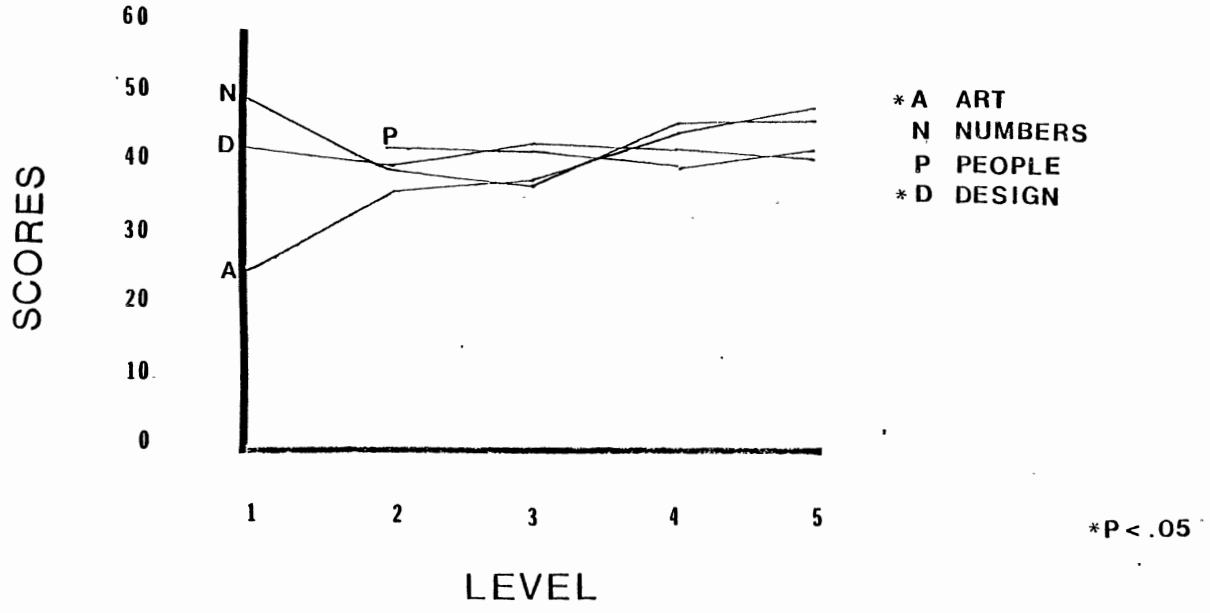

Figure 2. Mean Spatial Visualization Test Scores by Confidence Levels

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. With the T-Test, no significant difference in spatial visualization test scores occurred between the sexes. Chi-Square results supported these findings.

Table VIII illustrates the relationship between mean spatial visualization test scores and sex. The null hypothesis, therefore, is supported. There is not a significant correlation between sex and spatial visualization skill.

TABLE VIII

MEAN SPATIAL VISUALIZATION TEST SCORES BY SEX

	MALE	FEMALE
MEAN SCORE	43.18181818	43.06329114

Hypothesis 7

There is a significant correlation between spatial visualization skill and professional success in interior design as evidenced by membership in the American Society of Interior Designers (ASID).

The null hypothesis was assumed for statistical testing and the predetermined level of significance was .05. With the use of Analysis of Variance, significant difference in mean spatial visualization test scores was found to occur between test groups. The Duncan Test revealed that the difference occurred between the incoming students and the professionals as well as between the incoming students and the senior students. No significant difference occurred between the seniors and the professionals. The Duncan Test assumes equal cell sizes which did not occur and must, therefore, be considered with caution.

Figure 3 illustrates the relationship between test groups and mean spatial visualization test scores. On the basis of these findings, the null hypothesis is supported. There is not a significant correlation between spatial visualization skill and professional success as evidenced by membership in the American Society of Interior Designers.

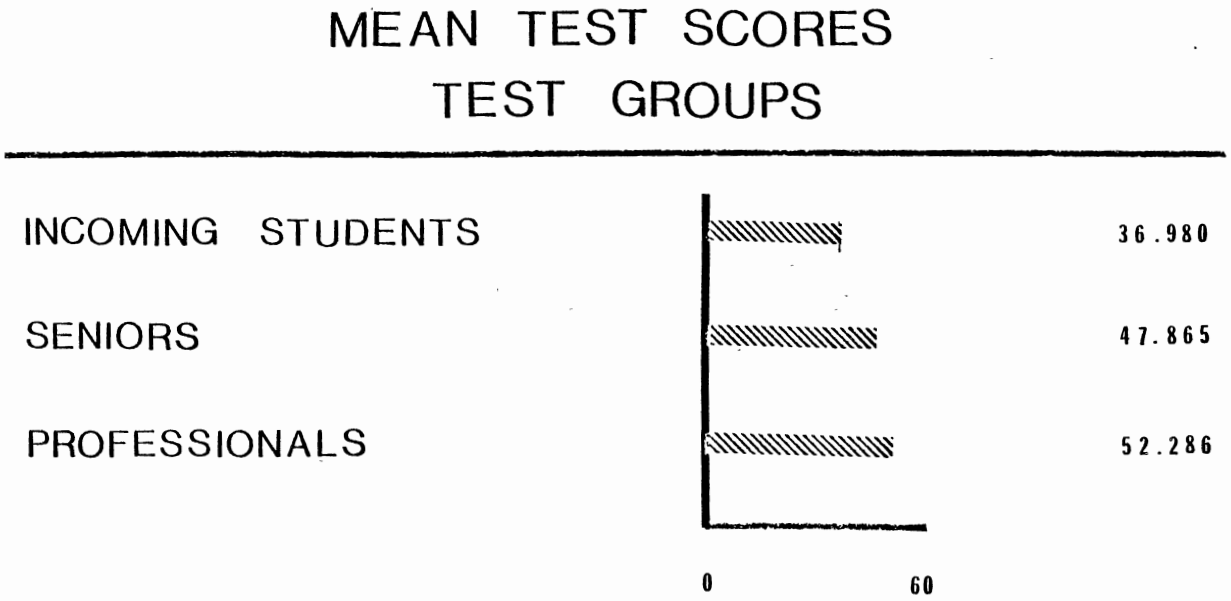

Figure 3. Mean Spatial Visualization Test Scores by Test Groups

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Interior design as an element of the environment is largely artificial and thus controlled to a great extent by those who design and build it. Creativity is a major component of a design profession and has been the topic of many studies (Guilford, 1959; Karlins, Schuerhoff, and Kaplan, 1969; Durio, 1975; Walkup, 1967). Interior design is an emerging and ever changing discipline as evidenced by Friedmann, Pile, and Wilson (1982). However, this researcher found few studies that investigate the relationship between spatial visualization, an individual's human environment, and interior design professional success.

Summary

With spatial visualization indicated as a component of creativity, interior design educators hoping to foster creativity in their students must look to the influences upon spatial visualization ability. The major purpose of this study was to determine if human environment, including training and experience, has an effect on spatial visualization capabilities and if spatial visualization skill correlates with success in the interior design profession.

The following objectives were derived from the purpose of the study:

1. To determine each individual's demographic background through

the use of the OSU Human Environment Questionnaire.

2. To determine each individual's biographic background through the use of OSU Human Environment Questionnaire.

3. To determine the characteristics of each individual's human environment through the use of the OSU Human Environment Questionnaire.

4. To determine each individual's three-dimensional perceptual level through the Space Relations Test of the Differential Aptitude Test (DAT).

5. To compare the responses of the students in HIDCS 2313 with the responses of the professionals in the Oklahoma ASID chapter to the OSU Human Environment Questionnaire.

6. To compare the scores of the students in HIDCS 2313 with the scores of the professionals in the Oklahoma ASID chapter on the Space Relations Test of the Differential Aptitude Test.

7. To compare the scores of the students in HIDCS 4264 with the scores of the students in HIDCS 2313 on the Space Relations Test of the Differential Aptitude Test.

8. To compare the scores of the students in HIDCS 4264 with the scores of the students in HIDCS 2313 on the OSU Human Environment Questionnaire.

9. To compare the responses of the students in HIDCS 4264 with the responses of the professionals in the Oklahoma ASID chapter to the OSU Human Environment Questionnaire.

10. To compare the scores of the students in HIDCS 4264 with the scores of the professionals in the Oklahoma ASID chapter on the Space Relations Test of the Differential Aptitude Test.

11. To determine if there is any correlation between an individual's human environment and spatial visualization as indicated by test scores.

12. To determine if there is any correlation between an individual's spatial visualization skill and success in interior design as indicated by test scores and membership in ASID.

In order to fulfill the purpose of the study, the following hypotheses were tested:

1. There is a significant correlation between the amount of design related coursework which an individual has completed and spatial visualization skill.

2. There is a significant correlation between the amount of design related work experience an individual has completed and spatial visualization skill.

3. There is a significant correlation between the amount of travel experience an individual has completed and spatial visualization skill.

4. There is a significant correlation between the urban and rural residence and spatial visualization skill.

5. There is a significant correlation between confidency level and spatial visualization skill.

6. There is a significant correlation between sex and spatial visualization skill.

7. There is a significant correlation between spatial visualization skill and professional success in interior design as evidenced by membership in the American Society of Interior Designers (ASID).

Data were collected during the Fall semester of 1983 from 50 students enrolled in Housing for Contemporary Living (HIDCS 2313), 37 students enrolled in Studio II (HIDCS 4264), and 14 professional

members of the Oklahoma Chapter of the American Society of Interior Designers. The instruments used to collect data consisted of the Oklahoma State University Human Environment Questionnaire adapted from Harris (1981) and the Space Relations Test of the Differential Aptitude Test (DAT) developed by Bennett, Seashore, and Wesman (1955).

Findings

Major statistics employed were Analyses of Variance, T-Test, Duncan Test, and Chi-Square Correlations. Significant correlations were considered between the background information supplied by the questionnaire and test scores from the DAT. The amount of design related coursework, the types of design related work experience, the amount of travel experience, urban versus rural residency, confidency level, sex, and professional success (as indicated by ASID membership were considered.

Analysis of Variance indicated a significant difference in mean test scores between those subjects having had technical drawing, sculpture, psychology, or design coursework and mean spatial visualization test scores. Art, freehand drawing, painting, architecture, industrial arts, and mechanical operations did not produce significant differences in spatial visualization scores on the DAT. Duncan Tests supported these findings as did the Chi-Square Correlations which also showed tendencies where those having had art and freehand drawing coursework had higher mean scores. The significant difference found in the area of psychology was not, however, supported by the Duncan Test.

T-Test results indicated that design work experience correlated with higher scores on the spatial visualization test while art, architecture,

technical drawing, construction, psychology, and industrial arts did not. The Chi-Square Correlations supported these findings. There was not a significant difference in spatial visualization mean scores among those subjects having had varied amounts of travel experience as evidenced by the Analysis of Variance.

The T-Test and Chi-Square procedures did not indicate significant difference in test scores of those having experienced urban or rural professional settings, urban or rural parental residence, life-long Oklahoma residence, or urban or rural residence before the age of 18. These findings were supported by the Chi-Square Correlations.

There was a significant difference in test scores among those having varied levels of confidence in art or design and drawing as evidenced by the Analysis of Variance and supported by the Duncan Test and Chi-Square Correlations. Levels of confidence in mathematics, English/writing, working with people, working with things, typing, playing a musical instrument, physical science, working a jigsaw puzzle, and atheletics (sports) did not indicate significant differences in test scores.

According to T-Test and Chi-Square Correlations, sex did not indicate a significant difference in test scores.

Analysis of Variance results indicate that a significant difference in mean spatial visualization test scores occurred between test groups. Results indicate that the significant difference in mean scores does not lie between the professional group and the students as a whole. Instead, the significant difference occurs between the professionals and seniors as a group and the incoming students, with the incoming students having lower scores. T-Test and Chi-Square Correlations supported the Analysis of Variance and Duncan Test results.

Limitations

In order to explain the entire scope of this research, the limitations of the study must be discussed. The limitations are as follows:

1. Due to the size of the population studied, the proportions of the test groups were not equal. Therefore, the results of the study may be significantly affected.

2. The samples used for the purpose of this research did not consist of equal proportions of males to females. This researcher recognizes that previous studies reveal that perceptual skill varies according to the sex of the individual. It should be considered that the results of the study may have been affected by the size of the population studied and its unequal proportion of males to females.

3. Since in numerous cases over 20% of the cells had expected counts of less than 5 and the tables were sparse, the Chi-Square results must be used with caution.

4. Since the Duncan Test assumes equal cell sizes and these did not always occur in this study, the results of this test must be considered with caution.

5. Due to the limited sample size of 50 incoming interior design students, 37 senior interior design students, and 14 interior design professionals, results of this study cannot be generalized to an entire population.

6. Previous exposure to the Space Relations Test of the Differential Aptitude Test may have influenced the senior interior design students test scores.

Conclusions

Based on the analyses of the data for this study, and considering the limitations and methodological procedures, the following conclusions can be made:

1. Research indicates that coursework taken, particularly in technical drawing and design; work experience, particularly in design; and confidence levels, particularly in art and design, significantly influence spatial visualization skill as evidenced by DAT scores.

2. Research indicates that travel both within the United States and in foreign countries did not influence spatial visualization skill as evidenced by DAT scores, nor did residence, sex, or professional success as evidenced by ASID membership.

Discussion

Results suggest that there is not as great a difference in senior students' and professional interior designers' skills in spatial visualization as anticipated. The results of this research would suggest that design related education, including internships, plays an important role in the development of spatial visualization skills as does the confidence level of the students involved in that educational process. Therefore, interior design education may be seen to contribute to the creativity of its students and those hoping to foster creativity must look at ways to develop spatial visualization skills.

Coursework content and structure as well as the internship programs need to be carefully examined in order to insure that the maximum amounts of knowledge as well as self-confidence are attained by interior design students. Continuing professional education may also be a significant

aspect in improving the spatial visualization skill of those undertaking further training.

The selection and thorough training of interior design educators also becomes a factor to be considered since they may be seen to be of influence upon the skills of their students.

Recommendations

The following recommendations are made for further research based on the results of this study:

1. In order to increase the validity of the research, this study should be repeated using a larger sample size, especially within the professional population.

2. A longitudinal study that would continue to evaluate the same test groups would aid researchers in establishing the pattern of environmental influence upon spatial visualization skill.

3. Further research should be conducted utilizing an equal proportion of males to females to ascertain if previous correlations of higher test scores among males do indeed exist.

4. Further research should investigate the development of teaching techniques and course content that will aid in the establishment of a curriculum designed to develop spatial visualization skills and therefore creativity.

5. Further research should investigate the content of the particular courses considered in each category of the questionnaire used for this type of study.

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APPENDIXES

OKLAHOMA STATE UNIVERSITY HUMAN ENVIRONMENT QUESTIONNAIRE

The purpose of the following questionnaire is to provide the researcher with background information from each participant in the study. There is no correlation between this questionnaire and a course grade for those respondants currently enrolled at Oklahoma State University. The questionnaire is not a test, there is no a right or wrong answer. Please, answer the questions as honestly as possible. Identity is not imperative to this questionnaire, therefore, your name is not necessary.

1. In which testing session are you participating?

_____ HIDCS 2313
_____ HIDCS 4264
_____ Tulsa ASID

2. What is your educational status?

_____ Freshman (0-29 hours)
_____ Sophomore (30-44 hours)
_____ Junior (45-74 hours)
_____ Senior (75 or more hours)
_____ Graduate Student
_____ Professional with undergraduate degree in design
_____ Professional with graduate degree in design
_____ Other

3. What is/was your major?

_____ Interior Design
_____ Architecture
_____ Art
_____ Clothing, Textiles, Merchandising
_____ Food Nutrition and Institutional Administration
_____ Family Relations and Child Development
_____ Housing
_____ Consumer Resources
_____ Home Economics Education
_____ Other (please specify) _____

4. Do/did you have a Minor? _____ Yes _____ No

If yes, what is/was your minor? _____

5. If currently enrolled at Oklahoma State University, how likely is it that you will continue your education in your current major?

1	2	3	4	5
Not likely		Undecided		Very likely

6. What is your Age (check one)?

_____ 17	_____ 20	_____ 22-30
_____ 18	_____ 21	_____ 31-40
_____ 19	_____ 22	_____ Over 40

7. Please indicate if you have had any of the following courses and at what level. Check the appropriate space.

COURSE			LEVEL						
	Yes	No	School	Summer Program	Vo-Tech	Junior College	Under-Graduate	Graduate	Other Please Specify
Art									
Technical Drawing									
Freehand Drawing									
Painting									
Sculpture									
Architecture									
Psychology									
Design									
Industrial Arts									
Mechanical Operations									
Other (Specify)									

8. Please indicate if you have had any work experience in the following areas:

_____ Art	_____ Psychology
_____ Architecture	_____ Design
_____ Technical Drawing	_____ Industrial Arts
_____ Construction	_____ Other (please specify)

9. Have you lived in Oklahoma all of your life? _____Yes _____No

10. If no, what other states and countries have you lived in? _____

_____

_____

How long of time did you live in each of the state/countries you have listed above:

_____ _____ _____ 0-3 months
_____ _____ _____ 4-7 months
_____ _____ _____ 8-12 months
_____ _____ _____ 1-2 years
_____ _____ _____ More than two years

11. What is your native language? _____

12. List the States (spent two weeks or more in that particular state) which you have traveled?

_____

_____

13. List the Countries (spent two weeks or more in that particular country) in which you have traveled?

_____

_____

14. In what setting did you spend the majority of your life before the age of 18?

_____ Urban
_____ Rural
Comment _____

15. In what setting has your professional life been spent?

_____

16. Where have your parent or guardians lived most of their lives?

FATHER	MOTHER
_____	_____ Urban Area
_____	_____ Rural Area

17. What is the occupation of your Father (Guardian)? _____
What is the occupation of your Mother (Guardian)? _____

18. What are the highest levels of education of your parents or guardians that they have completed?

FATHER	MOTHER	
_____	_____	1-8 Grade
_____	_____	9-12 Grade
_____	_____	12+ Some College or Vo-Tech School
_____	_____	College Graduate
_____	_____	Advanced Degree

19. Where do you currently reside?

_____ Stillwater
_____ Tulsa
_____ Oklahoma City
_____ Other (please specify) _____

20. How often do you go to art museums? (or galleries)

_____ Every month or more
_____ Every 2-4 months
_____ Every 5-6 months
_____ Every 7-12 months
_____ Every year
_____ Every 1-2 years
_____ Every 2 years or more

21. What are your favorite leisure activities? _____

_____

22. One the chart below, please indicate by circling a response on a scale of 5 (very confident) to 1 (not at all confident) where you feel your ability is.

	Very Confident	Somewhat Confident	Confident	Not Very Confident	Not at All Confident
A. Mathematics	5	4	3	2	1
B. Art, Drawing/Designing	5	4	3	2	1
C. English/Writing	5	4	3	2	1
D. Working with People	5	4	3	2	1
E. Working with Things	5	4	3	2	1
F. Working with Numbers	5	4	3	2	1

23. Please indicate by circling a response of your level of ability on a scale of 5 (Very Confident) to 1 (Not at All Confident) where you feel your ability is.

	Very Confident	Somewhat Confident	Confident	Not Very Confident	Not at All Confident
A. Typing	5	4	3	2	1
B. Playing Musical Instrument	5	4	3	2	1
C. Drawing/Designing	5	4	3	2	1
D. Physical Sciences	5	4	3	2	1
E. Working with Jigsaw Puzzles	5	4	3	2	1
F. Athletics (Sports)	5	4	3	2	1

24. Have you previously taken the Space Relations Test that you have just completed?

_____ Yes

_____ No

The above questionnaire was an adaptation from Lou Harris's Study "A Study of the Analytical Spatial Perception Ability of Selected Students in Art, Architecture, Landscape Architecture, and Interior Design," Master Thesis, Oklahoma State University, May 1981.

VITA

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Thesis: A STUDY OF THE RELATIONSHIP BETWEEN AN INDIVIDUAL'S HUMAN ENVIRONMENT AND SPATIAL VISUALIZATION SKILLS AND SUCCESS IN THE PROFESSION OF INTERIOR DESIGN AND SPATIAL VISUALIZATION SKILLS

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