

RELATIONSHIP BETWEEN APTITUDES AND ATTITUDES
TOWARD COMPUTER-AIDED DESIGN AND PERSONALITY
TYPES OF INTERIOR DESIGN STUDENTS

by

Youngsook Lim

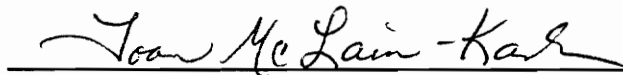
Thesis Submitted to the Faculty
of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirement
for the degree of

MASTER OF SCIENCE

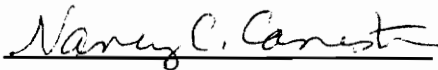
in

Housing, Interior Design, and Resource Management

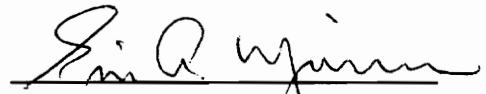
APPROVED:



Joan H. McLain-Kark, Chairperson



Nancy C. Canestaro



Eric A. Wiedegreen

July, 1991

Blacksburg, Virginia

c.2

LD
5655
V855
1991
L554
c.2

RELATIONSHIP BETWEEN APTITUDES AND ATTITUDES
TOWARD COMPUTER-AIDED DESIGN AND PERSONALITY
TYPES OF INTERIOR DESIGN STUDENTS

by

Youngsook Lim

Chairperson: Dr. Joan McLain-Kark
Housing, Interior Design and Resource Management

(ABSTRACT)

This study examined the relationship between attitudes and aptitudes toward Computer-aided design (CAD) and personality types among interior design students. Twenty-eight junior and 28 senior interior design students at Virginia Polytechnic Institute and State University comprised the population of this study. Information was mainly obtained from the survey questionnaire and Keirseley Temperament Sorter which were administered during the last week of the spring semester 1991.

The collected data was analyzed by descriptive statistics. The frequency distribution and mean scores were used to describe the characteristics of the sample population, attitudes and aptitudes toward CAD, and personality types.

Correlation coefficients were used to examine the hypotheses of this study that a significant relationship exists between students' attitudes and aptitudes toward CAD and personality types.

Results of this study revealed that students seem to have higher preference for Extravert, Intuition, Feeling, and Judging types rather than Introvert, Sensing, Thinking, and Perceiving. This finding suggests that most students in the classes tended to

perceive things by intuition, relied more on empathy and sensitivity in making judgment, and made systematic, orderly judgements about the world. It was found that the students who had stronger attitudes toward CAD usefulness tended to be the Feeling type rather than Thinking. It was also discovered that there was a correlation between the Judging type and higher CAD proficiency grades. While only an isolated case, this study revealed a significant difference between the CAD instructor and students in personality types.

ACKNOWLEDGEMENTS

The author wishes to express sincere appreciation to the following committee members:

* Dr. Joan McLain-Kark, committee chairperson, for her serious commitment and contribution to computer applications in interior design, and for her constructive assistance and support throughout this study.

* Dr. Nancy Canestaro, for her strong belief in interior design education and for her special care and assistance during the research process.

* Mr. Eric Wiedegreen, for his interest in computer-aided design and for his friendly attention and recommendations during this study.

The author would also like to thank the following people:

* Stephanie Clemons, assistant professor at Colorado State University, who provided the initial idea of exploring personality types and CAD education.

* Sungsue Rheem, for his assistance in statistical analysis.

My deepest appreciation is devoted to my parents, brothers, and sister who have been supporters during the graduate study, for their endless encouragement, love, and most of all their belief in me.

TABLE OF CONTENTS

Chapter	Page
ABSTRACT	
ACKNOWLEDGEMENTS-----	iv
TABLE OF CONTENTS-----	v
LIST OF FIGURES-----	vii
LIST OF TABLES-----	viii
I. INTRODUCTION-----	1
Purpose of the Study-----	2
Objectives-----	3
Importance of the Study-----	3
II. REVIEW OF THE LITERATURE-----	5
Computer-Aided Design-----	5
Learning/Computing Styles-----	8
CAD Instructional Strategies-----	11
Personality/Adaptation-----	14
Split-Brain Theory/Design Process/CAD Instruction-----	17
Myers-Briggs Type Indicator/ Keirsey Temperament Sorter-----	22
Myers-Briggs Type Indicator/Computer-assisted Instruction(CAI)-----	26
III. METHODOLOGY-----	28
Conceptual Framework-----	28
Hypotheses-----	29
Operational Definitions-----	31
Sampling Procedures-----	32
Data Collection-----	32
Data Analysis-----	35
Limitations-----	37
IV. RESULTS-----	38
Characteristics of Sample Population-----	38
Previous Experience with Computers and CAD-----	39
Attitudes toward CAD among Interior Design Students---	42
Aptitudes toward CAD among Interior Design Students---	45
Students' Opinion on their Skill of CAD and CAD Proficiency grade-----	47
Students' Opinion on their Skill of CAD and CAD Preference-----	47
CAD Proficiency Grade and Overall Course Grade---	47
Personality Types-----	48
Attitudes toward CAD and Personality Types-----	50
Aptitudes toward CAD and Personality Types-----	52

TABLE OF CONTENTS

(Continued)

V.	SUMMARY AND DISCUSSION-----	55
	Major Findings-----	58
	Implications-----	59
	Recommendations for Educators and Software Developers-----	61
	Recommendations for Further Study-----	62
	REFERENCES-----	64
	APPENDICES	
	Appendix A-----	68
	Appendix B-----	72
	VITA-----	78

LIST OF FIGURES

Figure		Page
1	The dual processing model-----	19
2	Model of personality types and CAD attitude/apptitude-----	30

LIST OF TABLES

Table		Page
1	Previous experience with computers-----	40
2	Previous experience with CAD-----	40
3	Types of computers most frequently used-----	41
4	Frequency distribution of the attitudes toward CAD-----	43
5	Correlation coefficients of students' opinion on their skill of CAD, CAD preference, and CAD proficiency grade-----	46
6	Correlation coefficients of CAD proficiency grade and course grade-----	46
7	Frequency distribution of personality types-----	49
8	Correlation coefficients of CAD attitudes and personality-----	51
9	Correlation coefficients of CAD aptitudes and personality-----	53

CHAPTER ONE

INTRODUCTION

Computer technology has rapidly advanced during the past twenty years in all areas of our society. The increasing reliance on computers has been accelerated furthermore since the introduction of microcomputers and its application dominated in industry and economy, and in management.

This trend has created the demand for computer applications in interior design. One of the common uses of the computer in the interior design field today is computer-aided design (CAD) (Clemons & McCullough, 1989), and its development flourished into its peak era since 1980's. Thus, the application of computers to education has become essential.

A study of Jenkins and Dankert (1981) stated that the acceptance of computers in the educational media is positive in general. However, a vendor study (Source: Datatech Inc.) suggests that some professionals become more proficient than others. The results indicate that "40% of people trained on a CAD system develop into top-notch expert operations with superior speed and skills. The same percentage of operators become "good," with adequate skill for performing a wide range of operations at a satisfactory speed. Of the remaining 20%, half apparently lack the aptitude to become more than marginal operators, while the rest fail to use the CAD system minimally" (Krouse, 1983, p. 80). What factors might have caused these varying levels of skills?

CAD systems have sequential and word-oriented processes. Most CAD systems use word rather than visual symbols to enter drawing commands (McLain-Kark & Rawls, 1988). Do these characteristics of CAD systems have any relationship with different aptitude levels that affect learning?

Snow (1980) states that "individual characteristics not under control of the student will determine, to a significant extent, what and how much that individual will learn in a given instructional setting" (p. 152). When applying various educational media, students' preferences for receiving and processing information from their environment may differ in their learning performances (Kern & Matta, 1988). If this is true, a student's personality may also have an influence on their ability to apply CAD instruction. Moreover, if certain personality types affect the student's aptitude and success in employing CAD, how can CAD education or manufacturers of CAD packages devise equally flexible systems which can make CAD adoption much easier? These questions comprise the focus of this study.

Purpose of the Study

The purpose of this study is to investigate if there is a relationship among personality differences and interior design students' aptitude and attitudinal levels in utilizing CAD systems.

Objectives

The following objectives have been formulated in order to accomplish the purpose of this study.

(1) To determine if there is any significant relationship between personality type and performance level in learning CAD systems.

(2) To determine if there is any significant relationship between personality type and attitudes toward CAD.

Importance of the Study

The increasing supplies of computer hardware and software to interior designers gave more options to computerize design projects. Loebelson (1988) reports in 1988 survey that 84% of the top 100 interior design firms are using CAD and this number is expected to be continuously increased. Thus, CAD training seems inevitable during a design students' education.

Every person has his own preference in perceiving information. Considering the fact from previous studies that people perform significantly different levels in adapting to CAD systems, the identification of such factors that cause these different learning levels would benefit educators incorporating CAD into their curricula. Manufacturers of CAD packages and software programmers could also foresee their user preferences in developing new marketing strategies.

Moreover, investigation of a possible link between personality types and attainment of CAD skills in design field

may help provide guidance as to the appropriate provision of alternative teaching methods in CAD education and anticipate ultimate success in the field.

CHAPTER TWO

REVIEW OF THE LITERATURE

Chapter two first begins with a general discussion of computer-aided design focusing on the emergence of this technology and attitudes of designers. A clear understanding of the characteristics and the specific learning skills required to operate computer-aided design will be helpful to proceed with the purpose of this study. Then, learning and cognitive styles on their relationship to computers are described. The third section discusses the instructional strategies of CAD. Next, a definition of personality and psychological adaptation, and their effect on computer-assisted instruction are explored. Section five includes the split-brain theory and the contributions of both hemisphere to the design process. Myers-Briggs Type Indicator (MBTI) and the Keirsey Temperament Sorter is introduced in section six and discussion of Computer-assisted instruction based on MBTI follows. Finally, a brief analysis of this chapter is presented.

Computer-Aided Design

In 1988, Crosely stated that "computers today are changing the ways we draw and the ways we use information. These tools have the potential to make the labor of architecture more productive, but, more importantly, they promise to transform the way we design" (p.3).

One of the common uses of the computer in design firms is computer-aided design (CAD). CAD systems have made tremendous technical advancements in recent years and have become an important part of interior design education. While IBM introduced the first commercial computer-aided drafting system in 1964, very few firms used CAD systems in the 1960's and 70's. The adoption of CAD technology to the smaller companies and interior design educational programs finally came during the 1980's when lower-cost microcomputers became available (McLain-Kark, 1991). This trend was evidenced by the report in Progressive Architecture in 1987 that 84% of their readers either had or planned to purchase a CAD system (Doubilet, 1987). Smith (1989) also estimated in his report that by 1990 there would be an estimated one million CAD workstations in the United States. These indicated that obtaining CAD skills will be essentially needed for today's designers.

Today, many specialized CAD software packages are introduced on the market as well as the typical drafting applications. Clemons & McCullough (1989) described some recently developed programs which include three-dimensional modeling, renderings with specifications, and lighting calculations that interpret the performance of proposed lighting system design" (p. 30).

Today, most CAD systems are relatively easy to learn. Cleminshaw explains in Green's (1988) article that "once students learn to deal with the technology, it even frees up and speeds up their creativity" (p.52). However, if the users are not content to increase their skills of operating CAD, they will fail to get

the full benefit of a CAD system and decrease their productivity. Thus, an investment in time in CAD training is needed for designers who expect to make full use of a CAD system.

Clemons & McCullough (1989) stated that "an understanding of designers' attitudes is critical to the implementation of CAD in the design field. By studying the attitudes of professional designers, educators can focus on how to best educate the students entering the design profession" (p. 30).

In 1985, McLain-Kark and Tang (1986) studied the attitudes of designers toward CAD. The results indicated that designers with computer experience have more positive responses toward computers than designers who had no computer experience. In spite of the fact that computer-experienced designers believed that computers are not too complex to use, both experienced and non-experienced designers showed negative opinion about the cost-effectiveness of CAD. In addition, computer-experienced designers more strongly agreed that interior designers will inevitably need computers for their profession. Since non-residential designers usually were more experienced with CAD, they showed more positive attitudes toward computers than residential designers.

In addition to designers' attitudes toward computers, it is important to study learning styles and how they might relate to computing styles in CAD education. This is covered in the next section.

Learning /Computing Styles

Learning is often used to designate the process of human behavior modified by individual experience and environment. Much of human behavior can be called learned behavior. Through learning, a person acquires knowledge, meanings, fears, attitudes, personality characteristics, ideals, frames of reference, prejudices, values. These results of learning forms the characteristics of people as individuals that it is vital to the understanding of man's behavior to obtain knowledge about learning and learning processes (Sawrey & Telford, 1975).

Bayazit (1987) defines "learning" as "the individual control and selection of information, the interpretation of what is perceived, and the perceiving of newness by an individual" (p. 139). He also explains it as understanding the complexities, borrowing the definition of Klir (1985) as follows:

"...degree of complexity is, according to the common-sense characterization, associated with the number of recognized parts as well as the extent of their interrelationship...[this is a] somewhat subjective connotation, since it is related to the ability to understand or cope with the thing under consideration" (p. 139).

There are various circumstances under which learning tends to occur and various levels of complexity of the performance task to be learned. Psychologists disagree as to whether or not there are different forms of learning. However, some agree that all

learning involves basically the same process, but that the environmental conditions controlled to produce learning vary, and thus interpret different responses as different forms of learning (Hull, 1943). Other theorists contend that there are several kinds of learning.

Although there are many different opinions such as mentioned above in the forms of learning, it is generally agreed that no two individuals perform a learning approach to task in exactly the same way, and no educators would deny the importance of recognizing these individual differences found in learners. Pask (1972) categorized one of the most important differences in learning styles, as serialist verses holist. "A serialist prefers to learn by proceeding in logical small steps, tries to get every point clear before moving on to the next, and pursues a straight path through the learning task, avoiding any digressions. A holist proceeds more broadly, picking up bits of information that are not necessarily logically connected, and learning things 'out of sequence.' A holist prefers to learn by having things presented in different ways, and approaching ideas from different viewpoints" (p. 157). In general, it is believed that designers prefer to be holistic rather than serialistic.

In psychology, the differences of the people in the ways of learning are referred to as 'cognitive styles' (Cross, 1985). Both teachers and students have different cognitive styles, and so vary the styles of teaching as well as styles of learning (Cross, 1985). According to Pask (1972), teaching strategies can

be either matched or mismatched to an individuals' different learning style. The study that he has conducted suggest that better performance for the tasks that they are supposed to have learned would be achieved if students' learning styles and the teaching strategy are matched.

Fry (1972) reports the "learning styles" or individual differences are related to learner/instructor control of instruction and the effectiveness of learner control relied on aptitude as well as inquisitiveness. Specific results indicate that "high-aptitude-high-inquiry subjects learned significantly more under a high degree of student control, and high-aptitude-low-inquiry subjects learned significantly more under a low degree of student control. Overall, subjects learning under a high degree of student control learned the least. However, they formed the most favorable attitude toward the method of instruction" (p. 459). Several other studies suggest evidence of the interaction of instructional condition with specific learner characteristics (Leith, 1970; Majer, 1969; Tallmadge & Shearer, 1969, 1971). This implies that certain student "types" will learn and satisfy less under a specific instructional condition, whether it be student controlled or instructor controlled (Fry, 1972). In fact, the idea that each student should be provided with the instructional systems that best suite to his individual differences such as cognitive style, aptitude, interests, personality characteristics, etc. was accepted by a few researchers in operating their learning systems (Gallagher, 1970;

Rigney & Towne, 1970; Taylor, Montague, & Hauke, 1970).

Steinberg (1977) also reports that students under inefficient instructional strategies perform poorly in managing time, and learned least when employing student control. The question prompted by this study was that which learning decisions should be left up to the student and which under computer control. Steinberg (1977) suggests that "one must assign the locus of control of such variables as instructional strategy, sequence of instruction, completion time, amount of practice, and level of difficulty" (p. 184). Overall, the results indicated that students under learner control did worse than those under computer control and students sometimes showed better attitudes when under their own learning control. However, better attitude and higher achievement did not necessarily correlated. Overall best performance was achieved by low aptitude, high inquiry students under low student control. The achievement of low aptitude, low inquiry students was too little to be interpreted by his study. Thus, both aptitude and inquisitiveness play an important role to the effectiveness of trait-treatment match. This study suggests that different computer instructional strategies are needed for different learning styles. This may also apply to CAD instruction.

CAD Instructional Strategies

CAD requires a different way to draw in its own special ways. Manual drawing may be the easier way to enter drawing

information initially, but the ease of changing and correcting CAD drawings surpasses the manual erasing and redrawing work (Kennedy, 1986). Virtually no one may feel at ease the first time they confront a computer, and it takes time to get fully comfortable with it. Once a person get used to do something one way, learning a totally new way can cause intimidations or frightening feeling (Crosley, 1988).

Drawing with new technology, such as the computer requires a different attitude from those acquired through conventional drawing. On the other hand, Crosley (1988) also stated that "once you overcome the possible trauma and inevitable fumbling, you may come to a sudden realization that the new drawing process is familiar, after all. You may also find sometimes that, at times, computer-aided drawing is closer to the way you think about design and drafting than hand drawing is; not always, but sometimes. The more you can use your thinking method to supplement drawing method, the more you will benefit from drawing with the assistance of the electronic beast" (p. 4).

Learning computer-aided design technologies is like learning to play a musical instrument (Crosley, 1988). Its success depends on if one has the inclination to it or not. Yet, it is generally believed that "performers who adapt better to the constraints on the task are more skilled than performers who do not adapt as well " (Logan, 1985, p.368). Thus, understanding of skill acquisition is relevant to this study.

Logan (1985) defines the term "skill" as performance of a

complex task. A task is defined again as "a set of goals which a person tries to obtain, and a set of constraints to which the person must adapt in order to obtain the goals" (p. 368).

However, none of the current theories of skill acquisition seem to agree that there are maximum limits on the skill that can be attained (eg., Anderson, 1982; Crossman, 1959; Mackay, 1982; Newell & Rosenbloom, 1981). Thus, assessing the level of skills is a relative judgement. That is, one individual can be considered to be more skilled than another, but at the same time, there can be someone who is more skilled or less skilled than either of them. According to Logan (1985), "skills consist of automatic procedures as well as metacognitive knowledge about how and when to use the procedures and declarative knowledge about the trappings and demographics of the skill" (p. 369). Although the performance of skilled people is more likely to be automatic, skilled performers are usually able to control their performance better than unskilled performers. Both skill and automaticity is acquired through practice and gradually over long periods of time. Logan (1985) concludes his report that learning is important in producing both automaticity and skill and that extensive practice is essential to acquire high levels of skill.

CAD can also be thought of as a skill that is acquired over repeated practice. And, just as learning styles can affect the performance of students' learning with the computer as Steinberg's (1977) research suggests, so too may personality types affect CAD instruction. This will be covered in the next

section.

Personality and Adaptation

The diversity of personality is often compared to the differences of everyone's handwriting. One's personality represents the individual characteristics of his behaviors, habits, attitudes, and value systems. Kaiser and Bostrom (1982) state that "either the skills required in a particular setting may attract individuals with particular personality characteristics, or the tasks that are performed in a user area or in a specific environment may cause these characteristics to be developed or reinforced" (p. 44). In a given environment, a particular trait of human beings in regard to behavior is fixed. This can be reinterpreted that a particular way of behavior of a person is predetermined by each individuals' properties in that environment (Hettema, 1979).

In classical personality theories, personality is primarily conceived as "an element in the species, equipped with a set of properties, largely determined by heredity factors" (Hettema, 1979, P. 30). Although no one particular definition of personality is universally agreed upon by psychologists, there are certain components of personality that are widely accepted. Among Allport's fifty different definitions, personality is described as all the characteristics of each individuals that identify him from other persons. It is also described as "the combination of all the traits, sentiments, aptitudes, prejudices,

emotions, attitudes, moods, self-perceptions, abilities, interests, skills, recollections, desires, ambitions and manners which make up the individual" (Heim, 1970, p. 53).

One of the most accepted theories on personality comes from Carl Jung. In 1920, he said that people are different in fundamental ways in spite of the common archetypes found in general. What is important, according to Jung, is his idea of "functions." The preference for the way how each individual act is characterized by its given functions, and this can be explained as so called "typed" by the preference (Keirsey & Bates, 1984). Whether inborn or adapted later, these given "functions" according to Jung develop fortuitously and become stronger through use. For example, if a person uses his intuition more than his feeling, the intuition becomes more powerful. At the same time, if a person depends more on his feelings, then they become stronger. The Jungian typology does not set down as a rule that one type of temperaments is superior to any of the others but rather points out that each type contains major strengths as well as weaknesses. The most important notice of Jungian Typology should be given to his description on the different preference for how people "function" (Kaiser & Bostrom, 1982). Jung (1968) described three different dimensions of personality in his "psychological types" he invented:

1. the way people relate to the world,
2. the way information is taken in, and
3. the way information is processed, i.e., decision making

style (quoted from Kaiser & Bostrom, 1982, p. 45).

On the other hand, some other classical personality theories emphasize more on the conception of adaptation (Hettema, 1979). In adaptational psychology, it is believed that future behavior can be predicted by studying how people adjust to their fixed environments through their learning and the use of past experience.

The psychological concept of adaptation conceives behavior as an adaptive modality and described as transformation or alteration of the environment (Hettema, 1979). Wolman (cf. 1978) describes adaptation as the adjustment to incoming stimulation, the acceptance of societal values and environmental conditions, as well as the learning process of adapting behavior to a reality. This also can be explained as the modification of the behavior to meet environmental demands through adjusting innate deficiencies and eliminating irrelevant attitudes and motives.

The increasing demand for tests assessing various psychological and educational attributes relating to computer technology and its use has been caused by the growing reliance on computers in every fields. The study of Kern and Matta (1988) addressed that individual psychological type contribute to the level of learning performance in a self-paced instructional setting. The results indicated that components of different personality types can influence the student effectiveness when employing computer-assisted instruction. Thus, the researchers recommended that educators should consider the individual

differences in personality types and their students' needs when planning an educational programs which will include computer-assisted instruction (Kern & Matta, 1988).

Judd (1972) also stated in his paper that a critical factor may be on individual differences in student response to an educational setting and thus future research should be directed toward individual differences, including the special training of learner control. The next section describes how split-brain theory may explain some of these individual differences in student responses to instruction.

Split-Brain Theory/Design Process/CAD Instruction

In 1984, Tovey stated that "there appears to be distinct differences between the two hemispheres of the human brain in terms of preferred styles of thinking. In designing, it seems necessary that both styles are engaged, with the designer switching from one to the other as appropriate" (p.219).

Furthermore, Cross (1985) stated that each hemisphere seem to be associated with different 'computing' styles, each with particular functions. It has become clear that "the two hemispheres tend to specialize in different styles of perception, cognition and communication. The left hemisphere does indeed dominate in verbal, analytical modes of thought. It controls serialistic, 'rational' ways of thinking. The right hemisphere dominates in nonverbal, visuospatial, synthetic modes of thought. It controls holistic, 'intuitive' ways of thinking" (p. 160).

Bogen (1969) characterized these different modes of thought as propositional (left brain) and oppositional (right brain) styles. Cross (1985) applies these two distinctive modes of thoughts to describe the 'computing styles' of people as follows: "The 'cognitive style' of people using computers is restricted to certain very limited aspects of propositional ability. This creates considerable problems of mismatch between the 'cognitive abilities' of computers and those of people. That is, in computer technology, styles as analogous to the concept of modes in which the computer only responds to certain types of specified input data and rejects all data which do not conform to the specification (p.161). These concepts give the confirmation for using the split-brain theory in this study. The following statements regarding hemisphere characteristics and their contributions to the design process are cited from the study of Tovey (1984) (see figure 1).

1. Two Halves of the Brain - In all higher level mental activities, both halves of the brain symmetrically operate, exchanging information in parallel. However, certain functions of hemisphere is dominated to on or the other, even though each hemisphere is intended to process many tasks in the same way as the other. Generally, the left brain has been conceived as the major hemisphere. The right hemisphere appears to be less strongly specialized in its information processing modes. The distinctive specializations underlined in different information processing modes on each hemisphere are as follows:

LEFT-BRAIN DOMINANT *RIGHT-BRAIN DOMINANT*

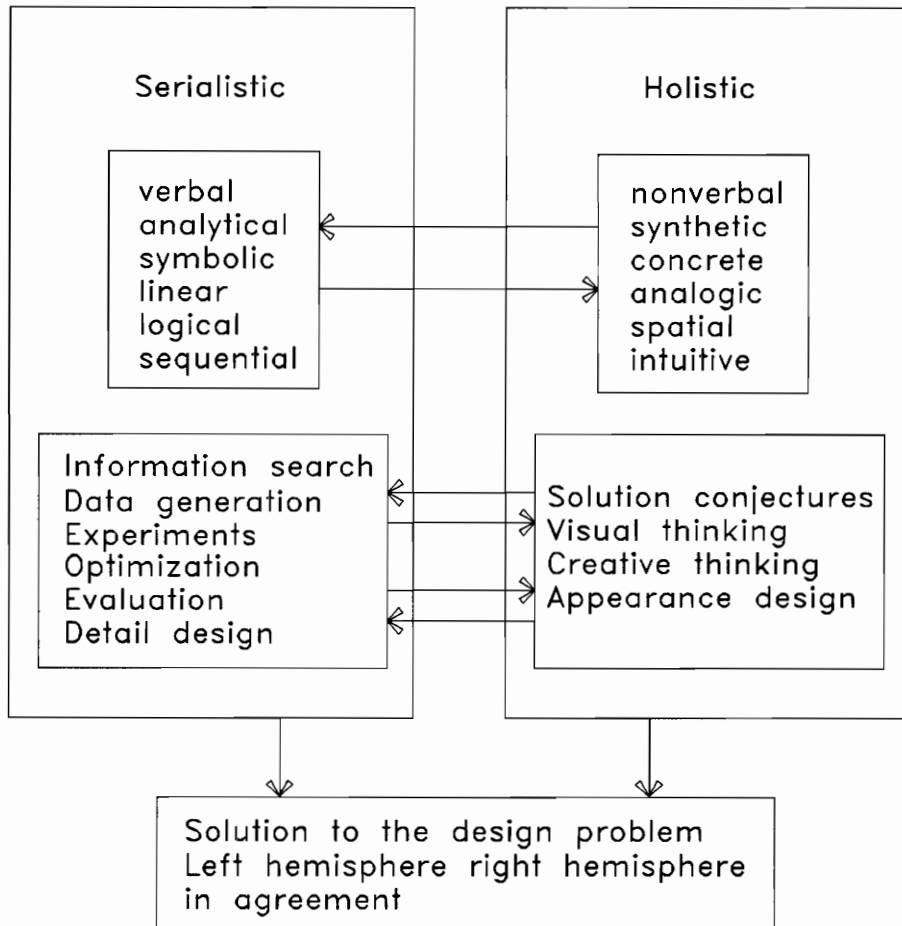


Figure 1. The Dual Processing Model
(adapted from Tovey, 1984)

Left hemisphere: verbal; analytic; symbolic; abstract; logical; linear; digital; and time oriented.

Right hemisphere: non-verbal; synthetic; concrete; analogic; intuitive; holistic; spatial; and timeless and diffuse" (p 220).

As stated previously, the right hemisphere has found to be somewhat less characterized and vague. However, there seems to be an evidence that the role of the right hemisphere should be more active, and superior for certain tasks and styles of thinking (Levy, 1983). Characterizing the differences in hemispheric dominance in information processing modes has been studied by many researchers. One of them is the terms propositional and oppositional for the two types of thought coined by Bogen (Bryden, 1982). That is, the left hemisphere dominates in propositional thought which seems to have linear processing and the right hemisphere dominates in oppositional thought which mode is a simultaneous parallel process (Tovey, 1984). The left hemisphere approaches analytically, concentrating on details, and is serialistic in imaging the possible solutions. On the other hand, the right hemisphere participates in more creative part of the brain with higher level of originality. Dominance of the right hemisphere in many areas of visual thinking has been identified by Tovey (1984). He reported that the right hemisphere is considered superior in handling visuospatial problems as a whole. It participates greatly in the creative aspects of thought, attributing to it in more inventive exploratory and improvisatory aspects of mental activity.

2. Contribution of the Right Hemisphere to the Design Process -

The most important contribution of the right hemisphere in design thinking is in visual thinking and drawing, creative thinking, and in appearance design. In the process of solving design problems, the activity of right hemisphere is emphasized both in "the perception of what aspects of the problem have this potential and in the development of the conjecture" (p. 225).

3. Contribution of the Left Hemisphere to the Design Process -

The left hemisphere's logical, analytical and symbolic thinking tends to control the design process in words and numbers. It perceives the design process as linear and sequential.

4. Designing with Both Halves of the Brain - The brain operates with its own preferred operating mode in the design process, the left leaning heavily on words and symbols, the right on drawings and spatial approach. Although the two halves of the brain seem to be characterized by its independent activity, the dual processing model of the design process assumes that there exists considerable interaction between the two and continuous attempts to modify the other (Tovey, 1984). That is, design process requires both linear analytical thinking and intuitive creative thinking depending on the problem to be solved (Tovey, 1984).

On the other hand, McLain-Kark & Rawls (1988) stated that there is a similarity between right/left brain functions and holist(exploratory approach)/serialist(linear approach) research. They reported that when designers are right-brain dominated, they seem to be more holistic and exploratory in approaching design

problem while serialistic approach flourish when dominated by left-brain. That is, "the right brain has more of a chance to explore, in holist manner, creative ideas for the project and left brain being less creative and more rigid solutions in solving design problems. Because of their reliance on word and precise sequencing in CAD systems, familiarity with CAD would suggest that the left brain could easily become dominant with computer operation" (p 24, 25). It was suggested that developing symbols in CAD operations rather than words would improve the creative process in solving design problems on the computer.

The previous research indicates that left- and right-brain may be a factor in learning CAD. And, as we shall see, personality types based on Jungian Typology as measured by the Keirsey Temperament Sorter, which was adapted from the Myers-Briggs Type Indicator also can be a measure of left- and right-brain dominance. Consequently, the Keirsey Temperament Sorter and the Myers-Briggs Type Indicator are discussed in the next section.

Myers-Briggs Type Indicator and Keirsey Temperament Sorter

The Myers-Briggs Type Indicator is based upon Jungian Typology and is the most widely used measure of temperament types and personality preference. Its educational uses are indicated as to understanding individual learning style, identifying differences in approaching learning tasks, developing teaching methods and evaluation tools, and analyzing and improving

curricula. The test has been used widely more than 30 years and has drawn noticeable interest in the idea of different types of people and in Jung's theory of psychological types (Keirse & Bates, 1988). It is important, however, to recognize that "the Myers-Briggs Type Indicator measures only preference toward a certain type. If one has a high score on one dimension, the other dimension on the continuum is viewed as complementary. MBTI does not necessarily indicate that one is deficient with regard to a particular dimension if one receives a low score; it only indicates a preference for the complementary score" (Kaiser & Bostrom, 1982, p.46).

There are four pairs of preferences designated on the Myers-Briggs Type Indicator test. The definitions for these preferences are quoted from the statement of Hoffman & Waters (1982). These are:

Extraversion (E) vs. Introversion (I) - Is the subject's primary focus on the outerworld of people and things or the inner realm of ideas?

Sensation (S) vs. Intuition (N) - Does he or she prefer to perceive by using senses or by employing intuition, imagination, and inspiration?

Thinking (T) vs. Feeling (F) - Does he or she prefer to judge or evaluate with mind or heart, i.e., is he or she more often analytical and logical, or does he or she rely on empathy, feelings, sensitivity?

Judging (J) vs. Perceiving (P) - Is the subject primarily

concerned with making systematic, orderly judgments about the world or with experiencing, understanding, and accepting it? (p. 20)

To fully understand these temperament types, there are several points that we should realize about what Jung meant by these. First, Jung did not segregate four pairs of temperament types to be either one or the other. It should be noted that one can be one type in some degree at the same time to be the opposite in some degree; extraverted in some degree and introverted in some degree, and so on as an example. Second, while one prefers to be one or another of the four different types, Jung admits that as time passes, changes may occur in one's preference that may strengthen or weaken. Third, the conflicts remain unsettled of whether these preferences are "inborn" or chosen later through times under given environments (Keirsey & Bates, 1984).

A modified version of the MBTI is the Keirsey Temperament Sorter. The standard MBTI is comprised of 166 multiple-choice items. Instead, the Keirsey Temperament Sorter consists of 70 questions, even though both tests are based on Jungian Topology. Keirsey & Bates (1984) described some representative combinations of different temperament types as part of the directions for identifying each types. The four main pairs of combinations are Sensing-Thinking (ST), Sensing-Feeling (SF), Intuition-Feeling (NF), and Intuition-Thinking (NT). Characteristics of these types are explained as follows:

(adapted from an earlier edition of "Please Understand Me" ,
Keirsey & Bates, 1978)

ST: practical and make decisions on facts by impersonal analysis. Applied science, business, production, construction, etc.

SF: interested in facts, but make decisions with personal warmth. Patient care, community service, sales, teaching, etc.

NF: interested in possibilities, not facts. make decisions with personal warmth. Behavioral science, research literature & art, teaching, etc.

NT: interested in possibilities with impersonal analysis. Physical science, research, management, forecasts & analysis, etc.

A considerable number of research studies in relation to MBTI have been conducted since the revived interest in Jung's theory of psychological types. In 1989, Shiflett has found the validity evidence of hemispheric dominance by testing the MBTI. He explained that there is a considerable similarity between the descriptions of the differences in mental processes of left and right hemisphere dominance (Taggart & Torrance, 1984) and the four pairs of mental processes described in MBTI, especially for the JP and SN scales. The study reported that the preference for Perception and Intuition mode on the MBTI is positively related to left brain dominance and negatively related to right brain dominance. Thinking/Feeling dimension of the MBTI was also found to be significantly related to brain laterality. Thinking

preference was positively related to left-brain dominance negatively related to right-brain dominance. No significant correlation was reported between Introvert/Extrovert type. However, Shiflett (1989) stated that gender difference clearly influenced the study and this measurement should be used cautiously until more valid evidence on measuring the hemisphere dominance is found.

The Myers-Briggs Type Indicator has also been found to be useful as a indicator of how well people with differing personality types adapted to computer-assisted instruction (CAI). This is discussed in the next section.

Myers-Briggs Type Indicator/Computer-Assisted Instruction(CAI)

The study of Hoffman and Waters (1982) indicated that the personality types correlated with the task performance rate and attrition rate of the students in computer-assisted instruction (CAI) program. Of the many personality type combinations, all sensing (S) types, compared to intuitive (N) types, tended to take less time in completing the computer-assisted portion of the program. A noticeable attrition rate was found among students who prefer to be Extravert, Intuitive, and Perceiving types (EN-PS). Neither Thinking nor Feeling types showed any significant differences. Furthermore, the (EPs) extraverted/perceptive (EP) types strongly tended to drop out of the Computer-Assisted-Instruction program than it was expected. Hoffman and Waters (1982) summarized their overall finding as "learning by means of

a computer-assisted instructional program would seem to favor those who have the ability to quietly concentrate, are able to pay attention to details, have an affinity for memorizing facts, and can stay with a single task until completion" (p. 21). These findings of this study suggested that those who showed higher preference for Sensing type are likely to do well with Computer-Assisted Instruction, while those with the Extravert, iNtuitive, and Perceiving (EN-P) personality types more tended to drop out of the CAI program.

According to Lawrence (1979), ENs (Extraverted/iNtuitive) like variety and action, and tend to pay more attention to the whole rather than the details. They also are attracted to group projects, team competition, and application of more creative approach instead of conventional ways of doing things. Regarding time management, and steady process in solving task assignment, those who have more flexible, open-ended, and perceiving types are expected to respond less effectively. The EN-Ps' low adaptation rate of the computer-assisted instruction format may be explained by this.

Clearly, a relationship exists between personality types as measured by Myers-Briggs Type Indicator and aptitudinal modes for computer-assisted instruction. This suggests that the same might be true for personality types and CAD instruction.

CHAPTER THREE

METHODOLOGY

The major objective of this study was to investigate if there is any significant relationship among personality types and student aptitude and attitudinal levels in utilizing CAD systems in an interior design program. In this chapter, the theoretical basis supporting the purpose of this study and the method of data collection will be explained in detail.

Conceptual Framework

Split-Brain theory and Jungian Typology form the theoretical basis of this study. As discussed in Chapter two, the two hemispheres of the human brain seem to have distinct differences in preferred styles of thinking. Although both hemispheres symmetrically operate in solving the design problems, different information processing modes on each hemisphere seem to influence the aptitudinal levels in adapting CAD into the interior design field. This is due to different characteristics between the CAD system and conventional drafting skill. On the other hand, a similar phenomenon has been found in the study of personality types, with measurement based on Jungian typology, and computer-assisted instruction (CAI) program. It seems that a CAD system may rely more on left hemisphere in its systematic orientation. In other words, CAD is more adaptive to analytical, sequential, and logical way of thinking rather than synthetic, analogic and

intuitive way. And so does the case of the study of CAI and personality types, on its preference of one side of the temperament; Introvert, Sensation, and Judging for better CAI adaptation. These three preferred temperament types are interpreted as the dependence on inner realms of the idea, perceiving things by senses rather than intuition, and making systematic, orderly judgement which seem to associate with the explanation of better CAD adoption. These similar results of the preferred thinking modes for better CAD and CAI adoption supports the theoretical framework of this study. That is, because CAI research indicates that people with Introvert, Sensation, and Judging personality types make better computer uses, the same may be true for CAD users.

A conceptual model created for this study, based on these theories, is illustrated in Figure 2. The model shows that Introvert, Sensation, and Judging types ought to have a more favorable attitude and more aptitude for CAD compared to their opposite temperaments. This means that people who focus on the inner realm of ideas, perceive things by senses, and make systematic, orderly judgments should have higher attitudes and aptitudes toward CAD.

Hypotheses

The following hypotheses form the framework of this study:

- (1) There is a relationship between more favorable attitude and stronger aptitude toward CAD and personality.

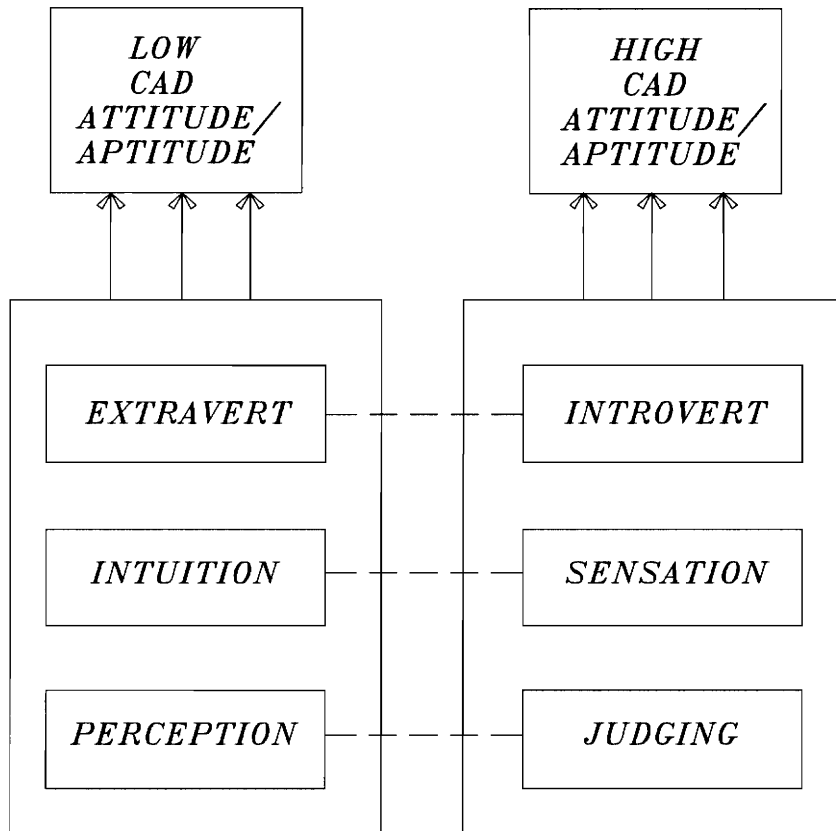


Figure 2. Model of Personality Types and CAD Attitude/Aptitude

- (2) Those students who have more favorable attitudes toward CAD will have higher preference scores on introversion, sensation, and judging.
- (3) Those students who have higher aptitudes toward CAD will have higher preference scores on introversion, sensation, and judging.

Operational Definitions

(1) CAD - the acronym for computer-aided design. CAD systems combine the computer's ability to process, store, retrieve, and display computer graphics with the users input.

(2) Software - a set of programs, documents, procedures, and routines associated with the operation of a computer systems.

(3) Computer software packages - software such as word processing, accounting, statistics, graphics, etc.

(4) Conventional drafting tools - the set of hand drafting tools that design students use to establish their conceptual and working drawings for their projects. Such tools may include a T-square, a triangle, a compass, a french curve, templates, pencils, inking pens, a shell, erase, etc.

(5) Favorable attitudes - design students acceptance of CAD in interior design problem solving.

(6) Myers-Briggs Type Indicator (MBTI) - the most widely used measure of personality dispositions and preferences. Its educational uses are indicated as to understanding individual

learning styles, identifying differences in motivation for learning, developing teaching methods and evaluation tools, and analyzing and improving curricula.

(7) Keirsey Temperament Sorter - adapted version of Myers-Briggs Type Indicator to measure personality types. Its descriptions are based on Jungian typology and designed to provide more personal involvement which include self-identifiable explanation of different personality types.

Sampling Procedures

The population in this study consisted of 28 junior and 28 senior interior design students. All participants were students of the College of Human Resources at Virginia Polytechnic Institute & State University (Virginia Tech) who were enrolled in the required CAD course offered in the interior design program. Participants were assumed to have had the prerequisites for this CAD course. Prerequisites include Design Drawing, Presentation Techniques, Two-Dimensional Design, Three-Dimensional Design, Interior Systems, Interiors, and House Planning.

Data Collection

The primary methods of data collection for this study were a survey questionnaire (see appendix A) and Keirsey Temperament Sorter (see appendix B). These were administered during the last week of the spring semester of 1991 to maximize students' CAD learning experience. The Computer-Attitude Scale (CAS) developed

by Poplin, Drew, and Gable (1984) was selected for the survey questionnaire format to collect data concerning attitudes toward CAD verses conventional drafting tools. CAS is a 40-item scale allowing for a total composite attitude score (negative to positive) and scores on four subscales (10 items each): (a) Computer Anxiety, (b) Computer Liking, (c) Computer Confidence, and (d) Computer Usefulness. Four items for each attitude subscale are provided in this study. The answer sheet was formed with an 8-point Likert-type scale ranging from strongly agree to strongly disagree. Data for aptitudes toward CAD were obtained by CAD proficiency grades evaluated exclusively from overall course grade by instructor on final project and by asking students of their opinion on CAD skill in item 19 of the survey questionnaire.

The survey questionnaire was designed to obtain the following information:

- (1) Experience with computers and CAD in particular.
- (2) Types of computer most frequently used.
- (3) Interior design students' general attitudes toward CAD on four subscales: CAD Anxiety, CAD confidence, CAD usefulness, CAD liking.
- (4) Interior design students' overall evaluation on their preference for CAD.
- (5) Students' overall opinions on their aptitudes toward the operation of CAD. For juniors, CAD proficiency grades will also be used to measure the aptitude.

The Keirsey Temperament Sorter rather than the MBTI was applied to test different types of personality because of time and monetary constraints. This adapted version of MBTI is comprised of 70 questions, while the standard MBTI consists of 166 multiple-choice items. Only an authorized psychologist can administer the MBTI. Instead, Keirsey Temperament Sorter is self-administered and self-scored. Students were asked to put a check mark for each question in the column for a and b. There are no right or wrong answers since about half the population agrees with either answer they choose. To score the answer sheet, add down the total number of "a" and "b" answers that were checked in the box at the bottom of each column. The next step is to transfer the number in each box of the answer sheet to the box below the answer sheet. By adding up all the pairs of numbers and entering the total in the boxes below the answer sheet, so each box has only one number. These leave four pairs of numbers in total. Circle the letter below the larger number of each pair and then those four letters identify the specific "temperament type". The survey questionnaire and Keirsey Temperament Sorter were given to three separate groups of students on their last day of the class of spring semester, 1991. The first group was seniors and this survey was taken at 10 A.M. in April 26, 1991. Juniors were surveyed in two separate groups due to different schedules of their final project presentations. One group was given the surveys at 1:00 P.M. in April 26, 1991. On April 29, 1991 at 8:30 A.M., the second group was tested with the same procedure.

Although all students were very supportive of the survey, there were some minor missing data. These were disregarded from the total data set to maintain the consistency of the analysis.

Aptitudes toward CAD was evaluated in three ways. First by asking students' opinion concerning their skill of CAD in the item 19 of the survey questionnaire, the CAD proficiency grade, and the overall course grade. The last two variables were analyzed only for juniors since CAD grades were not available for seniors.

Data Analysis

Collected data were subjected to descriptive and analytical statistical study. Correlation coefficient analysis was specifically used to test the hypotheses of this study. To test the attitudes toward CAD, items 1-to 18 and 20 were used from the survey. Item 19 was used for measuring the aptitudes toward CAD. Scores were assigned to each response on Likert-type items 1-8 on the self-administered survey as 1=strongly disagree to 8=strongly agree. Responses to all items was coded, transferred to the computer, and verified for accuracy.

The independent variable is personality type and it has four sub-categories. They are: X1(Extrovert/Introvert), X2(Sensing/Intuition), X3(Thinking/Feeling), and X4(Judging/Perceiving).

The dependent variables are classified as follows:
CAD Attitude - Y1: CAD Anxiety, Y2: CAD Confidence,

Y3: CAD Liking, Y4: CAD usefulness

CAD Aptitude - Y1: CAD proficiency grades

Y2: overall course grades

Y3: Students' overall opinion on their
aptitudes toward CAD

In order to test the hypotheses of this study, the scores gained from Keirsey Temperament Sorter which determines the temperament preferences X1(E-I), X2(S-N), X3(T-F), and X4(J-P) were correlated with the sum of the scores gained from each subscale of dependent variables (Attitude: Y1, Y2, Y3, Y4. Aptitude: Y1, Y2, Y3) using correlation coefficients. The range of the correlation coefficients goes between -1 to +1. The correlation coefficient was calculated and interpreted as follows:

.90 to 1.00	Very high positive correlation.
-.90 to -1.00	Very high negative correlation.
.70 to .90	High positive correlation.
-.70 to -.90	High negative correlation.
.50 to .70	Moderate positive correlation.
-.50 to -.70	Moderate negative correlation.
.30 to .50	Low positive correlation.
-.30 to -.50	Low negative correlation.
.00 to .30	Little, if any, correlation.
-.00 to -.30	Little, if any, correlation.

(from Applied Statistics for the Behavioral Sciences,
Hinkle, Wiersma, and Jurs, 1979)

In addition to correlation coefficients, the Two-Sample T-

Test and Wilcoxon-Mann-Whitney rank sum test were performed. In each case, the results from these nonparametric tests were the same as those from the correlation coefficients in terms of statistical significance. Therefore, only correlation coefficients appear in the analysis tables in Chapter 4. The alpha was set at .1 because of the small sample size.

Limitations

The scope of this study was limited to AutoCAD software usage. The Keirsey Temperament Sorter was used to measure the personality differences instead of the whole package of MBTI because of the budget and time constraints of this study. Consideration should be given in interpreting the result of this study to the disadvantage of Keirsey Temperament Sorter that it might lose some valuable information since it is a shorter version of MBTI. The respondents participating in the questionnaire survey and the results from the Keirsey Temperament Sorter were limited to junior and senior interior design students at Virginia Tech. Due to the small size of the population, non-random selection of subjects was conducted. Therefore, the results of this study can not be generalized to all interior design students.

CHAPTER FOUR

RESULTS

This chapter discusses the results of this study and consists of seven major sections. The first section explains the characteristics of the sample population. The second section is a brief description of the students' previous experience with computers and CAD. Section three and four discuss the statistics for the attitudes and aptitudes toward CAD among interior design students and includes a discussion of the results regarding the relationship between students' opinion on their CAD skill and CAD proficiency grade, their CAD preference, and CAD proficiency grade and overall course grade. The fifth section details the personality types of the sample population surveyed and section six and seven discuss the relationship between attitudes and aptitudes toward CAD and personality types. Section seven specifically explains the correlations of CAD proficiency grades and personality types, overall course grade and personality types, and students' opinion on their skill of CAD and personality types. Hypotheses developed in the early stages of this study were examined in the last two sections of this chapter.

Characteristics of Sample Population

Of all the respondents of 56 interior design students at Virginia Tech, half (28) of the population were juniors and the

other half (28) were seniors. A survey questionnaire measuring the attitudes and perceived aptitudes toward CAD and containing the Keirsey Temperament Sorter was administered to each group. Keirsey Temperament Sorter was given additionally to the CAD instructor to see the differences in personality between students and the CAD instructor. The majority of the students were female with only two male students. Juniors were the students who were currently taking the CAD class while seniors already had their CAD class a year before the survey was given. Some of the senior students had options to extend their usage of CAD skills to their final projects during their senior design studio class.

Previous Experience with Computers and CAD

Students were asked about their past experience with computers, type of computers they have used the most, and their previous experience with CAD before taking CAD class in items 1, 1a, and 2 of the survey questionnaire on attitudes toward CAD.

Approximately 82 % of the sample population had some kind of previous computer experience (see table 1). However, only 8.9% of the students reported that they had previous CAD experience before taking CAD class (see table 2). Types of computers that were used most frequently by students were WordPerfect, VolksWriter, and Apple in order(see table 3). Of the students who responded "yes" for previous computer experience, 11 students didn't fill out the supplementary item "1a", asking the types of computers they have experienced.

Table 1
Previous Experience with Computers

Computer Experience	Frequency	Percentage
Yes	46	82.1
No	10	17.9
Total	56	100.0

Table 2
Previous Experience with CAD

CAD Experience	Frequency	Percentage
Yes	5	8.9
No	51	91.1
Total	56	100.0

Table 3
Types of Computers Most Frequently Used

Software or Computer Type	Frequency	Percentage
WordPerfect	11	24.4
VolksWriter	9	20.0
Apple	5	11.1
MacIntosh	3	6.7
Microsoft Word	3	6.7
MacWrite	3	6.7
.	.	.
.	.	.
.	.	.

N=45 * Frequency missing=11

Attitudes toward CAD among Interior Design Students

Questions about students' attitudes toward CAD were given in the survey questionnaire from item 3 to 18 and 20. Students' attitudes toward CAD were formulated into four subscales and four equal numbers of questions were asked for each subscales; CAD Anxiety (Question 3 to 6), CAD Confidence (Question 7 to 10), CAD Liking (Question 11 to 14), and CAD Usefulness (Question 15 to 18). Items for answers were designed with a scale from 1 to 8 to score students CAD attitudes. Scale 1 stands for strongly disagree, while scale 8 stands for strongly agree. Since four equal numbers of questions were asked for each CAD attitude subscales, the actual score range appears on the analysis table were from 4 to 32 for each subscales. To convert the 4 to 32 scale into agree and disagree scale, the following breakdown was selected for its appropriateness:

4-11:low

12-18:medium low

19-25:medium high

26-32:high

Students' opinion on their overall preference for CAD which was asked in question 20 on the survey questionnaire was scored separately from the CAD Attitude Scales with a score range from 1 to 10. These scores were added to the sum of the four CAD Attitude Scales to evaluate the overall attitudes toward CAD.

The result indicated strong evidence of positive attitudes toward CAD among interior design students (see table 4). More

Table 4
Frequency Distribution of the Attitudes toward CAD

CAD Attitude		Frequency	Percentage	Mean
CAD Anxiety	L : 4-11	16	28.6	15.16
	ML:12-18	24	42.9	
	MH:19-25	10	17.9	
	H :26-32	6	10.7	
CAD Confidence	L : 4-11	0	0.0	25.5
	ML:12-18	6	10.7	
	MH:19-25	21	37.5	
	H :26-32	29	51.8	
CAD Liking	L : 4-11	1	1.8	24.39
	ML:12-18	8	14.3	
	MH:19-25	21	37.5	
	H :26-32	26	46.4	
CAD Usefulness	L : 4-11	0	0.0	26.41
	ML:12-18	4	7.1	
	MH:19-25	16	28.6	
	H :26-32	36	64.3	
CAD Preference	L :1-2	0	0.0	7.79
	ML:3-5	8	14.3	
	MH:6-7	12	21.4	
	H :8-10	36	64.3	
Total	L : 17-47	0	0.0	108.93
	ML: 48-76	0	0.0	
	MH: 77-106	21	37.5	
	H :107-138	35	62.5	

N=56

- * Score range for CAD Anxiety, Confidence, Liking, Usefulness:
4=strongly disagree, 32=strongly agree
(Score range for each question of the subscales:1=strongly disagree, 8=strongly disagree. These were multiplied by 4 because four questions were asked for each subscales, resulting the total score range for each subscales 4 to 32)
- * Score range for CAD Preference: 1=very low, 10=very high
- * Score range for Total CAD attitude: 17=very low, 138=very high

than 71% of the students ranked their anxiety about CAD low. The mean score of CAD Anxiety was 15.16 out of the maximum score range of 32. Students showed strong confidence with their performance of CAD with a mean score of 25.5. The positive response covered 89% and 52% scored the top one fourth of the total scale range. No negative response was received below 12 which is the bottom one fourth of the total scale range. Significantly positive attitudes were also reflected from the rest of the other CAD Attitude Scales. Eighty-four percent responded that they liked using CAD and 93% of the students thought that CAD is very useful. the mean score for CAD usefulness was 26.41.

In item 20 of the survey questionnaire, students were asked to rate their overall preference for CAD from scale 1 to 10. As indicated from the results of the CAD Attitude Scales, students showed very strong preference for CAD with 86% positive response. The mean score for this was 7.79 out of maximum range of 10.

Students commented on their attitudes toward CAD that they all were fascinated by the options that CAD benefits their design problems. In spite of many advantages that CAD offers, students expressed some negative factors that come along with the usage of CAD. These frustrations were prompted by the unexpected breakdown of the plotter at the end of the semester which required students to print out their drawings on the laser printer.

Overall, the results revealed that students have strongly positive attitudes toward CAD. Of the four CAD Attitude

Subscales, the highest mean score was obtained for CAD usefulness. Therefore, it can be concluded that CAD is preferred by most of the interior design students and the usage in interior design field is going to be increasingly expanded.

Aptitudes toward CAD among Interior Design Students

Information on aptitudes toward CAD was gathered from three main sources. In item 19 of the survey questionnaire, students were asked to rate their skill of CAD from scale 1 very low to scale 10 very high. CAD skill was evaluated separately from the overall course grades for juniors. Four subcategories were formulated to grade CAD skill with each score ranging from 1 to 6. Therefore, the possible total score range for CAD proficiency grade was from 4 very low to 24 very high. It is revealed that most of the students did not have difficulties in operating CAD. The mean score was reported 19.96 out of 24 (see table 6). These statistics could not be conducted for seniors since CAD proficiency grades separate from overall course grades were not available for them.

Most of the students rated their CAD skills relatively high with a mean score of 7.13 out of maximum score of 10 (see table 5). More than 80% of the students rated their CAD skill to be higher than the medium score and 50% of the students thought that their skill is over 8 to 10 which covers the top one fourth of the total scale.

Table 5

**Correlation Coefficients of Students' Opinion
on their Skill of CAD ,CAD Preference, and CAD Proficiency Grade**

	Mean	Correlations P-Value	
		CAD Preference	CAD Proficiency Grade
Self-rating of CAD Skill	7.13	0.55668* (0.0001)	0.25844 (0.1842)

p<.1 significance level

* CAD Preference :N=56

* CAD Proficiency Grade :N=28

* Score Range for Self-rating of CAD Skill: 1=very low, 10=very high

Table 6

**Correlation Coefficients of
CAD Proficiency Grade and Overall Course Grade**

	Mean	Correlations P-Value
		Overall Course Grade
CAD Proficiency Grade	19.96	0.66458* (0.0001)

p<.1 significance level

* N=28

* Score range for CAD proficiency grade:4=very low, 24=very high (CAD proficiency grade was evaluated with 4 subcategories with score range from 1=very low to 6=very high for each subscale.)

Students' opinion on their skill of CAD and CAD proficiency grade

Correlation analysis was conducted for the relationship between students' opinion on their skill of CAD and CAD proficiency grade among junior students. This test couldn't be performed for seniors because separate CAD proficiency grades were not available for them. No significant relationship was found from correlation coefficients test between these two variables. The correlation was 0.25844 with p-value equivalent to 0.1842 (see table 5).

Students' opinion on their skill of CAD and CAD preference

Correlation analysis for the relationship between students' opinion on their skill of CAD and their CAD preference resulted with considerable correlation of .56 ($p=.0001$) with the significance level of 0.01 (see table 5). This indicates that students who think they did well in operating CAD seem to have stronger preference for CAD.

CAD proficiency grade and overall course grade

The statistical analysis examining the relationship between the CAD proficiency grade and overall course grade was also conducted only for junior interior design students. A considerably significant correlation was found from the result of this study between these two variables. The correlation coefficients was 0.66 ($p=.0001$) under the significance level of .01 (see table 6). Therefore, it is concluded that the students

who performed well in operating CAD also received better overall course grades which included other design criteria. This result was not surprising because students would have to fully understand the CAD functions in order to solve their design problems effectively by using CAD.

Personality Types

Myers-Briggs Type Indicator which is the validated measurement for personality types could not be used in this study due to the time constraints and budget. Instead, Keirsey Temperament Sorter which is a shorter version of Myers-Briggs Type Indicator was used. Keirsey Temperament Sorter consists of four pairs of temperament types. These are Extravert/Introvert, Sensing/iNtuition, Thinking/Feeling, Judging/Perceiving. The statistical analysis was performed for the first segment of each pairs; Extravert, Sensing, Thinking, and Judging. The total score was converted to 100% for its convenience.

The frequency distribution indicated students' stronger preference for Extravert, iNtuition, Feeling, and Judging type against Introvert, Sensation, and Thinking(see table 7). The mean score of Extravert vs. Introvert was 64.37 and 45.95, 40.79, and 62.20 for Sensing vs. iNtuition, Thinking vs. Feeling, and Judging vs. Perceiving, respectively (see table 7). Comparing these results with the one with the CAD instructor showed strong contrast in personality types between students and instructor. The CAD instructor showed high preference scores on Introvert and

Table 7
Frequency Distribution of Personality Types

Personality		Frequency	Percentage	Mean
Extravert	L:<50%	12	21.4	64.37
vs.	M:=50%	8	14.3	
Introvert	H:>50%	36	64.3	
Sensing	L:<50%	33	58.9	45.95
vs.	M:=50%	3	5.4	
iNtuition	H:>50%	20	35.7	
Thinking	L:<50%	40	71.4	40.79
vs.	M:=50%	5	8.9	
Feeling	H:>50%	11	19.6	
Judging	L:<50%	14	25.0	62.20
vs.	M:=50%	2	3.6	
Perceiving	H:>50%	40	71.4	

N=56

- * Score range:1=very low, 100=very high
(The possible score range for each temperament type was different. So, all scores were converted to 100% maximum for consistency.)
- * L:Low, M:Medium, H:High

Perceiving which is in contrast to the students' preference for Extravert and Judging. The other two, iNtuition and Feeling were found strongly preferred by both students and CAD instructor against Sensing and Thinking. Since the comparison was conducted between a group of students to only one instructor, this result can not be generalized for CAD instructors in general.

Attitudes toward CAD and Personality Types

It was stated in hypothesis II that those students who have more favorable attitudes toward CAD will have higher preference scores on Introversion, Sensing, and Judging. This hypothesis was supported partially by the results of this study. A significant relationship was found only between CAD usefulness of the CAD Attitude Scales and Thinking/Feeling type. The result indicated that those students who have more positive attitudes toward CAD usefulness have stronger preference for Feeling type rather than Thinking type (see table 8). The correlation coefficients between CAD usefulness and Thinking was -0.25799 ($p=.0549$) under the significance level of 0.1. There was no significant correlations between other CAD Attitude Scales and any of the temperament types. The same result was produced in testing the relationship between students' opinion for their preference of CAD and personality types. That is, no significant correlation was found between these two variables.

Table 8
Correlation Coefficients of CAD Attitudes and Personality

	Correlations P-Value			
	Extravert	Sensing	Thinking	Judging
CAD Anxiety	-0.05479 (0.6884)	-0.03190 (0.8155)	0.09681 (0.4778)	0.12887 (0.3439)
CAD Confidence	0.05541 (0.6850)	0.06447 (0.6369)	0.10350 (0.4478)	0.18632 (0.1692)
CAD Liking	0.02132 (0.8761)	0.01466 (0.9146)	-0.01169 (0.9319)	0.12309 (0.3661)
CAD Usefulness	-0.09305 (0.4952)	-0.00933 (0.9456)	-0.25799* (0.0549)	0.05924 (0.6645)
Total	-0.02964 (0.8283)	0.03290 (0.8098)	0.01204 (0.9298)	0.19078 (0.1590)

P<.1 significance level

N=56

Aptitudes toward CAD and Personality Types

Relationship between aptitudes toward CAD and Personality Types was examined into three subcategories; CAD proficiency grade and personality types, overall course grade and personality types, and students' opinion on their skill of CAD and personality types. The statistical analysis indicated that there is no significant relationship between students' overall aptitudes toward CAD and personality types except for between CAD proficiency grade and Judging types(see table 9). The detailed information is explained as follows.

The correlation analysis for the relationship between CAD proficiency grade and personality types was conducted to test hypothesis three. Hypothesis three stated that those students who have higher aptitude toward CAD will have higher preference scores on Introversion, Sensing, and Judging. The result of this study supported only for the high CAD aptitude associated with stronger preference for Judging type (see table 9). The correlation between these two variables was 0.40412 ($p=0.03$) under the significance level at 0.05. Therefore, this result can be interpreted that students who achieved high CAD proficiency grade will have higher preference for Judging type rather than Perceiving type. This result correlated with the result of the study conducted by Hoffman and Waters discussed in Chapter II. They reported that students with better performance with computers tend to be Judging types rather than Perceiving.

The relationship between overall course grades and

Table 9
Correlation Coefficients of CAD Aptitudes and Personality

	Correlations P-Value			
	Extravert	Sensing	Thinking	Judging
CAD Proficiency Grade	0.13702 (0.4869)	0.11143 (0.5724)	0.28447 (0.1423)	0.40412* (0.0329)
Overall Course-Grade	0.11104 (0.5737)	0.13598 (0.4902)	0.21948 (0.2618)	0.28955 (0.1350)
Self-rating of CAD Skill	0.09203 (0.4999)	0.03246 (0.8123)	0.08713 (0.5231)	0.02689 (0.8441)

p<.1 significance level

* CAD proficiency grade and overall course grade: N=28

* Self-rating of CAD skill: N=56

personality types was examined separately from CAD proficiency grades to see the difference between the two. The correlation between these two variables were very low and thus concluded that there was no relationship between overall course grades and personality types (see table 9). The lowest correlation was found from testing the relationship between students' opinion on their skill of CAD and personality types.

Hypothesis one stated that there is a relationship between favorable attitudes and higher aptitudes toward CAD and personality types. Even though some considerable correlations were found between a few subvariables, it is concluded from the overall result of this study that no significant relationship exists between students' attitudes and aptitudes toward CAD and personality types.

CHAPTER FIVE
SUMMARY AND DISCUSSION

Computer usage has rapidly increased in the interior design field in recent years. This trend called for an investigation of the factors of different levels of performing CAD skill found in CAD operators in both educational and manufacturing aspects. Based on the idea that individual characteristics determine the level of individual learning performance when applying various educational media, this study investigated the personality factors that might have influenced different levels of attitudes and aptitudes toward CAD among interior design students. The information revealed in this study may be useful for the interior design educators incorporating CAD into their curricula as well as for the manufacturers developing more flexible software programs incorporating their user preferences.

This study examined the relationship between personality types and attitudes and aptitudes toward CAD. Specific background variables in relation to personality types include: CAD Anxiety, CAD Confidence, CAD Liking, CAD Usefulness, self-rated preference of CAD, self-rated skill of CAD, CAD proficiency grade, and overall course grade.

Information was gathered mainly from the survey questionnaire and Keirsey Temperament Sorter given to junior and senior interior design students at Virginia Tech. A total of 56 responses were used in the statistical analysis. Frequency

distributions were used to explain the sample population characteristics, personality types, and attitudes and aptitudes toward CAD. Correlation coefficient was used to determine if any significant relationship exists between students' attitudes and aptitudes toward CAD and their personality types.

It was found that the majority of interior design students at Virginia Tech had relatively positive attitudes and aptitudes toward CAD. These results parallel with the statement of Jenkins & Dankert (1981) from the review of the literature that student acceptance of computers in education is positive in general. Students showed strong confidence with their performance of CAD and their anxiety level about CAD was ranked extremely low. Of the four CAD attitude subscales, the highest mean scores were obtained for CAD usefulness and CAD confidence, respectively.

In terms of personality types, students seem to have higher preference for Extravert, Sensing, Thinking, and Judging in their temperament types rather than Introvert, iNtuition, Feeling, and Perceiving. These results can be interpreted that students perceive things by intuition and imagination, rely on empathy and sensitivity in judging, and make systematic, orderly judgements about the world.

The focus of this study was aimed at the investigation of the relationship between personality types and the attitudes and aptitudes toward CAD among interior design students. Overall, the findings revealed that there is no significant relationship between these variables. The specific details are explained as

follows by examining the hypothesis developed in this study.

The first hypothesis stated that there is a relationship between more favorable attitudes and stronger aptitudes toward CAD and personality types. This hypothesis was not supported by the result of this study. Even though some relationship was found between several subvariables, the overall significance level was very low. Thus, it is concluded from the correlation analysis that no significant relationship exists between attitudes and aptitudes toward CAD and personality types. This may have caused by the small sample size and by not using the whole package of Myers-Briggs Type Indicator due to the time constraints of this study.

The second hypothesis stated that students who have more favorable attitudes toward CAD will have higher preference scores on Introversion, Sensing, and Judging. The result of this study revealed that students who think that CAD is very useful have higher preference for Feeling type. There was no significant correlations for the other two temperament types. Therefore, hypothesis two was also rejected.

The third hypothesis stated that those students who have higher aptitudes toward CAD will have higher preference scores on Introversion, Sensation, and Judging. Correlation analysis indicated that there is a relationship between CAD proficiency grade among Aptitude Subscales and Judging type. This provides the evidence that the people with systematic and orderly judgments will find it more beneficial in operating CAD. No

significant relationship was found for other temperament types in relation to aptitudes toward CAD.

Other minor findings from this study include that students who have stronger preference for CAD also rated their CAD skill higher. Also, students who performed higher in CAD tend to obtain higher overall course grades.

Major Findings

Seven major findings were formulated from this study:

- (1) Interior Design Students had higher preference on Extravert, Intuition, Feeling, and Judging types as opposed to Introvert, Sensing, Thinking, and Perceiving.
- (2) Students who have more favorable attitudes toward CAD usefulness have a higher preference for Feeling personality type compared to Thinking type.
- (3) Students who perform higher in CAD grade have stronger preference for Judging type.
- (4) Students who performed well in operating CAD also received higher overall course grades which includes other design criteria.
- (5) Students who thought that they did well in operating CAD also had stronger preference for CAD.
- (6) Most of the students rated their skill of CAD high.
- (7) Most of interior design students had strongly positive attitudes toward the usage of CAD.

Implications

This study revealed that the interior design students have stronger preference for Extrovert, iNtuition, Feeling, and Judging in their personality types. This result suggests that students rely more on intuition, imagination, and sensitivity in making judgements rather than sensual, analytical, and logical judgement. Considering that CAD may be more adaptive toward the linear and sequential design process as discussed in the conceptual framework of this study, developing CAD software that matches designers' temperament types may offer more options for applying CAD effectively in the field of interior design. Even though this study failed to draw, in general, a significant relationship between personality types and CAD attitudes and aptitudes, some considerable correlations were found between favorable attitudes for CAD usefulness and stronger preference for Feeling type, and between higher CAD proficiency grades and stronger preference for Judging type. This means that people making systematic, orderly judgements about the world seem to do well in CAD. If the study could be conducted with a larger sample size and more valid test method, there may also be found even stronger relationship between the other variables. The broader information then could provide more supportive prediction on investigating the specific personality types that adopt CAD usage better. Furthermore, research can be expanded on how to develop the CAD software programs minimizing the different levels of user aptitudes.

Some attention should be given to the different results for the interior design students' preferred personality types and the one for better CAD adoption. Based on the statement of Tovey (1984) that design process requires both functions of the hemisphere modifying the other depending on the problem to be solved, it is recommended that CAD instruction that appeals to both sides of the brain is desirable. As different instructional/teaching strategies is needed for different learning styles, so too may CAD instruction need to have different strategies for different students. Although students were overall found to be Extravert, iNtuition, Feeling, and Judging types, they were not homogeneous. Therefore, different teaching strategies for different temperament types may need to be developed for CAD to be fully utilized and appreciated as a design tool.

The study also revealed a significant difference between the CAD instructor and students in personality types. While only an isolated case, the finding should be researched further to determine whether this result would apply to a larger population. For instance, if this test could be performed with larger sample size of CAD instructors and interior design students, the information obtained from such a study will be very useful in developing appropriate teaching methods matching the learning styles between students and CAD educators.

Recommendations for Educators and Software Developers

The result of this study supported a strong conviction that CAD usage is directed more toward linear, logical, and sequential way of thinking, while design students depend on possibilities and insights rather than absolute facts, in approaching design problems. The initial development of CAD was designed mostly for the application in engineering field rather than design profession, where creativity and originality might have been ignored. The most widely used CAD software, dominating the design market, is AutoDesk's AutoCAD software packages. So far, most of the drawing aids of AutoCAD are restricted to word-oriented commands. Thus, more expansion of graphics as is done with the present hatch and font options on icon menus should enhance the creative operation of CAD. Also, eliminating many numerical commands that might interfere with the creative design process is advised. Providing more free drawing aids that do not have to go through several sequences to reach the visualization of the image will diminish the limitations which often result in mundane solutions, and thus vitalize the originality of ideas.

This research has significant relevance for CAD educators. Design students can not be classified to only one specific type of personality as is indicated by the results of this study. This implies that one selected way of teaching method can not be generalized and applied to all students. To solve this problem, team teaching method that matches the personality types between students and instructors such as NF to NF or NT to NT would

provide better CAD adoption in design education. At the same time, combining students with different personality types in one team and have them participate together, sharing different possible approaches to draw the best solution will assist students with more variety of ideas and help minimize the disadvantage of using CAD in creative design process.

Recommendations for Further Study

Recommendations drawn from this study are formulated as follows:

- (1) The number of subjects was limited to 56 interior design students at Virginia Tech. These numbers were not enough to test the hypothesis of this study, resulting in low correlations for most of the variables. Larger size of sample population is strongly recommended.
- (2) Larger number of CAD instructors compatible to the number of students could be added to the sample population. Valuable results may be produced from testing the differences in personality types between CAD instructors and students.
- (3) The whole package of the Myers-Briggs Type Indicator should be used to test the personality types of the sample population. Keirsey Temperament Sorter which is the shorter version of the Myers-Briggs Type Indicator was used in this study. It was due to the time constraints of this study that the students had to take the survey questionnaire and the

personality test in short period of time. Considering that the information might have been lost by using the abstracted form of the test instrument, using the whole package of the Myers-Briggs Type Indicator is highly recommended for further research.

- (4) More objective measurement for CAD aptitude could be added into the instrument. Students' CAD skill was measured exclusively by the instructor's subjective opinion in this study. Future researchers may want to assign students with a sequence of different levels of CAD problems and have them solve these in limited period of time to evaluate their CAD performance more precisely.
- (5) A valid measurement of brain dominance could be added to obtain more accurate information on the relationship between hemispheric dominance and personality types.

References

- Anderson, J.R. (1982). Acquisition of cognitive skill. Psychological Review, 89, 369-406.
- Bayazit, N. (1987). Theoretical basis of a computer-aided design education and research laboratory. Design Studies, 8, 138-149.
- Bogen, J. (1969). The other side of the brain: the oppositional mind. Bulletin of Los Angeles Neurological Society, 34, 135-162.
- Bryden, M.P. (1982). Laterality: functional asymmetry in the intact brain. New York: Academic Press.
- Burger, K. (1985). Computer assisted instruction: Learning style and academic achievement. Journal of Computer-Based Instruction, 12, 21-22.
- Clemons, S.A., & McCullough, J. (1989). Attitudes of interior designers toward CADD and CADD education. Journal of Interior Design Education and Research, 15, 29-34.
- Crosley, M.L. (1988). The architect's guide to computer-aided design. New York: John Wiley & Sons, Inc.
- Cross, N. (1985). Styles of learning, designing and computing. Design Studies, 3, 157-161.
- Crossman, E.R.F.W. (1959). A theory of the acquisition of speed-skill. Ergonomics, 2, 153-166.
- Doubilet, S. (August, 1987). Computer use. Progressive Architecture, 15, 16, 19.
- Fry, J. (1972). Interactive relationship between inquisitiveness and student control of instruction. Journal of Educational Psychology, 63, 459-465.
- Gallagher, P.D. (1970). An investigation of instructional treatments and learner characteristics in a computer-managed instruction course. (Tech. Rep. No. 12, CAI Center, Institute of Human Learning) Tallahassee, Fla.: Florida State University).
- Green, D. (1988). Student talent:Computers. Magazine of International Design, 35, 52-53.
- Heim, A. (1970). Intelligence and personality: Their assessment and relationship. Middlesex, England: Penguin Books Ltd.

- Hettema, P. (1979). Personality and adaptation. Amsterdam: North-Holland Publishing Co.
- Hoffman, J. & Waters, K. (1982). Some effects of student personality on success with computer-assisted instruction. Educational Technology, 22, 20-21.
- Hull, C.L. (1943). Principles of behavior. New York: Appleton-Century-Crofts.
- Jenkins, T. & Dankert, E. (1981). Results of a three month PLATO trial in terms of utilization and student attitudes. Educational Technology, 44-47.
- Judd, W. (1972). Learner-controlled computer-assisted instruction. Presented at the International School of Computer in Education, Pugnochivso, Italy.
- Jung, C.G. (1968). Analytical Psychology: Its theory and practice. New York: Vintage.
- Kaiser, K., & Bostrom, R. (1982). Personality characteristics of MIS project teams: An empirical study and action-research design. MIS Quarterly, 6, 43-60.
- Keirse, D., & Bates, M. (1984). Please understand me. Del Mar, CA: Prometheus Nemesis Book Co.
- Kennedy, E.L. (1986). CAD: drawing, design, data management. New York: Whitney Library of Design.
- Kern, G. & Matta, K. (1988). The influence of personality on self-paced instruction. Journal of Computer-Based Instruction, 15, 104-108.
- Klir, G.J. (1985). Many faces of complexity. London: The United Nations University.
- Krouse, J.K. (1983). Training CAD/CAM operators. Machine Design, 79-81.
- Lawrence, G. (1979). People types and tiger stripes: A practical guide to learning styles. Gainesville, Fla.: Center for Applications of Psychological type, Inc.
- Leith, G.O.M. (1970). The acquisition of knowledge and mental development of students. Journal of Educational Technology, 1, 116-128.
- Levy, J. (1983). Language, cognition, and the right hemisphere: a response to Gazzaniga. American Psychologist, 38, 538-541.

- Loebelsson, A. (1988). Survey of interior design's top 100 giants. Interior Design, 59, 149-151.
- Logan, G. (1985). Skill and automaticity: Relations, implications, and future directions. Canadian Journal of Psychology, 39, 367-386.
- Loyd, B. & Gressarc, C. (1984). Reliability and factorial validity of Computer Attitude Scales. Educational and Psychological Measurement, 44, 501-505.
- Loyd, B., & Loyd, D. (1985). The reliability and validity of an instrument for the assessment of computer attitudes. Educational and Psychological Measurement, 45, 903-908.
- Mackay, D.G. (1982). The problems of flexibility, fluency, and speed-accuracy trade-off in skilled behavior. Psychological Review, 89, 483-506.
- Majer, K.S. (1969). A study of computer-assisted multi-media instruction augmented by recitation sessions. (Tech. Rep. No. 1, CAI Center, Institute of Human Learning) Tallahassee, Fla.: Florida State University.
- McLain-Kark, J. (1991). The designer's AutoCAD tutor. New York: Van Nostrand Reinhold.
- McLain-Kark, J., & Rawls, S. (1988). CAD education in interior design: Computers and the creative process. Journal of Interior Design Education and Research, 14, 23-26.
- McLain-Kark, J., & Tang, R. (1986). Computer usage and attitudes toward computers in interior design field. Journal of Interior Design Education and Research, 12, 25-32.
- Newell, A., & Rosenbloom, P.S. (1981). Mechanisms of skill acquisition and the laws of practice. In J.R. Anderson (Ed.), Cognitive skills and their acquisition (pp. 1-55). Hillsdale, N.J.: Erlbaum.
- Owen, C. (1990). Design education in the information age. Design Studies, 11, 202-206.
- Pask, G., & Scott, B. (1972). Learning strategies and individual competence. International Journal of Man-Machine Study, 3, 217-253.
- Poplin, M., Drew, D., & Gable, R. (1984). CALIP: Computer aptitude, literacy, and interest profile. Austin, TX: Pro-Ed.

- Rigney, J.W., & Towne, D.M. (1970). TASKTEACH: A method for computer-assisted performance training. Human Factors, 12, 285-296.
- Sawrey, J.M., & Telford, C.W. (1975). Adjustment and personality. Boston: Allyn & Bacon.
- Shiflett, S.C. (1989). Validity evidence for the Myers-Briggs type indicator as a measure of hemisphere dominance. Educational and Psychological Measurement, 49, 741-745.
- Snow, R. (1980). Aptitude, learner control, and adaptive instruction. Educational Psychologist, 15, 151-158.
- Smith, A.D. (1989). Ensuring worker comfort and optimum output in a CAD environment. National Productivity Review, 8, 119-128.
- Steinberg, E. (1977). Review of control on computer-assisted instruction. Journal of Computer-Based Instruction, 3, 84-90.
- Taggart, W. & Torrance, E.P. (1984). Administrator's Manual: Human Information Processing Survey. Bensenville, IL: Scholastic Testing Service.
- Tallmadge, G.K., & Shearer, J.W. (1969). Relationships among learning styles, instructional methods, and the nature of learning experiences. Journal of Educational Psychology, 60, 222-230.
- Tallmadge, G.K., & Shearer, J.W. (1971). Interactive relationships among learner characteristics, types of learning, instructional methods, and subject matter variables. Journal of Educational Psychology, 62, 31-38.
- Taylor, J.E., Montague, E.K., & Hauke, R. (1970). The interrelationships of ability level, instructional system, and skill acquisition (Professional Paper 29-70). Alexandria, VA: Human Resources Research Organization.
- Tovey, M. (1984). Designing with both halves of the brain. Design Studies, 5, 219-228.
- Wolman, B.B. (1973) Dictionary of behavioral science. London: McMillan.

**APPENDIX A:
SURVEY QUESTIONNAIRE**

6. I feel intimidated by CADD.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
7. I could get good grades in CADD course.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
8. I have a lot of self-confidence when it comes to working with CADD.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
9. I am not the type to do well with CADD.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
10. I am sure I could do advanced work in CADD.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
11. I like working with CADD.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
12. Figuring out CADD problems does not appeal to me.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
13. Once I start working on CADD, I find it hard to stop.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
14. I do not understand how some people can spend so much time working with CADD and seem to enjoy it.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
15. I will need a firm mastery of CADD for my future work.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
16. I can not think of any way that I will use CADD in my career.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8
17. CADD usage is beneficial in interior design field.
 (Strongly Disagree) (Strongly Agree)
 1 2 3 4 5 6 7 8

18. Using CADD is more accurate than manual drafting.
(Strongly Disagree) (Strongly Agree)
1 2 3 4 5 6 7 8
19. On a scale of 1-10, how would you rate your skill with Auto-CAD? _____ (1=very low, 10=very high)
20. On a scale of 1-10, how would you rate your preference for CADD? _____ (1=I hate it, 10=I love it)
21. OTHER COMMENTS:

**APPENDIX B:
THE KEIRSEY TEMPERAMENT SORTER**

KEIRSEY TEMPERAMENT SORTER

SS# _____

Please circle either (a) or (b) that best suits your answer. ALL ANSWERS WILL BE KEPT CONFIDENTIAL.

1. **At a party do you**
(a) interact with many, including strangers
(b) interact with a few, known to you
2. **Are you more**
(a) realistic than speculative
(b) speculative than realistic
3. **Is it worse to**
(a) have your "head in the clouds"
(b) be "in a rut"
4. **Are you more impressed by**
(a) principles (b) emotions
5. **Are you more drawn toward the**
(a) convincing (b) touching
6. **Do you prefer to work**
(a) to deadlines (b) just "whenever"
7. **Do you tend to choose**
(a) rather carefully (b) somewhat impulsively
8. **At parties do you**
(a) stay late, with increasing energy
(b) leave early, with decreased energy
9. **Are you more attracted to**
(a) sensible people (b) imaginative people
10. **Are you more interested in**
(a) what is actual (b) what is possible
11. **In judging others are you more swayed by**
(a) laws than circumstances
(b) circumstances than laws
12. **In approaching others is your inclination to be somewhat**
(a) objective (b) personal
13. **Are you more**
(a) punctual (b) leisurely

14. **Does it bother you more having things**
(a) incomplete (b) completed
15. **In your social groups do you**
(a) keep abreast of other's happenings
(b) get behind on the news
16. **In doing ordinary things are you more likely to**
(a) do it the usual way (b) do it your own way
17. **Writers should**
(a) "say what they mean and mean what they say"
(b) express things more by use of analogy
18. **Which appeals to you more**
(a) consistency of thought
(b) harmonious human relationships
19. **Are you more comfortable in making**
(a) logical judgments (b) value judgments
20. **Do you want things**
(a) settled and decided (b) unsettled an undecided
21. **Would you say you are more**
(a) serious and determined (b) easy-going
22. **In phoning do you**
(a) rarely question that it will all be said
(b) rehearse what you'll say
23. **Facts**
(a) "speak for themselves"
(b) illustrate principles
24. **Are visionaries**
(a) somewhat annoying
(b) rather fascinating
25. **Are you more often**
(a) a cool-headed person (b) a warm-hearted person
26. **Is it worse to be**
(a) unjust (b) merciless
27. **Should one usually let events occur**
(a) by careful selection and choice
(b) randomly and by chance
28. **Do you feel better about**
(a) having purchased (b) having the option to buy

29. **In company do you**
(a) initiate conversation (b) wait to be approached
30. **Common sense is**
(a) rarely questionable (b) frequently questionable
31. **Children often do not**
(a) make themselves useful enough
(b) exercise their fantasy enough
32. **In making decisions do you feel more comfortable with**
(a) standards (b) feelings
33. **Are you more**
(a) firm than gentle (b) gentle than firm
34. **Which is more admirable:**
(a) the ability to organize and be methodical
(b) the ability to adapt and make do
35. **Do you put more value on the**
(a) definite (b) open-ended
36. **Does new and non-routine interaction with others**
(a) stimulate and energize you
(b) tax your reserves
37. **Are you more frequently**
(a) a practical sort of person
(b) a fanciful sort of person
38. **Are you more likely to**
(a) see how others are useful
(b) see how others see
39. **Which is more satisfying:**
(a) to discuss an issue thoroughly
(b) to arrive at agreement on an issue
40. **Which rules you more:**
(a) your head (b) your heart
41. **Are you more comfortable with work that it**
(a) contracted (b) done on a casual basis
42. **Do you tend to look for**
(a) the orderly (b) whatever turns up
43. **Do you prefer**
(a) many friends with brief contact
(b) a few friends with more lengthy contact
44. **Do you go more by**
(a) facts (b) principles

45. **Are you more interested in**
(a) production and distribution
(b) design and research
46. **Which is more of a compliment:**
(a) "There is a very logical person."
(b) "There is a very sentimental person."
47. **Do you value in yourself more that you are**
(a) unwavering (b) devoted
48. **Do you more often prefer the**
(a) final and unalterable statement
(b) tentative and preliminary statement
49. **Are you more comfortable**
(a) after a decision (b) before a decision
50. **Do you**
(a) speak easily and at length with strangers
(b) find little to say to strangers
51. **Are you more likely to trust your**
(a) experience (b) hunch
52. **Do you feel**
(a) more practical than ingenious
(b) more ingenious than practical
53. **Which person is more to be complimented: one of**
(a) clear reason (b) strong feeling
54. **Are you inclined more to be**
(a) fair-minded (b) sympathetic
55. **Is it preferable mostly to**
(a) make sure things are arranged
(b) just let things happen
56. **In relationships should most things be**
(a) renegotiable
(b) random and circumstantial
57. **When the phone rings do you**
(a) hasten to get to it first
(b) hope someone else will answer
58. **do you prize more in yourself**
(a) a strong sense of reality
(b) a vivid imagination

59. **Are you drawn more to**
(a) fundamentals (b) overtones
60. **Which seems the greater error:**
(a) to be too passionate (b) to be too objective
61. **Do you see yourself as basically**
(a) hard-headed (b) soft-hearted
62. **Which situation appeals to you more:**
(a) the structured and scheduled
(b) the unstructured and unscheduled
63. **Are you a person that is more**
(a) routinized than whimsical
(b) whimsical than routinized
64. **Are you more inclined to be**
(a) easy to approach (b) somewhat reserved
65. **In writings do you prefer**
(a) the more literal (b) the more figurative
66. **Is it harder for you to**
(a) identify with others (b) utilize others
67. **Which do you wish more for yourself:**
(a) clarity of reason (b) strength of compassion
68. **Which is the greater fault:**
(a) being indiscriminate (b) being critical
69. **Do you prefer the**
(a) planned event (b) unplanned event
70. **Do you tend to be more**
(a) deliberate than spontaneous
(b) spontaneous than deliberate

VITA

Youngsook Lim was born in Korea in July 27, 1965. She graduated from Kyungpook Girls' High School in 1984 and received a Bachelor of Arts degree in English Language & Literature from Kyungpook National University in Korea in March, 1988. From February to August, 1988, Youngsook was an English instructor at the SDA English Institute in Korea. She also worked as a part-time counselor at the American Counseling Center in Taegu, Korea from March to August, 1988.

Youngsook began her graduate studies in the United States in August, 1988 and received a Master of Science degree from Virginia Polytechnic Institute & State University with specialty in Interior Design in July, 1991.

During her graduate study, she was a Graduate Assistant in the Department of Housing, Interior Design, & Resource Management where she directed Interior Design Resource Library and Computer-Aided Design Laboratory. In March 1991, her abstract was accepted to Interior Design Education Council (IDEC) and was presented at the IDEC Annual Conference held in Arlington, Virginia. She is currently a student member of the American Society of Interior Design (ASID) and Interior Design Education Council (IDEC).


Youngsook Lim