ARCHITECTURAL EDUCATION:

A One-Year Longitudinal Study in Design Drawing Methodology

Master Report By:

Wendle R. Bertelsen

College of Architecture
University of Arizona
Tucson, Arizona

Committee: William Kirby Lockard, Professor of Architecture
Fred S. Matter, Director of Graduate Studies
Professor of Architecture
Kenneth N. Clark, Professor of Architecture

This Master Report has been approved on the date indicated below:

Fred S. Matter

Professor Fred S. Matter, Director of Graduate Studies
College of Architecture, University of Arizona, Tucson, Arizona

Dec. 6, 1985

Date

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PREFACE

This study is an exploration of teaching methodology in architecture. Its goal is to improve the quality of architectural education. The hope is that by investigating methods of delivery, testing and analyzing the results, something concrete may be learned about perceptual skills and strategies for improved teaching methodologies of design drawing courses in architecture and related fields.

CREDITS

This study is a Masters report. It is a partial requirement for the degree, Master of Architecture, College of Architecture, University of Arizona at Tucson, Arizona.

I am indebted to many faculty members in the College of Architecture, University of Arizona. First, I wish to thank Professor Kirby Lockard, Professor Fred S. Matter, and Professor Kenneth N. Clark for serving on my graduate committee. A special thanks to Professor Lockard for allowing the necessary research for this study to be administered in his first-year design drawing course. Without his support in this study, the research would not have been possible.

I also wish to thank Karl Rald, Video; Brody Lockard, Computer Programming; Dr. David Krus, ASU Testing Services, Statistics; Dr. Nancy Haas; Instructional Design; Kristine Erickson, Word Processing; and the many students who took part in the demographic study and test conscientiously.

Finally, thanks to my wife Betty for her typing and editing skills and loving support during the past two years of graduate study.

OVERVIEW

OVERVIEW

Many teaching problems are the result of the lack of the knowledge and understanding about educational principles, rather than the lack of commitment. Much time is wasted, sometimes years of valuable time, not to mention the money spent through poor planning or lack of application. For example, failing to communicate with students because we did not know the important range of background education...or alienating many in lecture courses because we took for granted issues which were cultural and not understood...or trying to design courseware without thoroughly understanding its impact...or utilizing or not utilizing new delivery systems (computers, laser-disc video), because we did not research its effectiveness...or assigning only handouts or reading assignments without recognizing or researching the magnitude of students where English was their second language...or presenting a body of knowledge without first understanding the principles of perception before selecting a delivery system, or systems...or having to teach in awkward or inadequate rooms because we did not schedule or plan in advance. These problems, and many more, have been identified and have been hindrances to providing quality architectural education by reason of our lack of adequate planning or research. To this end, a one-year longitudinal study of architectural students was initiated.

Beginning with more than one hundred architectural students; as much information as possible about themselves, about their skills, and biographical data was collected.

What resulted was a beginning study of architectural students in studio/lecture situations. This report attempts to present the findings in as systematic a form as possible. We began by developing various delivery systems, pre-testing the systems, testing, and collecting biographical information, and then proceeding to analyze the database; and at that point to present findings, question the findings and suggest areas of additional research.

The setting for the study is the College of Architecture, University of Arizona, Tucson, Arizona.

Why a school? A school presents a convenient location for observing a large number of architectural students. But, more compelling is the reason that without a professional degree in architecture, it becomes very difficult to practice architecture. For all purposes, one needs the diploma. Architects need the professional training as much as doctors and lawyers. Hence, a majority of serious students interested in architecture are found in schools and colleges of architecture.

Why this college? The reason for choosing this college is its visibility, both regionally and nationally, in the area of design drawing as a means to architecture. Over the past two decades, the faculty has published many books, articles, and professional papers in the area of theory and concept development.

Given the interest in the drawing process, and more specifically in the beginning, or "core" program, the architectural drawing course at the first-year level provided an ideal sample. And finally, young candidates in their formative stages, presumably not yet committed to a style or ideology does not foreclose the study of their development and change. This leaves open the potential study in the future for following the student on through graduation and into the profession.

INTRODUCTION

INTRODUCTION

The study of perception deals with the way in which we sense, or become immediately aware of our environment. Being one of the earliest stages in cognition, perception has an important influence on other stages of learning, such as conceptualizing, problem-solving, and synthesis. The reciprocal is also true, that the other aspects of the design process will markedly influence perception. For example, prior experiences, education, likes and dislikes, influence how we perceive. Fundamentally, perceptual principles are pertinent because one perceives before one learns, and those perceptions set important limits and conditions on what one learns (Fleming, 1981).

Therefore, the study of perception is of great interest to the application of delivery systems in teaching design drawing. There are several reasons which bear on the knowledge and understanding of these principles. First, the better an object or environment is perceived, the better it can be remembered (Berelson & Steiner, 1964). Secondly, it is important to avoid misperceptions. If the delivery system delivers falsely, or inadequately the intent, or content of the lecture, videotape or computer program, misunderstanding may result or false information may be learned.

Finally, where it is desirable to substitute the real world with a substitute or surrogate, such as a slide presentation, videotape or drawing, it is important to know how to represent that reality adequately (Hochberg, 1966).

There are many factors or theories which attempt to explain the principles of perception. There are five principles basic to perception (Forgus, 1966; Helson, 1974; Rock, 1975; Triesman, 1974; Dodwell, 1975). There are three basic theories dealing with perception of figures, objects and environments(Berelson and Steiner, 1964; Murch, 1973). Then, there is the theory of single and two-channel perceptual capacity (Travers, 1966; Standings, Conezio and Haber, 1970). And finally, the theories of perception of size, depth, space, time, and motion (Haber and Hershonson, 1973; Rock, 1975). However, since this report is not a review of past research, the citations indicated are illustrative only. To a large extent, the delivery system theories build upon and complement those cited.

Part 1: DELIVERY SYSTEMS

Computer

Handout

Lecture

Videotape

DEMOGRAPHICS

Questionnaire

Demographics

Demographic Survey

Part 1: DELIVERY SYSTEMS

The methodologies, or procedures which were used were not intended to produce a subjective and impressionistic account of architectural schools, students, or design drawings. The intent was very modest, and somewhat risky. The procedures for the study were designed to explore the possibilities of a systematic, possibly experimental, investigation into the cognitive and spatial perception development of architectural students, using concepts and methods of the behavioral sciences.

The specific methodologies and concepts were not at hand, ready to be applied to understand the complexities of the student or the system of delivering information to the student, although there were some general procedures. Therefore, it meant that much time had to be devoted to develop procedures step-by-step as the study wend along. New questions arose, new methods evolved, on the basis of results obtained from preceding methods. Each new study into delivery systems helped to shape the study of another delivery system.

The study focused on first-level design drawing students at the University of Arizona. Fifty-four percent of these students were freshmen. Since they had just entered the College of

Architecture, one could question their commitment to architecture. However, since much evidence exists showing that all social groups share the same images of the professions (Reiss, 1961; Shinar, 1975; O'Dowd and Beardsley, 1960; and Gottfredson, 1981), their commitment vis-a-vis their image of architecture, would by and large be the same. This then was the target population. More importantly was the fact that the student was a beginning architectural student, with all the confusion and vagueness that would imply.

The four major types of delivery systems chosen to be tested (computer, handout, lecture, and videotape) are interrelated. Taken together, they represent diversified strategy for the deliverance of a fixed body of knowledge. To be able to formulate design drawing cognitive and spatial perception in a variety of delivery systems is basic to this report. The main goal of the study is to answer the question: how do architectural students extract information from their environment? And, what procedures or methodologies enhance that capability? The odds were that with this kind of limited experimental process one would not get us any closer to the answer. However, it might give a clue to the success of the procedures. Much of the research was the grappling with the undefined issues crucial to design drawing and the diverse modes, of presenting it.

Delivery system modes versus attributes: The issues researchers have raised such as, "Is videotape (television) more effective than lecture?" and other similar inquiries have been called media comparison studies (Fleming and Levi, 1981). There are hundreds of research cases dealing with learning and these types of delivery systems. However, the overwhelmingly predominant finding has been the same: No significant difference.

According to Fleming, the problem lies in the research question. The aspect of the channel that determines its effectiveness is not the delivery system used, but the media attributes employed. A media attribute is a potential to present information of a certain kind by a given delivery system. The questions one might ask are: Is the delivery system icon (picture) oriented? Is color possible? Can sound be used? Can motion be shown? Is the presentation flexible or fixed? In what ways can the user interact with the delivery system? Research, however, on the effectiveness of the attributes of the delivery systems is virtually non-existent.

Computer

In spite of its common usage, computers are a relative stranger in the architectural drawing studio. Bell (1969), in writing about the industrial versus the post-industrial society, states: "A service profession, to a great extent, is based more on a person-to-person relation rather than a machine-to-machine relation." What then is the consequence of a person-to-machine relationship? Such a system was developed (B. Lockard, 1984) at Stanford, utilizing the Plato computer program. The content of the program was written by K. Lockard (1983) for use in the design drawing course. It covered all the major principles of perceiving space represented by surfaces and edges, and a drawing technique appropriate to classify them. Computers then became the first system. The question then is: How effective is this system, and what are its attributes?

For purposes of this study, one section of twenty-five students were directed to the University of Arizona Engineering Center for a one-hour block of time. During that period, students were introduced to the computer hardware and software. The software was a CAI (Computer-Aided Instruction) interactive program which tested students' understanding of common content area: spatial perception, as explained in the next part of the study.

Handout

Since the advent of copy services, the prevalence of distributing handouts seems to have increase markedly. Faculty give handouts for design programs, for programming information, and for just about every conceivable concern. Handouts became an experimental part of this study. Design drawing information was photo-copied from the text, "Design Drawing" for the course. Those few pages which dealt specifically with spatial edges was then distributed to one section of 25 students. No further explanation was offered, except that the handout material would be tested in one week.

The above system is one which stems from the humanistic view which realizes that learning is something students must do for themselves. "Effective" education is student-centered. The emphasis is for discovery and meaning. Faculty direct less and students take more initiative and more responsibility for their educations (Fuhrman and Grasha, 1983).

Lecture

Historically, lecturing emerged as a supplement to recitation. However, the question remains; is lecturing an effective delivery system in design drawing? The answer is not always clear. Yet, one form of lecturing associated with architecture seems to have a great deal of credibility - a lecture-demonstration. It answers many questions raised by Fleming, for the media has many attributes. It is possible to have color, icon (pictures), motion, sound and flexibility. Therefore, it employed not only a single channel (vision or sound), but two channels. Two channel research has been extensive and mostly positive. That is, multiple modes, (audio-visual) can be an effective system to perception and learning.

Controversy is raised, however, when presentation is so rapid the receiver must choose between the two channels. Overloading either channel, presenting unrelated cues, and inputting information too rapidly will cause interference with the perceptual process.

Specifically, the lecture and its content for the study was prepared and delivered as a two-channel (audio-visual) presentation. A single lecture period was devoted to the presentation of material on spatial perception related to surfaces and edges. This system was delivered to one of the sections of approximately twenty-five students. And, as with all four sections, a short multiple answer test was administered a week later.

Videotape

The last of the four delivery systems used in the study was videotape. It was chosen primarily because of its acceptance in our society as a powerful communications media. Videotape has been used several times in research on performance. Ferreire (1981), used videotape feedback to find performance increase in university students in a motor learning lab. The conclusions indicated that a small quantity of videotape feedback as a supplement to demonstration and practice is efficient in learning a balanced motor skill. Steinmetz (1982) concluded with similar findings on the effects of videotape feedback on the development of presentation skills using both experimental and control groups in speech delivery.

In the field of architecture, Rald (1983), at the University of Arizona, videotaped Professor Kirby Lockard for this portion of the study. Opening with Professor Lockard in the Centrum, the issue of spatial edges was documented and later shown to a section of students. The tape was twenty-five minutes long. If we had to guess at this point, we might conclude that videotape as employed in this study would be an effective medium for learning. It answered many research questions that Fleming posed: Is color possible? Yes. Can sound be used? Yes. Can motion be used? Yes. Is the delivery system icon (picture) oriented? Again the answer is yes. However, the video mode is not flexible. And the user cannot interact at this point in its technical development with the system. The question remains to be answered: Is videotape a viable alternative to lecturing or handouts or computer simulation in teaching spatial perception in architecture?

DEMOGRAPHICS

Questionnaire

In this portion, we turn to the students themselves and to some of the biographical information obtained from a questionnaire given to them.

Why questionnaires, or "demographic" studies of students? It was important to describe this group as accurately as possible. Even more important, it would provide a database for comparison with other student "norms", or other colleges of architecture for future study.

At this point, it became necessary to obtain the professional advice of other disciplines. The questionnaire needed to be selected. The single most commonly used tool in the behavioral sciences is statistics. All areas of the behavioral sciences rely on descriptive statistics, which are used to describe the results of research studies in an efficient way. Descriptive statistics provide a summary of data. These were calculated in the form of percentages, means, frequencies and standard deviations.

Recruitment of the students was handled by the faculty of the first-year drawing course. Professor William Kirby Lockard of the College of Architecture at the University of Arizona developed this drawing course over the past two decades and facilitated the research for this study. Graduate teaching assistants from the College of architecture helped administer the questionnaire and testing. The course was composed of four studio sections with a common lecture period held twice each week. All four sections were "recruited," and the purpose of the study was explained. Of the total of 103 students in the common lecture, eighty-nine, or 86.4 percent completed one of the four testing devices. This presented the study with a large percentage of the population as a sample and gave serious credibility to this limited longitudinal study. Because of the need to pre-test the instruments, the study was continued over two semesters. Only a small amount of student time was devoted to the study; twenty minutes for the demographics, one hour for the "delivery" of content, and twenty minutes for the test. This procedure took place over a period of six weeks.

Demographics

Demographically, architectural students are changing, and so is architectural education. General demographic items were collected; such as student's age, sex, sibling position, family income, and education. Other items were categorized into ethnic or racial group and a question about native or secondary language for there seems to be a strong correlation between the two.

Indeed, if the magnitude is great, it should certainly manifest itself in teaching procedures, counseling, and retention policies.

Values make our lives consistent and meaningful. One of the areas of inquiry that needed more work than time permitted in this limited study is the area of values. Only two questions were asked, and those covered only one of the six areas which the Allport-Vernon-Lindsey Study of Values tests (Allport-Vernon-Lindsey, 1960). The one area concerning values in the demographic study related to the students' values in religion The remaining areas of the Allport-Vernon-Lindsey study are students' values in these additional areas: theoretical, economic, social, esthetic, and political.

Attitudinal information was gathered to determine a database for interest in the high technical hardware, software and coursework related to computer and videocassette (VCR).

The length of the questionnaire was made to be as concise as possible, and followed guidelines established by the behavioral sciences.

The results of the demographic questionnaire were tabulated and recorded for each student. Statistical percentages were determined and are contained in the next section as a demographic summary.

Demographic Summary

Although the College of Architecture at the University of Arizona is a post-secondary degree-granting institution, the majority of students did not enter the architectural program directly from high school. Almost 12 percent had already completed college elsewhere, and 46 percent had other prior college experiences - mostly community college. The students are somewhat older than many college students at the beginning year of their major; the average age in the first year design drawing class is 21.98 years.

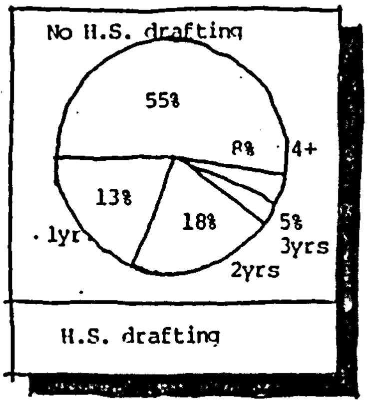
The economic and social background of the students is varied. All strata of social and economic levels are represented. Twelve percent came from homes earning below $15,000 per year. One quarter of the students came from families with an annual income of between $15,000 and $30,000. The majority by far of the homes represented earned $30,000 annually or more - a substantial 63 percent. Unemployment was not a problem for many fathers. Only 2 percent reported unemployment. In contrast, 30 percent of the fathers were junior executives and above. Forty-five percent were white collar workers and 23 percent indicated father's occupation as blue collar. Mothers play an important economic role. Sixty-four percent of the mothers were employed. Eleven percent were blue collar, 43 percent were white collar, and 10 percent reported their mothers as being junior executives and above.

The father's and mother's education was mostly at the college graduate level, with many having post-graduate work. Sixty percent of the fathers were college graduates and 35 percent of those had post-graduate work. Thirty percent of the mothers were reported to be college graduates, with 14 percent having post-graduate work.

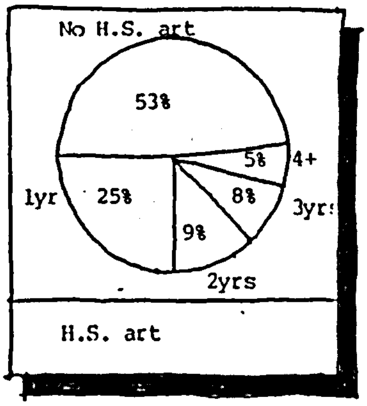
A very large percent of the students came from intact families; only 17 percent reported their parents separated or divorced. The breakdown of religious preferences included 17 percent Protestant, 31 percent Catholic, 39 percent other, and 13 percent indicated "none" under religion. Surprisingly, for those who hold the stereotype for the overloaded architecture student, almost one-third (30 percent) were reported to have found time to attend religious services at least once a month. The ethnic or racial mix of the students is unusually heavy with Asian, or Middle Eastern flavor. Although 69 percent were Caucasian, Asian or middle Eastern students made up 17 percent of the first-year design drawing course students, Hispanics composed 12 percent, Blacks, 2 percent, and no American Indians were reported in the survey. As a result of the relatively large percent of both Asian or Middle Eastern and Hispanic students, it is not surprising that 19 percent of the students reported English as their second language.

There seems to be a certain ambivalence toward high-technical impact among this group of architectural students. Twenty-five percent of the students reported owning personal computers, yet only 57 percent indicated they would be willing to spend their own money to purchase a personal computer. On the other hand, 45 percent indicated they already own VCRs (video cassette recorders). Interest in purchasing a computer seems to be directly related to computer instruction. Fifty percent of the students have already taken some computer coursework.

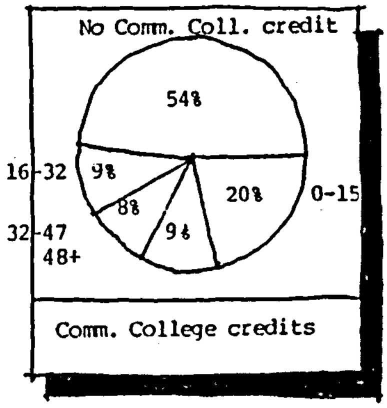
Many had drafting skills



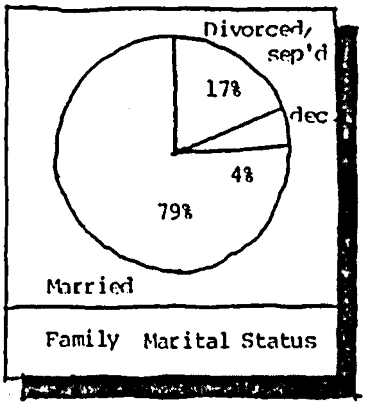
Many had art skills



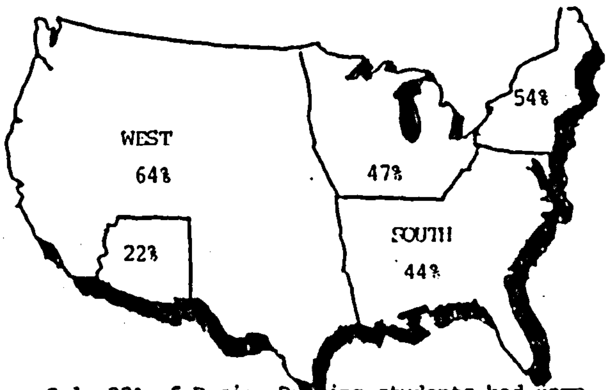
Comm. College experience?



Intact families



Computer programming comparison (51% national H.S. avg.)



Only 22% of Design Drawing students had comp. prog.

Part 2: TEST

Content

Administration

Results

Lecture Delivery System

Videotape Delivery System

Part 2: TEST

Content

Although personal interviews and firsthand observations are important procedures, certain questions cannot be answered alone by interviews and observation. For example, what is the level of intelligence or spatial perception skills among architectural students? How does it compare with those individuals of the same sex, age, and education? What values are prevalent among architectural students? What kind of family structures do architectural students come from? How do they compare with other groups?

To answer questions of this order, recourse to some standard instruments was considered. Instruments most commonly employed by educators and researchers are: intelligence tests, perceptual measures, value and demographic questionnaires, and personality inventories. The problem is: which instruments? Insofar as there are no generally recognizable, or acceptable schemes applicable to architectural students, no certain guidelines for choosing instruments seemed certain.

Since these early stages of study were not designed to test hypothesis, but to explore possibilities, it seemed prudent to select certain instruments, tailor them to architecture, and collect data in areas related to architectural performance.

The criteria for selecting an instrument were the presumed relevance of what it measured to the study of perception, notably, spatial perception in architectural students, the suitability of the instrument to students, the ease of administration without disrupting the normal flow of programmed assignments and exercises, and its usefulness as a future instrument with this and other similar groups for comparative data. (See Appendix for an example of the test instrument.)

Administration

Perhaps the best way to begin gathering information on the profile of an entering architectural student in design drawing is to sketch an outline of his/her way of thinking and perceiving. The standard manner in which this outline is accomplished is to seek out IQ Tests and standard three-dimensional objects in two-dimensional space testing. But these standard tests do not measure the crucial ability of spatial perception required for a first-year drawing course. Therefore, a test, critical to the success of this particular drawing course and one which had its content well-rooted in the required text by Professor Lockard, was developed.

The first portion of this test instrument dealt with the cognitive domain of memory principles and concept learning. The last portion of the instrument required distinctions in the area of visual and spatial perception, notably spatial profiling of edges in perspective drawing.

The test was administered in a lecture hall during a normally scheduled one-hour lecture and was given to all four sections simultaneously.

The answers were multiple choice and grading was conducted by University Testing Services Using an optical scanner on an IBM Answer Sheet. Results of the test included the following:

- alphabetized class list
- score distributions
- item analysis
- estimates of item convergence and discriminate validities
- descriptive statistics for test score distribution
- analysis of item difficulties distribution
- reliability analysis
- graphical plot of the distribution of test scores

The specific information gathered from the list above about each student who took the test included:

a. Test score (maximum correct answers = 24) for each student

b. Student's relative standing in the group

c. Student's level of mastery (100 percent = all correct answers)

d. Intergroup comparison score (mean = 100)

e. Student test score compared to mean score for sub-group

The instrument was pre-tested the semester before the final test was administered.

Results

The test results led to a central conclusion; although success in the test of spatial perception can be attributed to the delivery system to some extent, this prediction of success cannot be generalized from one sub-group of students to another. There was no way to analyze statistically all 89 students in the short time of this study. The best that can be done is to look at the test results, make some observations, but not become dogmatic regarding the test scores analysis.

Lecture Delivery System

Yet, the results are interesting. Of all four delivery systems, the highest mean score and the smallest standard deviation is the "lecture" delivery system. Lecture students scored a mean of 19.80, with 24 being the maximum possible correct answers. This can be compared to the handout delivery system which had a mean score of only 16.23, and a standard deviation of 4.95. This was the lowest mean score of all delivery systems. The difference may mean that a high quality lecture from an authority on the subject area whose presentation is supplemented by slides and overhead projection provides greater perception and memory retention of visual, spatial material than does a handout without any explanation.

Videotape Delivery System

Given these circumstances, one can also understand why both the computer and videotape delivery systems fared better than the handouts. The computer students scored almost one point higher than the handout mean at 17.4. However, the standard deviation was greater which meant the spread around the mean was greater, indicating greater variability in scores. The second highest mean scores were the videotape delivery students, with a mean of 18.50, only 1.30 points below the mean for lecture students. The videotape delivery students scored very high in perception, memory retention, and conceptualization. Needless to say, more testing, especially in terms of what these systems could become if more research in architectural education would be done on perfecting the newer technology; then serious questions concerning the validity of each system could be answered.

Summary of Test Scores and Delivery Systems

Everything points to the conclusion that cognition of empirical knowledge is best presented by diversified delivery systems. Perhaps the more diversified the system becomes, the greater the perception and understanding of the knowledge.

Part 3: TEST SCORE AND DEMOGRAPHIC CORRELATIONS

Significant Correlations
Review
Secondary Correlations

Part 3: TEST SCORE AND DEMOGRAPHIC CORRELATIONS

The profile of the architectural student that will take form here will not reveal any essential traits of success in architecture. At the moment, the task is much simpler; to provide a description of beginning architectural students who have chosen an intensive university undergraduate program.

What measures can be looked at? And, what characteristics might one look for which distinguish the architectural student from others? How important are hand-skills, i.e., drafting and drawing, to the beginning architectural student and are those skills measurably different from those students who are not as successful in spatial perception tests?

Four delivery systems were used to determine the success of architectural students in our sample: computer, handout, lecture and videotape. Having devised a method for delivering a body of knowledge related to spatial perception, and having tested each delivery system with one common test, one reaches a crucial point in this phase of the methodology: the analysis of the results.

If the models developed for the delivery were valid, then there should be a systematic relationship between the delivery systems and the test results.

The effectiveness of the delivery systems was expected to correlate with the test scores. Since performance in pressure situations in school is one of the earliest determinants in the selection of continuing architectural students, the study wanted to determine what delivery systems were most appropriate for spatial perception material, and what characteristics of students were most closely associated with higher test scores and success in drawing courses at the freshman level in architecture.

Review:

The descriptive statistic used in this study is called the Pearson Product Moment Correlation Coefficient. It is a measure of correlation. It can take on any numerical value from -1.0 through 0.0 up to +1.0. A perfect correlation would be a -1.0 or +1.0. Correlations close to zero would mean there is little or no relationship between the two variables.

Significant Correlations

No one expects a one-to-one relationship between test scores in spatial perception with demographic variables. Yet, test scores are an important criteria at this stage of a student's development.

Since the relationships, both among the descriptive variables and the correlations vary so much, few generalizations are possible. To get a set of relationships with any precision, it was necessary to focus on each sub-group separately. The entire group was divided by high and low test scores for both male and female students. Twelve high scores and twelve low scores were chosen: six from each delivery system. These test scores were then correlated with many demographic variables (i.e., age, ACT, SAT, college credit, high school art, drafting, plane geometry, solid geometry, family income, father's education, sibling position, ethnic background, the knowledge of English and computer courses).

Gender

Female architecture students out-performed their male counterparts in the study on spatial perception. They composed 58.33 percent of the high-scoring group, compared to 41.67 percent males in the same group. In tests with related fine arts students, males were found superior to females in difficult spatial perception tasks and both were found to be significantly better than college norms as noted by Getzels and Csikszentmihalyi (1976).

Age

Older students in architecture scored higher on spatial perception tests than younger students. Sixty-six percent of the low-scoring students were nineteen years old or less. Astin (1978) confirms this result by noting that younger students are more likely to get involved in athletics and in student government, whereas older students are more likely to interact with faculty, to get academically involved, and to participate in honors programs.

ACT

The correlation between high test scores in spatial perception and high ACT scores was not significant. Also, more than one-fifth of the fitted cells were sparse in the statistical study, therefore the test was regarded suspect.

SAT

Only 33 percent of the students in the high- and low-scoring groups could report SAT scores. Therefore, the results are suspect. Greater numbers of students are necessary to achieve any degree of reliability.

Previous Community College Credit

Students who come into the architecture program with previous community college credits score much higher than students with no community college background in spatial perception tests. Almost 60 percent of the high-scoring students had prior community college credit. Seventy-five percent of the low-scoring students had no community college credit. Clearly, college experience or maturation (the distinction is not clear in related research) has a positive effect on scores.

Previous College Degree

Ninety-two percent of the total high- and low-scoring group had no college degree. For this reason, the number of students in certain cells was very sparse and the results are suspect.

High School Drafting

How important are hand skills? Are traditional skills such as drafting and drawing important as prerequisites to success in beginning architectural design drawing courses? This study strongly supports high school drafting.

Almost 60 percent of the high-scoring students had drafting in high school. Almost two-thirds of the low-scoring students had no high school drafting. The probability was .094 - not significant, but worth noting.

High School Art

Counselors for colleges of architecture would do well to note that there is no correlation between high school art and success in spatial perception test as administered for this study. Whereas the arts are often experimental and abstract, the basis for architectural design drawing is controlled and rational at the

University of Arizona. Time spent on a design drawing is carefully monitored and structured. Drawings are "pressure drawings."

Plane Geometry

Are math courses such as plane geometry helpful in achieving successful scores in spatial perception tests? No! Although 96 percent of the high- and low-scoring students had taken plane geometry; 50 percent of the group scored high and 50 percent of the group scored low.

Solid Geometry

Solid geometry scored even worse than did plane geometry. Forty-seven percent of the high-scoring students had solid geometry and 53 percent of the low-scoring students had solid geometry. Evidently, both male and female students reach architecture school by many different routes. More study in this area may be necessary. It would certainly seem premature to rate descriptive geometry in such a negative light without additional research.

Success and Family Background

In determining the antecedents of success in spatial perception test of architectural students at the entry level, differences in family background was necessary. What characteristics of family life might one look for which would distinguish significant differences between or among students in architecture? The point was to establish whether there were any differences between the high-scoring group and low-scoring group.

Family Income

Do the better students come from higher socioeconomic families? There is no significant difference between the two groups. Sixty-four percent of the high-scoring students had families with high family incomes. However, 70 percent of the low-scoring students came from families with high incomes. Only 10 percent of the low-scoring group had low family income.

Father's Education (Significant)

The most significant of all the correlations in this study is the father's education. All of the high-scoring students' fathers attended college. Only 36 percent of the low-scoring students' fathers went to college. Fathers' educations also had a high correlation with many other areas. The pattern was repeated throughout: higher income family; children who had high school courses in art, drafting, plane and solid geometry; children who had community college credit before entering the university. The probability for this correlation was .001. This correlation is statistically significant in the study.

Sibling Position

No serious relationship could be found for the high and low scores of first-born children and later siblings. Why is this so unclear?

Getzels (1976) spent years performing a longitudinal study of fine art students to determine that the eldest sons are far more likely to succeed as artists than middle sons. But, again, architecture and art appear to have prerequisitive characteristics unmistakenly different in achieving success in spatial perception and other factors.

Ethnicity (Significant)

The second most significant correlation in this study links test scores and ethnicity. Low test scores were compiled by ethnic groups. The overwhelming associated correlation is that many ethnic students also indicated that English was not their primary language. It seems that these students not only had to learn a graphic drawing language which was new to them, but also struggled with English.

This study notes and lauds the large percentage of Hispanic and Asian or Middle Eastern students in the first-year architecture program, but encourages the faculty of the College of Architecture and its administrators to consider the mandate of the Tri-University Study Group on Minority Recruitment and Retention (University of Arizona, Arizona State University and Northern Arizona University) which requires an ethnic composition of approximately 2 percent Native American, 4 percent black, 13 percent Hispanic, and 1 percent Asian students in the three universities during the next ten years (1995). Additionally, the group recommends continued work on longitudinal studies of persistence of minority students to be coordinated among the universities and community colleges. This study would contain selected academic and biographic variables which examine graduation rates of entering students and methods of tracking students through the academic system.

English as a Second Language

Another student characteristic of potential interest to the Study Group of Minorities is the concern for students with English as a second language. Twenty percent of the high- and low-scoring groups indicated this variable. Sixteen percent of the students in that group scored low on the spatial perception test. These students tended to isolate themselves from their peers, but sought out graduate students from their home countries in the College of Architecture for help. It is interesting to note that one-third to one-half of the University of Arizona's students in architecture who are enrolled in the graduate program are from Middle Eastern or Asian countries.

Computer Courses

There is no correlation between the high and low test scores and having taken computer courses.

SUMMARY AND RECOMMENDATIONS

SUMMARY OF EXPLORATIONS

1. Delivery Systems:

This study began with the presumption that procedures are exploratory and that consequently a body of knowledge about spatial perception related to design drawing can be delivered many ways.

The four key delivery systems were: Computer, handout, lecture and videotape. Students grouped into four separate drawing sections were the target population. The content was spatial perception. Perception principles are based on similarities, but test scores may depend considerably on the differences that distinguish one delivery system from another.

A number of patterns emerged. Although the study was quite limited, it yielded a number of guidelines, such as:

A. Lecture/demonstration presentations which combine overhead transparencies or slides combined with a prepared, relevant lecture will provide very high test scores.

B. Videotape, a multi-channel delivery system which contains color, sound, movement, and relevance will yield less information retention if the option for replay is taken away.

C. Computer multi-channel systems which are not user-friendly, inconvenient and not used regularly will not result in significantly high test scores.

D. Handouts, which totally rely upon the initiative of the student, without faculty participation, will be weakest of all the delivery systems tests.

2. Test scores and demographic correlations:

Demographic characteristics are those variables that typically appear in statistical descriptions of populations: sex, age, ethnicity, social factors and others. While there are differences in individuals within any demographic category, some correlations between performance and demographics may be stated.

A. When high and low test scores are correlated with demographic factors, education of the parents, especially the father, is significant. According to this study, high test scores correlate significantly when father's education extended into college or beyond.

B. Ethnicity is negatively related to high test scores when English is a second language.

C. That prior hand skills such as drafting do yield higher test scores in spatial perception tests.

Recommendations

- Recommendation 1:

The continuation of longitudinal studies in architecture related to design drawing and concerns related to architectural education is recommended. A group from each Arizona university with a college of architecture or community college with a strong pre-architecture program meet periodically to review the progress of the studies, and the implementation and impact on teaching methodology and student retention, recruitment and graduation. A time frame of ten years would be appropriate for a longitudinal study to be effective.

Recommendation 2:

It is recommended colleges of architecture in other regions of the country be encouraged to develop studies in teaching methodology in architecture, specifically in the area of design drawing at the entry level. These schools and colleges should form a consortium in order to work together for research and study in the area of design drawing. No precedent exists to guide the formation of such a consortium, however, a publication such as Professor Kirby Lockard's Representation: Journal of Graphic Education could advance the notion.

<u>Recommendation 3</u>:

It is recommended that workshops for graduate students who are teaching assistants in design drawing courses be offered on a regular basis. Workshops are to be designed specifically to teach methodologies in architectural education related to design drawing. Special care would be taken to recruit graduate students who could meet the sociocultural needs of the undergraduate student body in architecture, not only the needs of minority students, but the needs of others with drawing skill development needs.

APPENDICES

APPENDIX 1

Demographic Questionnaire

1. b.

2. Sex:
(a) male (b) female

3. Age:
(a) 19 or less (b) 20-24 (c) 25-29 (d) 30-39 (e) 40 or more

4. Major:
(a) Architecture (b) Interiors (c) Industrial (d) Urban
(e) Landscape

5. ACT score:
(a) 33-30 (b) 29-27 (c) 26-20 (d) 19-16 (e) 15-0

6. SAT score:
(a) 1600-1401 (b) 1400-1201 (c) 1200-1001 (d) 100-801 (e) 800 or less

7. Previous community college credit:
(a) none (b) 0-15 (c) 16-32 (d) 32-47 (e) 48 or more

8. Previous college degree(s):
(a) none (b) Bachelors (c) Masters (d) Doctorate (e) Associated Degree

9. High school drafting courses:
(a) none (b) 1 year (c) 2 years (d) 3 years (e) 4 years

10. High school art courses:
(a) none (b) 1 year (c) 2 years (d) 3 years (e) 4 years

11. College drafting courses:
(a) none (b) 1 year (c) 2 years (d) 3 years (e) 4 years

12. College art courses:
(a) none (b) 1 year (c) 2 years (d) 3 years (e) 4 years

Which math courses have you taken:

13. Plane geometry: (a) yes (b) no

14. Solid gemoetry: (a) yes (b) no

15. Do you draw right-handed: (a) yes (b) no

Family Information

16. Father's occupation:
(a) blue collar (b) white collar (c) junior executive and above
(d) unemployed outside home

17. Mother's occupation:
(a) blue collar (b) white collar (c) junior executive and above
(d) unemployed outside home

18. Family income:
(a) below $15,000 (b) 15,000-30,000 (c) 30,000 and above

19. Father's education:
(a) high school or less (b) H.S. graduate (c) some college
(d) college graduate (e) post-graduate work

20. Mother's education:
(a) high school or less (b) H.S. graduate (c) some college
(d) college graduate (e) post-graduate work

21. Marital status of parents:
(a) married (b) separated, divorced (c) deceased

22. Sibling position:
(a) eldest (b) middle (c) youngest (d) only child (e) other

23. Religion: (a) Protestant (b) Catholic (c) other (d) none

24. Church attendance:
(a) once a month or more (b) less often than once a month
(c) not at all

25. Ethnic or racial group:
(a) Am. Indian (b) Asian or Middle Eastern (c) Black (d) Caucasian
(e) Hispanic

26. Is English your second language? (a) yes (b) no

27. Do you or your family own the following computer?
(a) none (b) IBM PC/IBM Compatible (c) Apple IIe/IIc
(d) MacIntosh (e) other

28. Which computer courses have you taken?
(a) none (b) Intro to Computer Science (c) Computer-Aided Design
(d) Computer Graphics (e) programming course(s)

29. Do you or your family own a VCR (video cassette recorder)?
(a) none (b) VHS (c) Beta

30. How much would you be willing or able to spend as a student for a personal computer?
(a) none (b) $500-$1,000 (word processing, limited software)
(c) $1,000-$1,500 (word processing, graphics)
(d) $1,500-$3,000 (word processing, software for arch. draw., printer)
(e) $3,000 or more (word processing, drawing, CAD, MODEM software, printer and furniture)

APPENDIX 2

TEST ON SPATIAL PERCEPTION

1.

2. Our perception of space depends on our perception of:
   A. tone and texture
   B. perspective
   C. surfaces and edges
   D. edges and vanishing points

3. Certain lines in line drawings were recommended to be profiled, or "heavied up" because:
   A. they are indicating fundementally different spatial/perceptual conditions
   B. their profiling will make the drawing more interesting
   C. they converge to one of the two vanishing points
   D. They are above or below eye level

4. We pay special attention to spatial edges in our environment because:
   A. they always converge to the near vanishing point
   B. during our evolution, danger often lurked behind such edges
   C. they are always vertical
   D. they are the chief source of textural interest

5. By the location of an object in relation to a continuous background like the earth's surface, we can tell:
   A. how far away the object is and how big it is
   B. what time it is
   C. in which direction the sun is shining
   D. where the eye-level line is

6. We perceive most about a space by:
   A. looking at it very observantly from a single viewpoint
   B. making a very careful drawing of the space
   C. walking through the space
   D. taking careful verbal notes about our observations

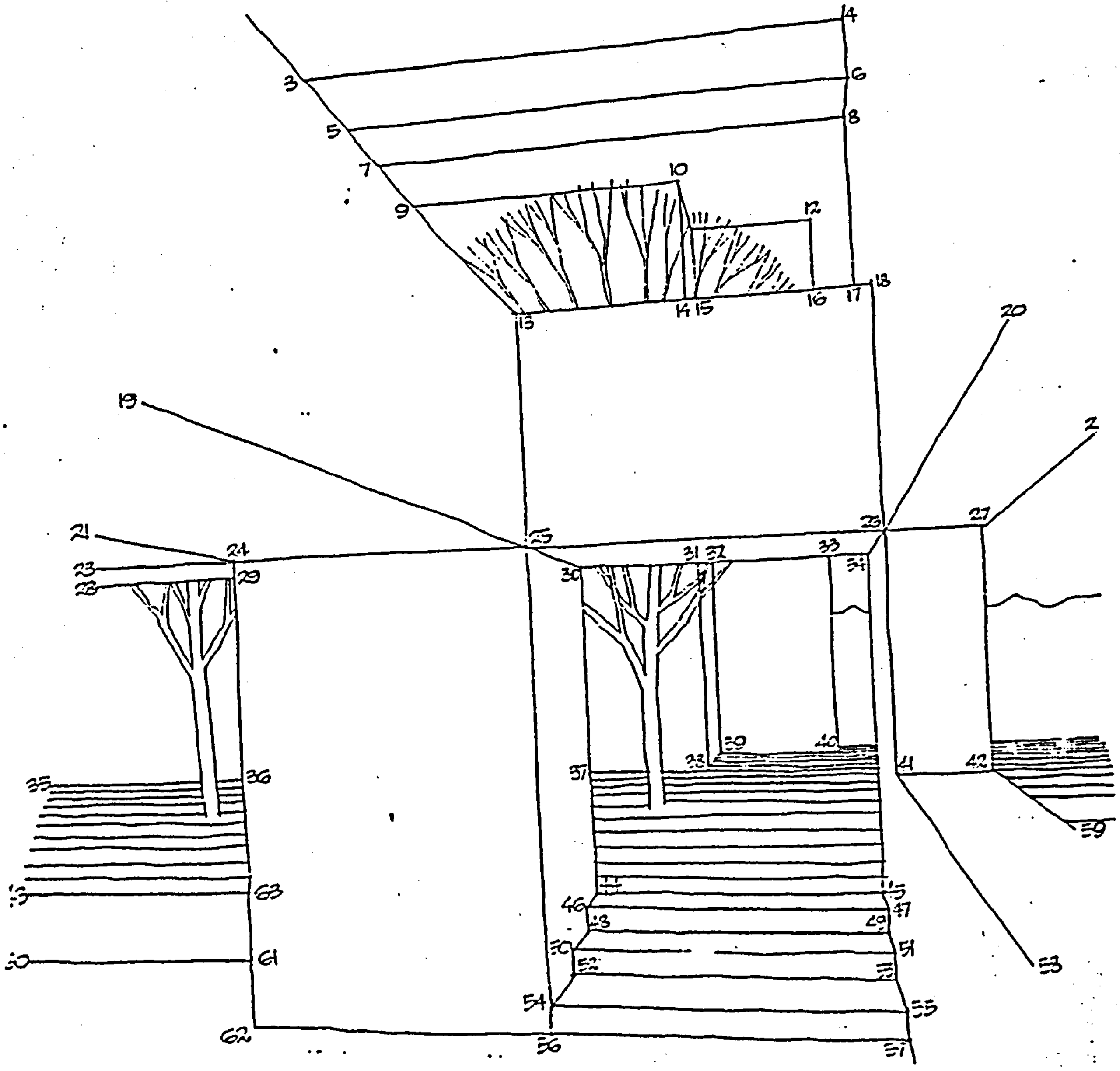
7. The edges which are recommended to be profiled are those:
   A. which are transverse horizontal lines
   B. which conceal space
   C. which converge to the near VP
   D. which indicate the intersection of two planes, both of which can be seen

PROFILE THE ACCOMPANYING PERSPECTIVE SPATIALLY
(heavy up all the spatial edges)

After you have profiled the perspective, identify the correct line (indicated by the numbers at the end of the line) from the four listed as answers for each question.

In other words, one of the lines indicated in each question is one of the 17 lines in the perspective which should be profiled as a spatial edge. Notice that the pair of numbers which indicates the pair of numbers identifying the line always begins with the smaller number.

8. a. 1-13 b. 56-57 c. 10-13 d. 46-48
9. a. 47-49 b. 2-3 c. 13-17 d. 50-51
10. a. 6-7 b. 55-57 c. 45-47 d. 8-17
11. a. 9-10 b. 44-46 c. 54-55 d. 8-18
12. a. 52-53 b. 12-15 c. 2-4 d. 10-11
13. a. 11-14 b. 53-55 c. 43-63 d. 11-12
14. a. 35-36 b. 46-47 c. 12-16 d. 7-10
15. a. 30-34 b. 4-6 c. 51-53 d. 26-42
16. a. 22-27 b. 56-62 c. 27-41 d. 32-39
17. a. 23-24 b. 21-24 c. 41-45 d. 49-51
18. a. 6-8 b. 44-45 c. 28-29 d. 25-62
19. a. 31-38 b. 35-36 c. 24-62 d. 25-29
20. a. 30-44 b. 11-15 c. 52-54 d. 24-28
21. a. 29-35 b. 54-56 c. 3-4 d. 34-45
22. a. 5-6 b. 50-52 c. 27-42 d. 58-59
23. a. 10-14 b. 60-61 c. 42-59 d. 6-20
24. a. 33-40 b. 7-8 c. 48-50 d. 20-22



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APPENDIX 3

Test Statistics

```
Bertelsen                                                    Spring Semester, 1985

Frequency distribution of test scores for Sec 1 Test #1 Arch

**********************************************************************************


Cum   Cum
Freq  Prop       Score  0    5    10   15   20   25   30   35   40
----  ----       -----  +----+----+----+----+----+----+----+----+

           -3SD    1
                   2
                   3
   1  0.05         4  *
   1  0.05         5
   1  0.05 -2SD    6
   2  0.09         7  *
   2  0.09 CL>>    8
   2  0.09         9
   5  0.23        10  ***
   5  0.23 CL95   11
   5  0.23 CL99   12
   6  0.27        13  *
   6  0.27        14
   7  0.32        15  *
   8  0.36 Mean   16  *
  10  0.45        17  **
  12  0.55        18  **
  15  0.68        19  ***
  19  0.86        20  ****
  20  0.91 +1SD   21  *
  22  1.00        22  **
                  23
                  24
                  25
           +2SD   26
                  27
                  28
                  29
                  30
           +3SD   31
                  32
                  33
                  34
```

```
    Bertelsen                                              Spring Semester, 1985

Frequency distribution of test scores for Sec 2 Test #1 Arch

********************************************************************************


Cum    Cum
Freq   Prop      Score 0    5   10   15   20   25   30   35   40
----   ----      ----- +----+----+----+----+----+----+----+----+

              CL>>   8
                     9
              CL95  10
   1   0.03   CL99  11  *
   1   0.03         12
   2   0.07         13  *
   3   0.10   -2SD  14  *
   3   0.10         15
   3   0.10         16
   5   0.17   -1SD  17  **
   6   0.20         18  *
  11   0 37         19  *****
  15   0 50   Mean  20  ****
  20   0 67         21  *****
  26   0.87         22  ******
  30   1 00   +1SD  23  ****
                    24
                    25
              +2SD  26
                    27
                    28
              +3SD  29
                    30
                    31
                    32
```

Bertelsen Spring Semester, 1985

Frequency distribution of test scores for Sec 3 Test 1 Arch

```
*******************************************************************************

Cum   Cum
Freq  Prop           Score 0    5    10   15   20   25   30   35   40
----  ----           ----- +----+----+----+----+----+----+----+--- +

                          1
                -3SD      2
                          3
                          4
                          5
  1   0.04                6  *
  2   0.07      -2SD      7  *
  3   0.11      CL/>      8  *
  3   0.11                9
  3   0.11               10
  4   0.15      CL95     11  *
  6   0.22      CL99     12  **
  8   0.30               13  **
  8   0.30               14
  9   0.33               15  *
 10   0 37               16  *
 10   0 37      Mean     17
 14   0.52               18  ****
 16   0 59               19  **
 19   0 70               20  ***
 22   0.81               21  ***
 24   0.89      +1SD     22  **
 26   0.96               23  **
 27   1.00               24  *
                         25
                         26
                +2SD     27
                         28
                         29
                         30
                         31
                +3SD     32
                         33
                         34
                         35
```

Bertelsen Spring Semester, 1985

Frequency distribution of test scores for Sec 4 Test#1 Arch

```
*****************************************************************************************

Cum   Cum
Freq  Prop        Score Ø    5    10   15   20   25   30   35   40
----  ----        ----- +----+----+----+----+----+----+----+----+

                      5
                      6
                      7
            CL>>      8
                      9
   1  Ø.Ø4           1Ø  *
   2  Ø.Ø8  CL95     11  *
   3  Ø.12  CL99     12  *
   3  Ø.12           13
   4  Ø.17           14  *
   5  Ø.21  -1SD     15  *
   6  Ø.25           16  *
   6  Ø.25           17
   8  Ø.33           18  **
  12  Ø 5Ø  Mean     19  ****
  15  Ø.62           2Ø  ***
  21  Ø.87           21  ******
  22  Ø.92  +1SD     22  *
  24  1.ØØ           23  **
                     24
                     25
            +2SD     26
                     27
                     28
            +3SD     29
                     3Ø
                     31
                     32
```

STATISTICAL INDICES

****

Num of Stdnts	Mean	SD	Min	Max	Poss
22	16.23	4.95	4	22	24

Var	Skew	Sig	Kurt	Sig
24.54	-0.97	yes	-0.13	no

Distribution of item difficulties

.00	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
0.04	0.00	0.00	0.08	0.04	0.08	0.04	0.21	0.29	0.17	0.04

Average Difficulty	Average Discrimination	Item	Average Reliability
0.72	0.57		0.44

KR-20 Reliability	Standard Error of Measurement
0.89	1.67

Num of Alter	Chance level	.90 conf	.95 conf	.99 conf
3	8.00	10.14	10.75	11.89

Distribution of responses over alternatives

Alter	A	B	C	D	E
Prop	0.35	0.14	0.31	0.15	0.00

- I T E M   A N A L Y S I S

****

Item	Alternative	A	B	C	D	E	Scored Alter	Reliab Index
Item # 1	Diff	1.00*	0.00	0.00	0.00	0.00	A	0.00
	Disc	0.00	0.00	0.00	0.00	0.00		
Item # 2	Diff	0.00	0.12	0.75*	0.12	0.00	C	0.35
	Disc	0.00	-0.26	0.40*	-0.26	0.00		
Item # 3	Diff	1.00*	0.00	0.00	0.00	0.00	A	0.00
	Disc	0.00	0.00	0.00	0.00	0.00		
Item # 4	Diff	0.17	0.35*	0.00	0.48	0.00	B	0.22
	Disc	0.16*	0.23*	0.00	-0.13	0.00		
Item # 5	Diff	0.75*	0.00	0.00	0.25	0.00	A	0.19
	Disc	0.21*	0.00	0.00	-0.21	0.00		
Item # 6	Diff	0.21	0.12	0.58*	0.08	0.00	C	0.35
	Disc	-0.24	-0.09	0.35*	-0.17	0.00		
Item # 7	Diff	0.00	0.83*	0.08	0.08	0.00	B	0.51
	Disc	0.00	0.69*	-0.59	-0.34	0.00		
Item # 8	Diff	0.96*	0.04	0.00	0.00	0.00	A	-0.03
	Disc	-0.09	0.09*	0.00	0.00	0.00		
Item # 9	Diff	0.00	0.00	0.96*	0.04	0.00	C	0.17
	Disc	0.00	0.00	0.44*	-0.44	0.00		
Item # 10	Diff	0.00	0.00	0.04	0.96*	0.00	D	0.00
	Disc	0.00	0.00	-0.15	0.00	0.00		
Item # 11	Diff	0.95*	0.00	0.05	0.00	0.00	A	0.34
	Disc	0.22*	0.00	-0.46	0.00	0.00		
Item # 12	Diff	0.00	0.09	0.35	0.57*	0.00	D	-0.04
	Disc	0.00	0.17*	0.15*	-0.04	0.00		
Item # 13	Diff	0.04	0.00	0.21	0.75*	0.00	D	0.33
	Disc	-0.38	0.00	-0.21	0.38*	0.00		
Item # 14	Diff	0.12	0.00	0.87*	0.00	0.00	C	0.52
	Disc	-0.79	0.00	0.79*	0.00	0.00		
Item # 15	Diff	1.00*	0.00	0.00	0.00	0.00	A	0.00
	Disc	0.00	0.00	0.00	0.00	0.00		

Students' copies of exam results

```
-----------------------------cut off here-----------------------------------------
Name:      DAJCHES    , M.          (ID:4109560000)                  Score: 20
                                    [X = omitted, M = multiple, * = correct]
                    1         2
Question #...  123456789012345678901234
Answers......  ACABABBACDADDCAAAACADCCA
Key..........  *****C**********BC*****B
-----------------------------cut off here-----------------------------------------
Name:      LIKINS     , T. .        (ID:4762220000)                  Score: 17
                                    [X = omitted, M = multiple, * = correct]
                    1         2
Question #...  123456789012345678901234
Answers......  ABAADABACDACDCAABCCACCCA
Key..........  *C*BAC*****D********D**B
-----------------------------cut off here-----------------------------------------
Name:      GREENWAY   , D. .        (ID:4923320000)                  Score: 20
                                    [X = omitted, M = multiple, * = correct]
                    1         2
Question #...  123456789012345678901234
Answers......  ACABACBACDADDAAABCBADCBA
Key..........  *************C****C***CB
-----------------------------cut off here-----------------------------------------
Name:      FRIEHAUF   , C.L.        (ID:4783740000)                  Score: 20
                                    [X = omitted, M = multiple, * = correct]
                    1         2
Question #..   123456789012345678901234
Answers......  ACADACBCCDADDCAAACCADCCA
Key..........  ***B***A********B******B
-----------------------------cut off here-----------------------------------------
Name:      DWORSCHAK  , M.D.        (ID:4788280000)                  Score: 21
                                    [X = omitted, M = multiple, * = correct]
                    1         2
Question #...  123456789012345678901234
Answers......  ADABACBACDADDCAABCAADCCA
Key..........  *C***************C****B
-----------------------------cut off here-----------------------------------------
Name:      DWYER      , J. .        (ID:4752670000)                  Score: 21
                                    [X = omitted, M = multiple, * = correct]
                    1         2
Question #..   123456789012345678901234
Answers......  ADADACBACDADDCAABCCADCCA
Key..........  *C*B*******************B
-----------------------------cut off here-----------------------------------------
```

APPENDIX 4

Statistical Correlations

TABLE OF TESTSC (ROWS) BY GENDER (COLUMNS)

FREQUENCIES

	M 1	F 2	TOTAL
HI 1	5	7	12
LO 2	7	5	12
TOTAL	12	12	24

TABLE OF TESTSC (ROWS) BY GENDER (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	20.83	29.17	50.00
2	29.17	20.83	50.00
TOTAL	50.00	50.00	100.00

TABLE OF TESTSC (ROWS) BY GENDER (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	41.67	58.33	100.00
2	58.33	41.67	100.00
TOTAL	50.00	50.00	100.00

TABLE OF TESTSC (ROWS) BY GENDER (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	41.67	58.33	50.00
2	58.33	41.67	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 1 ITERATIONS.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = .67 PROBABILITY = .414
LIKELIHOOD RATIO CHI-SQUARE = .67 PROBABILITY = .413

TABLE OF TESTSC (ROWS) BY AGE (COLUMNS)

FREQUENCIES

	1 (-19)	2 (20-24)	3 (25-29)	TOTAL
HI 1	4	7	1	12
LO 2	8	4	0	12
TOTAL	12	11	1	24

TABLE OF TESTSC (ROWS) BY AGE (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	3	TOTAL
1	16.67	29.17	4.17	50.00
2	33.33	16.67	.00	50.00
TOTAL	50.00	45.83	4.17	100.00

TABLE OF TESTSC (ROWS) BY AGE (COLUMNS)

ROW PERCENTS

	1	2	3	TOTAL
1	33.33	58.33	8.33	100.00
2	66.67	33.33	.00	100.00
TOTAL	50.00	45.83	4.17	100.00

TABLE OF TESTSC (ROWS) BY AGE (COLUMNS)

COLUMN PERCENTS

	1	2	3	TOTAL
1	33.33	63.64	100.00	50.00
2	66.67	36.36	.00	50.00
TOTAL	100.00	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 2
PEARSON CHI-SQUARE = 3.15 PROBABILITY = .207
LIKELIHOOD RATIO CHI-SQUARE = 3.57 PROBABILITY = .167

TABLE OF TESTSC (ROWS) BY ACT (COLUMNS)

FREQUENCIES

	33-30 1	29-27 2	26-20 3	19-16 4	TOTAL
HI 1	0	2	2	0	4
LO 2	1	0	2	2	5
TOTAL	1	2	4	2	9

TABLE OF TESTSC (ROWS) BY ACT (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	3	4	TOTAL
1	.00	22.22	22.22	.00	44.44
2	11.11	.00	22.22	22.22	55.56
TOTAL	11.11	22.22	44.44	22.22	100.00

TABLE OF TESTSC (ROWS) BY ACT (COLUMNS)

ROW PERCENTS

	1	2	3	4	TOTAL
1	.00	50.00	50.00	.00	100.00
2	20.00	.00	40.00	40.00	100.00
TOTAL	11.11	22.22	44.44	22.22	100.00

TABLE OF TESTSC (ROWS) BY ACT (COLUMNS)

COLUMN PERCENTS

	1	2	3	4	TOTAL
1	.00	100.00	50.00	.00	44.44

2	100.00	.00	50.00	100.00	55.56
TOTAL	100.00	100.00	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 3
PEARSON CHI-SQUARE = 4.95 PROBABILITY = .175
LIKELIHOOD RATIO CHI-SQUARE = 6.82 PROBABILITY = .078

TABLE OF TESTSC (ROWS) BY SAT (COLUMNS)

FREQUENCIES

	1600-1401 1	1400-1201 2	1201-1001 3	TOTAL
HI 1	1	1	2	4
LO 2	0	2	2	4
TOTAL	1	3	4	8

TABLE OF TESTSC (ROWS) BY SAT (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	3	TOTAL
1	12.50	12.50	25.00	50.00
2	.00	25.00	25.00	50.00
TOTAL	12.50	37.50	50.00	100.00

TABLE OF TESTSC (ROWS) BY SAT (COLUMNS)

ROW PERCENTS

	1	2	3	TOTAL
1	25.00	25.00	50.00	100.00
2	.00	50.00	50.00	100.00
TOTAL	12.50	37.50	50.00	100.00

TABLE OF TESTSC (ROWS) BY SAT (COLUMNS)

COLUMN PERCENTS

	1	2	3	TOTAL
1	100.00	33.33	50.00	50.00
2	.00	66.67	50.00	50.00
TOTAL	100.00	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 2
PEARSON CHI-SQUARE = 1.33 PROBABILITY = .513
LIKELIHOOD RATIO CHI-SQUARE = 1.73 PROBABILITY = .422

TABLE OF TESTSC (ROWS) BY CCREDIT (COLUMNS)

FREQUENCIES

	YES 1	NO 2	TOTAL
HI 1	7	5	12
LO 2	3	9	12
TOTAL	10	14	24

TABLE OF TESTSC (ROWS) BY CCREDIT (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	29.17	20.83	50.00
2	12.50	37.50	50.00
TOTAL	41.67	58.33	100.00

TABLE OF TESTSC (ROWS) BY CCREDIT (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	58.33	41.67	100.00

	1	2	TOTAL
2	25.00	75.00	100.00
TOTAL	41.67	58.33	100.00

TABLE OF TESTSC (ROWS) BY CCREDIT (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	70.00	35.71	50.00
2	30.00	64.29	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = 2.74 PROBABILITY = .098
LIKELIHOOD RATIO CHI-SQUARE = 2.80 PROBABILITY = .094

TABLE OF TESTSC (ROWS) BY CDEGREE (COLUMNS)

FREQUENCIES

		COLL. DEG 1	NO DEG. 2	TOTAL
HI	1	1	11	12
LO	2	1	11	12
TOTAL		2	22	24

TABLE OF TESTSC (ROWS) BY CDEGREE (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	4.17	45.83	50.00
2	4.17	45.83	50.00
TOTAL	8.33	91.67	100.00

TABLE OF TESTSC (ROWS) BY CDEGREE (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	8.33	91.67	100.00
2	8.33	91.67	100.00
TOTAL	8.33	91.67	100.00

TABLE OF TESTSC (ROWS) BY CDEGREE (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	50.00	50.00	50.00
2	50.00	50.00	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = .00 PROBABILITY = 1.000
LIKELIHOOD RATIO CHI-SQUARE = .00 PROBABILITY = 1.000

TABLE OF TESTSC (ROWS) BY HSDRAFT (COLUMNS)

FREQUENCIES

	NO HS DRAFT 1	HS DRAFT 2	TOTAL
HI 1	5	7	12
LO 2	9	3	12
TOTAL	14	10	24

TABLE OF TESTSC (ROWS) BY HSDRAFT (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	20.83	29.17	50.00
2	37.50	12.50	50.00

TOTAL	58.33	41.67	100.00

TABLE OF TESTSC (ROWS) BY HSDRAFT (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	41.67	58.33	100.00
2	75.00	25.00	100.00
TOTAL	58.33	41.67	100.00

TABLE OF TESTSC (ROWS) BY HSDRAFT (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	35.71	70.00	50.00
2	64.29	30.00	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = 2.74 PROBABILITY = .098
LIKELIHOOD RATIO CHI-SQUARE = 2.80 PROBABILITY = .094

TABLE OF TESTSC (ROWS) BY HSART (COLUMNS)

FREQUENCIES

		NO HS ART 1	HS ART 2	TOTAL
HI	1	8	4	12
LO	2	8	4	12
TOTAL		16	8	24

TABLE OF TESTSC (ROWS) BY HSART (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL

	1	2	
1	33.33	16.67	50.00
2	33.33	16.67	50.00
TOTAL	66.67	33.33	100.00

TABLE OF TESTSC (ROWS) BY HSART (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	66.67	33.33	100.00
2	66.67	33.33	100.00
TOTAL	66.67	33.33	100.00

TABLE OF TESTSC (ROWS) BY HSART (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	50.00	50.00	50.00
2	50.00	50.00	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = .00 PROBABILITY = 1.000
LIKELIHOOD RATIO CHI-SQUARE = .00 PROBABILITY = 1.000

TABLE OF TESTSC (ROWS) BY PLANEG (COLUMNS)

FREQUENCIES

	YES PLANE G 1	NO PLANE G 2	TOTAL
HI 1	12	0	12
LO 2	11	1	12
TOTAL	23	1	24

TABLE OF TESTSC (ROWS) BY PLANEG (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	50.00	.00	50.00
2	45.83	4.17	50.00
TOTAL	95.83	4.17	100.00

TABLE OF TESTSC (ROWS) BY PLANEG (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	100.00	.00	100.00
2	91.67	8.33	100.00
TOTAL	95.83	4.17	100.00

TABLE OF TESTSC (ROWS) BY PLANEG (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	52.17	.00	50.00
2	47.83	100.00	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = 1.04 PROBABILITY = .307
LIKELIHOOD RATIO CHI-SQUARE = 1.43 PROBABILITY = .232

TABLE OF TESTSC (ROWS) BY SOLIDG (COLUMNS)

FREQUENCIES

	YES SOLID G 1	NO SOLID G 2	TOTAL

		1	2	
HI	1	8	4	12
LO	2	9	3	12
TOTAL		17	7	24

TABLE OF TESTSC (ROWS) BY SOLIDG (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	33.33	16.67	50.00
2	37.50	12.50	50.00
TOTAL	70.83	29.17	100.00

TABLE OF TESTSC (ROWS) BY SOLIDG (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	66.67	33.33	100.00
2	75.00	25.00	100.00
TOTAL	70.83	29.17	100.00

TABLE OF TESTSC (ROWS) BY SOLIDG (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	47.06	57.14	50.00
2	52.94	42.86	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = .20 PROBABILITY = .653

LIKELIHOOD RATIO CHI-SQUARE = .20 PROBABILITY = .653

ABLE OF TESTSC (ROWS) BY INCOME (COLUMNS)

REQUENCIES

	1	2	3	TOTAL
1	0	4	7	11
2	1	2	7	10
OTAL	1	6	14	21

ABLE OF TESTSC (ROWS) BY INCOME (COLUMNS)

ERCENTS OF TOTAL OF THIS (SUB)TABLE

	-$15,000 1	15-30,000 2	30,000 & up 3	TOTAL
[1	.00	19.05	33.33	52.38
) 2	4.76	9.52	33.33	47.62
OTAL	4.76	28.57	66.67	100.00

ABLE OF TESTSC (ROWS) BY INCOME (COLUMNS)

OW PERCENTS

	1	2	3	TOTAL
1	.00	36.36	63.64	100.00
2	10.00	20.00	70.00	100.00
OTAL	4.76	28.57	66.67	100.00

ABLE OF TESTSC (ROWS) BY INCOME (COLUMNS)

OLUMN PERCENTS

	1	2	3	TOTAL
1	.00	66.67	50.00	52.38
2	100.00	33.33	50.00	47.62
OTAL	100.00	100.00	100.00	100.00

ODEL WAS FIT AFTER 2 ITERATIONS.

ARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
OLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

EST OF FIT OF MODEL

DEGREES OF FREEDOM = 2
PEARSON CHI-SQUARE = 1.62 PROBABILITY = .444
LIKELIHOOD RATIO CHI-SQUARE = 2.02 PROBABILITY = .365

ABLE OF TESTSC (ROWS) BY FATHERED (COLUMNS)

REQUENCIES

	1 HS OR LESS	2 COLLEGE	TOTAL
1	0	11	11
2	7	4	11
OTAL	7	15	22

ABLE OF TESTSC (ROWS) BY FATHERED (COLUMNS)

ERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	.00	50.00	50.00
2	31.82	18.18	50.00
OTAL	31.82	68.18	100.00

ABLE OF TESTSC (ROWS) BY FATHERED (COLUMNS)

OW PERCENTS

	1	2	TOTAL
1	.00	100.00	100.00
2	63.64	36.36	100.00
OTAL	31.82	68.18	100.00

ABLE OF TESTSC (ROWS) BY FATHERED (COLUMNS)

OLUMN PERCENTS

	1	2	TOTAL
1	.00	73.33	50.00
2	100.00	26.67	50.00

TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = 10.27 PROBABILITY = .001
LIKELIHOOD RATIO CHI-SQUARE = 13.10 PROBABILITY = .000

TABLE OF TESTSC (ROWS) BY SIBBLING (COLUMNS)

FREQUENCIES

	ELDEST CHILD 1	OTHER 2	TOTAL
HI 1	3	9	12
LO 2	2	9	11
TOTAL	5	18	23

TABLE OF TESTSC (ROWS) BY SIBBLING (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	13.04	39.13	52.17
2	8.70	39.13	47.83
TOTAL	21.74	78.26	100.00

TABLE OF TESTSC (ROWS) BY SIBBLING (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	25.00	75.00	100.00
2	18.18	81.82	100.00
TOTAL	21.74	78.26	100.00

TABLE OF TESTSC (ROWS) BY SIBBLING (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	60.00	50.00	52.17
2	40.00	50.00	47.83
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = .16 PROBABILITY = .692
LIKELIHOOD RATIO CHI-SQUARE = .16 PROBABILITY = .691

TABLE OF TESTSC (ROWS) BY ETHNIC (COLUMNS)

FREQUENCIES

	ASIAN 2	BLACK 3	CAUCASIAN 4	HISPANIC 5	TOTAL
HI 1	1	0	11	0	12
LO 2	4	1	4	3	12
TOTAL	5	1	15	3	24

NOTE: THERE WERE NO AMER INDIANS IN THE INITIAL STUDY.

TABLE OF TESTSC (ROWS) BY ETHNIC (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	2	3	4	5	TOTAL
1	4.17	.00	45.83	.00	50.00
2	16.67	4.17	16.67	12.50	50.00
TOTAL	20.83	4.17	62.50	12.50	100.00

TABLE OF TESTSC (ROWS) BY ETHNIC (COLUMNS)

ROW PERCENTS

	2	3	4	5	TOTAL
1	8.33	.00	91.67	.00	100.00
2	33.33	8.33	33.33	25.00	100.00

TAL	20.83	4.17	62.50	12.50	100.00

BLE OF TESTSC (ROWS) BY ETHNIC (COLUMNS)

LUMN PERCENTS

	2	3	4	5	TOTAL
1	20.00	.00	73.33	.00	50.00
2	80.00	100.00	26.67	100.00	50.00
TAL	100.00	100.00	100.00	100.00	100.00

DEL WAS FIT AFTER 2 ITERATIONS.

ARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
OLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

EST OF FIT OF MODEL

DEGREES OF FREEDOM = 3
PEARSON CHI-SQUARE = 9.07 PROBABILITY = .028
LIKELIHOOD RATIO CHI-SQUARE = 10.87 PROBABILITY = .012

ABLE OF TESTSC (ROWS) BY ENGLISH (COLUMNS)

REQUENCIES IS ENGLISH YOUR SECOND LANGUAGE?

		YES 1	NO 2	TOTAL
HI	1	1	11	12
LO	2	4	8	12
OTAL		5	19	24

ABLE OF TESTSC (ROWS) BY ENGLISH (COLUMNS)

ERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	4.17	45.83	50.00
2	16.67	33.33	50.00
OTAL	20.83	79.17	100.00

ABLE OF TESTSC (ROWS) BY ENGLISH (COLUMNS)

OW PERCENTS

	1	2	TOTAL
1	8.33	91.67	100.00
2	33.33	66.67	100.00
TOTAL	20.83	79.17	100.00

TABLE OF TESTSC (ROWS) BY ENGLISH (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	20.00	57.89	50.00
2	80.00	42.11	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = 2.27 PROBABILITY = .132
LIKELIHOOD RATIO CHI-SQUARE = 2.40 PROBABILITY = .121

TABLE OF TESTSC (ROWS) BY COMPUTER (COLUMNS)

FREQUENCIES HAVE YOU TAKEN COMPUTER COURSES?

	NO 1	YES 2	TOTAL
HI 1	6	6	12
LO 2	5	7	12
TOTAL	11	13	24

TABLE OF TESTSC (ROWS) BY COMPUTER (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	TOTAL
1	25.00	25.00	50.00
2	20.83	29.17	50.00

TOTAL	45.83	54.17	100.00

TABLE OF TESTSC (ROWS) BY COMPUTER (COLUMNS)

ROW PERCENTS

	1	2	TOTAL
1	50.00	50.00	100.00
2	41.67	58.33	100.00
TOTAL	45.83	54.17	100.00

TABLE OF TESTSC (ROWS) BY COMPUTER (COLUMNS)

COLUMN PERCENTS

	1	2	TOTAL
1	54.55	46.15	50.00
2	45.45	53.85	50.00
TOTAL	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

TEST OF FIT OF MODEL

DEGREES OF FREEDOM = 1
PEARSON CHI-SQUARE = .17 PROBABILITY = .682
LIKELIHOOD RATIO CHI-SQUARE = .17 PROBABILITY = .682

TABLE OF TESTSC (ROWS) BY DELIVERY (COLUMNS)

FREQUENCIES

	COMPUTER 1	HANDOUT 2	LECTURE 3	VIDEO 4	TOTAL
HI 1	3	3	3	3	12
LO 2	3	4	2	3	12
TOTAL	6	7	5	6	24

TABLE OF TESTSC (ROWS) BY DELIVERY (COLUMNS)

PERCENTS OF TOTAL OF THIS (SUB)TABLE

	1	2	3	4	TOTAL

	1	2	3	4	TOTAL
1	12.50	12.50	12.50	12.50	50.00
2	12.50	16.67	8.33	12.50	50.00
TOTAL	25.00	29.17	20.83	25.00	100.00

TABLE OF TESTSC (ROWS) BY DELIVERY (COLUMNS)

ROW PERCENTS

	1	2	3	4	TOTAL
1	25.00	25.00	25.00	25.00	100.00
2	25.00	33.33	16.67	25.00	100.00
TOTAL	25.00	29.17	20.83	25.00	100.00

TABLE OF TESTSC (ROWS) BY DELIVERY (COLUMNS)

COLUMN PERCENTS

	1	2	3	4	TOTAL
1	50.00	42.86	60.00	50.00	50.00
2	50.00	57.14	40.00	50.00	50.00
TOTAL	100.00	100.00	100.00	100.00	100.00

MODEL WAS FIT AFTER 2 ITERATIONS.

WARNING: MORE THAN ONE-FIFTH OF FITTED CELLS ARE SPARSE (FREQUENCY < 5)
FOLLOWING SIGNIFICANCE TESTS ARE SUSPECT.

TEST OF

FIT OF MODEL

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DEGREES OF FREEDOM =    3
PEARSON CHI-SQUARE =          .34 PROBABILITY =  .952
LIKELIHOOD RATIO CHI-SQUARE =        .34 PROBABILITY =  .951
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SYSTAT PROCESSING FINISHED

INPUT STATEMENTS FOR THIS JOB:



OUTPUT=AUX

USE ARCH
SUBMIT A
TABULATE TESTSC*GENDER /MISS FREQUENCY PERCENT ROWPCT COLPCT
MODEL TESTSC+GENDER
TABULATE TESTSC*AGE /MISS FREQUENCY PERCENT ROWPCT COLPCT
MODEL TESTSC+AGE
TABULATE TESTSC*ACT /MISS FREQUENC
```

	ENGLISH	COMPUTER	DELIVERY
ENGLISH	12		
COMPUTER	12	12	
DELIVERY	12	12	12

THE FOLLOWING RESULTS ARE FOR:
TESTSC = 2.00 (Low Test Scores)

PEARSON CORRELATION MATRIX

	TESTSC	(M and F) GENDER	AGE	ACT	SAT
TESTSC	.				
GENDER	.	1.000			
AGE	.	0.478	1.000		
ACT	.	-0.373	-0.745	1.000	
SAT	.	1.000	0.577	.	1.000
CCREDIT	.	0.098	-0.000	0.000	-0.577
CDEGREE	.	0.255	0.213	.	.
HSDRAFT	.	0.293	-0.000	-0.913	0.577
HSART	.	0.120	-0.125	-0.000	1.000
PLANEG	.	0.357	0.426	-0.913	.
SOLIDG	.	-0.098	-0.408	0.456	0.577
INCOME	.	0.302	0.492	.	-0.500
FATHERED	.	-0.311	0.214	-0.373	-0.577
SIBBLING	.	-0.516	-0.624	0.745	-0.577
ETHNIC	.	-0.213	-0.149	0.289	-0.894
ENGLISH	.	-0.120	0.125	.	-0.577
COMPUTER	.	0.714	0.239	-0.000	1.000
DELIVERY	.	0.442	0.053	-0.373	0.905

	CCREDIT	CDEGREE	HSDRAFT	HSART	PLANEG
CCREDIT	1.000				
CDEGREE	0.522	1.000			
HSDRAFT	-0.111	0.174	1.000		
HSART	-0.408	0.213	0.408	1.000	
PLANEG	0.174	0.091	0.522	-0.213	1.000
SOLIDG	0.333	0.174	0.111	0.408	-0.174
INCOME	0.592	0.302	-0.592	-0.592	0.201
FATHERED	0.463	0.239	-0.039	-0.463	0.418
SIBBLING	0.241	-0.149	-0.241	-0.241	-0.671
ETHNIC	0.566	0.380	-0.404	-0.297	0.127
ENGLISH	0.408	0.426	-0.408	-0.250	0.213
COMPUTER	-0.098	0.357	0.488	0.239	0.255
DELIVERY	0.043	0.383	0.647	0.370	0.428

	SOLIDG	INCOME	FATHERED	SIBBLING	ETHNIC
SOLIDG	1.000				
INCOME	-0.075	1.000			
FATHERED	0.134	0.492	1.000		
SIBBLING	0.222	-0.302	-0.134	1.000	
ETHNIC	0.081	0.672	0.418	-0.056	1.000

ENGLISH	-0.000	0.739	0.571	-0.356	0.891
COMPUTER	0.098	-0.066	-0.214	-0.356	-0.355
DELIVERY	0.129	-0.270	-0.075	-0.261	0.031

	ENGLISH	COMPUTER	DELIVERY
ENGLISH	1.000		
COMPUTER	-0.239	1.000	
DELIVERY	-0.053	0.619	1.000

FREQUENCY TABLE

	TESTSC	GENDER	AGE	ACT	SAT
TESTSC	12				
GENDER	12	12			
AGE	12	12	12		
ACT	5	5	5	5	
SAT	4	4	4	1	4
CCREDIT	12	12	12	5	4
CDEGREE	12	12	12	5	4
HSDRAFT	12	12	12	5	4
HSART	12	12	12	5	4
PLANEG	12	12	12	5	4
SOLIDG	12	12	12	5	4
INCOME	10	10	10	5	3
FATHERED	11	11	11	5	4
SIBBLING	11	11	11	5	4
ETHNIC	12	12	12	5	4
ENGLISH	12	12	12	5	4
COMPUTER	12	12	12	5	4
DELIVERY	12	12	12	5	4

	CCREDIT	CDEGREE	HSDRAFT	HSART	PLANEG
CCREDIT	12				
CDEGREE	12	12			
HSDRAFT	12	12	12		
HSART	12	12	12	12	
PLANEG	12	12	12	12	12
SOLIDG	12	12	12	12	12
INCOME	10	10	10	10	10
FATHERED	11	11	11	11	11
SIBBLING	11	11	11	11	11
ETHNIC	12	12	12	12	12
ENGLISH	12	12	12	12	12
COMPUTER	12	12	12	12	12
DELIVERY	12	12	12	12	12

	SOLIDG	INCOME	FATHERED	SIBBLING	ETHNIC
SOLIDG	12				
INCOME	10	10			
FATHERED	11	10	11		

THE FOLLOWING RESULTS ARE FOR:
TESTSC = 1.00 (High Test Scores)

PEARSON CORRELATION MATRIX

	TESTSC	(M and F) GENDER	AGE	ACT	SAT
TESTSC	.				
GENDER	.	1.000			
AGE	.	-0.355	1.000		
ACT	.	0.577	0.577	1.000	
SAT	.	-0.522	0.522	.	1.000
CCREDIT	.	0.371	-0.781	.	-0.522
CDEGREE	.	0.357	-0.633	-0.577	.
HSDRAFT	.	0.657	-0.071	0.577	-0.522
HSART	.	-0.478	0.297	-0.000	-0.870
PLANEG	.	.	.	.	.
SOLIDG	.	0.239	0.000	.	0.522
INCOME	.	0.069	0.090	0.577	0.870
FATHERED	.	.	.	.	.
SIBBLING	.	-0.098	-0.243	0.577	.
ETHNIC	.	-0.255	-0.127	.	.
ENGLISH	.	-0.255	-0.127	.	.
COMPUTER	.	0.169	-0.420	-1.000	-0.905
DELIVERY	.	0.227	-0.188	0.229	0.636

	CCREDIT	CDEGREE	HSDRAFT	HSART	PLANEG
CCREDIT	1.000				
CDEGREE	0.255	1.000			
HSDRAFT	0.029	0.357	1.000		
HSART	-0.239	-0.426	-0.120	1.000	
PLANEG	.	.	.	.	.
SOLIDG	0.120	0.213	0.239	-0.500	.
INCOME	0.179	-0.239	-0.179	-0.214	.
FATHERED	.	.	.	.	.
SIBBLING	0.098	-0.174	-0.098	0.408	.
ETHNIC	0.255	-0.091	-0.255	0.213	.
ENGLISH	0.255	-0.091	-0.255	0.213	.
COMPUTER	0.169	0.302	-0.169	0.000	.
DELIVERY	0.076	0.405	0.529	-0.316	.

	SOLIDG	INCOME	FATHERED	SIBBLING	ETHNIC
SOLIDG	1.000				
INCOME	0.179	1.000			
FATHERED	.	.	.		
SIBBLING	-0.408	-0.039	.	1.000	
ETHNIC	-0.426	0.418	.	-0.174	1.000
ENGLISH	-0.426	0.418	.	-0.174	1.000
COMPUTER	-0.354	-0.449	.	0.192	-0.302
DELIVERY	0.158	-0.080	.	0.258	-0.405

ENGLISH	COMPUTER	DELIVERY

ENGLISH	1.000		
COMPUTER	-0.302	1.000	
DELIVERY	-0.405	-0.000	1.000

FREQUENCY TABLE

	TESTSC	GENDER	AGE	ACT	SAT
TESTSC	12				
GENDER	12	12			
AGE	12	12	12		
ACT	4	4	4	4	
SAT	4	4	4	1	4
CCREDIT	12	12	12	4	4
CDEGREE	12	12	12	4	4
HSDRAFT	12	12	12	4	4
HSART	12	12	12	4	4
PLANEG	12	12	12	4	4
SOLIDG	12	12	12	4	4
INCOME	11	11	11	4	4
FATHERED	11	11	11	4	4
SIBBLING	12	12	12	4	4
ETHNIC	12	12	12	4	4
ENGLISH	12	12	12	4	4
COMPUTER	12	12	12	4	4
DELIVERY	12	12	12	4	4

	CCREDIT	CDEGREE	HSDRAFT	HSART	PLANEG
CCREDIT	12				
CDEGREE	12	12			
HSDRAFT	12	12	12		
HSART	12	12	12	12	
PLANEG	12	12	12	12	12
SOLIDG	12	12	12	12	12
INCOME	11	11	11	11	11
FATHERED	11	11	11	11	11
SIBBLING	12	12	12	12	12
ETHNIC	12	12	12	12	12
ENGLISH	12	12	12	12	12
COMPUTER	12	12	12	12	12
DELIVERY	12	12	12	12	12

	SOLIDG	INCOME	FATHERED	SIBBLING	ETHNIC
SOLIDG	12				
INCOME	11	11			
FATHERED	11	11	11		
SIBBLING	12	11	11	12	
ETHNIC	12	11	11	12	12
ENGLISH	12	11	11	12	12
COMPUTER	12	11	11	12	12
DELIVERY	12	11	11	12	12

SIBBLING	11	10	11	11	
ETHNIC	12	10	11	11	12
ENGLISH	12	10	11	11	12
COMPUTER	12	10	11	11	12
DELIVERY	12	10	11	11	12

	ENGLISH	COMPUTER	DELIVERY
ENGLISH	12		
COMPUTER	12	12	
DELIVERY	12	12	12

TOTAL OBSERVATIONS: 24

	TESTSC	GENDER	AGE	ACT	SAT
N OF CASES	24	24	24	9	8
MINIMUM	1.00	1.00	1.00	1.00	1.00
MAXIMUM	2.00	2.00	3.00	4.00	3.00
MEAN	1.50	1.50	1.54	2.78	2.38
VARIANCE	0.26	0.26	0.35	0.94	0.55
STANDARD DEV	0.51	0.51	0.59	0.97	0.74
STD. ERROR	0.10	0.10	0.12	0.32	0.26

	CCREDIT	CDEGREE	HSDRAFT	HSART	PLANEG
N OF CASES	24	24	24	24	24
MINIMUM	1.00	1.00	1.00	1.00	1.00
MAXIMUM	2.00	2.00	2.00	2.00	2.00
MEAN	1.58	1.92	1.42	1.33	1.04
VARIANCE	0.25	0.08	0.25	0.23	0.04
STANDARD DEV	0.50	0.28	0.50	0.48	0.20
STD. ERROR	0.10	0.06	0.10	0.10	0.04

	SOLIDG	INCOME	FATHERED	SIBBLING	ETHNIC
N OF CASES	24	21	22	23	24
MINIMUM	1.00	1.00	1.00	1.00	2.00
MAXIMUM	2.00	3.00	2.00	2.00	5.00
MEAN	1.29	2.62	1.68	1.78	3.67
VARIANCE	0.22	0.35	0.23	0.18	0.93
STANDARD DEV	0.46	0.59	0.48	0.42	0.96
STD. ERROR	0.09	0.13	0.10	0.09	0.20

	ENGLISH	COMPUTER	DELIVERY
N OF CASES	24	24	24
MINIMUM	1.00	1.00	1.00
MAXIMUM	2.00	2.00	4.00
MEAN	1.79	1.54	2.46
VARIANCE	0.17	0.26	1.30
STANDARD DEV	0.41	0.51	1.14
STD. ERROR	0.08	0.10	0.23

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