

To Fred

Thanks for the advice and
for the DPM

Paul

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ABSTRACT

AN EXAMINATION OF THE RELATIONSHIP OF THE EDUCATIONAL COGNITIVE STYLE AND DRIVING BEHAVIOR OF SELECTED NOVICE DRIVERS AS MEASURED BY THE DRIVER PERFORMANCE MEASUREMENT PROCEDURE

By

Paul G. Specht

The purpose of this study was to examine the relationship of the educational cognitive style of novice drivers and their driving behavior. To measure cognitive style the Educational Cognitive Style Interest Inventory of Oakland Community College (Michigan) was used. The Driver Performance Measurement Procedure (DPM), developed at Michigan State University, was employed to measure driving behavior.

The subjects for this study were high school driver education graduates from the Lansing, Michigan area who had less than three months licensed driving experience. Fifty-six subjects, who had participated in an earlier study in which DPM scores were produced, volunteered to take the Educational Cognitive Style Interest Inventory. Twenty-five of these subjects came from the fourth

quartile of DPM scores and were labeled the "good" drivers. The remaining thirty-one volunteers scored in the first quartile of the DPM and were labeled the "poor" drivers. The DPM measured the four variables of behavior pattern, search, speed control and direction control. The Educational Cognitive Style Interest Inventory measured twenty cognitive traits which describe the way an individual seeks meaning in his environment.

Two procedures were used to examine the relationship of educational cognitive style and driving behavior. The first was to compare the collective cognitive styles of the highest scoring DPM group with the styles of the lowest scoring DPM group. The second procedure was to formulate regression models (equations) to determine what cognitive style elements could be generated to predict the driving behaviors measured by the DPM.

Collective cognitive style maps were produced for both groups of drivers. Only one element, QCH (Qualitative Code Histrionic), appeared between the two that was significantly different. The "good" drivers had a major orientation in this element while the "poor" drivers had a minor orientation. A Chi-square analysis was used in this comparison and the results were significant at the .10 level.

Through the use of a Stepwise regression procedure, a model was produced for all four dependent

variables, i.e. pattern concept, search concept, speed control, and direction control. This model, which can be used to predict driving behavior, was significant at the .10 level.

This model could be useful to driver education teachers who take their students' predicted driving behavior and develop individual instructional plans based on the students' strengths and weaknesses.

The models generated by the Stepwise regression procedure cannot be guaranteed to represent real world situations accurately. However, they do indicate elements of cognitive style which should be investigated further.

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By

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DEDICATION

To the late Dr. Joseph E. Hill, teacher and
educational scientist, who provided the
foundation for this study.

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CHAPTER I

THE PROBLEM

Statement of the Problem

The central problem of this study was to examine the relationship of the educational cognitive styles of novice drivers as determined by the Educational Cognitive Style Interest Inventory and their driving behavior as measured by Michigan State University's Driver Performance Measurement Procedure. In general terms, this study attempted to determine if a person's learning style influences his driving style.

Background of Study

The knowledge and skill necessary to properly perform the driving task requires that the vehicle operator constantly evaluate and reevaluate his environment and make adjustments to changing traffic and environmental conditions. The driver is, essentially, reading the environment to interpret its significance. This reading of the traffic environment is performed by searching for those factors outside the vehicle which can affect the driving task. The ability to read the

traffic environment must be used in combination with the psychomotor skills necessary to control speed and direction while maneuvering a car in the highway transportation system.

According to Michigan State University's Driver Performance Measurement (DPM) procedure, the factors of speed control, direction control and search behavior; together with the relative timing of these components, determine the suitability of a person's driving pattern (Forbes, 1973:47). Because the driving task is dynamic, due to changing traffic and environmental conditions, driver behavior patterns must be constantly changing to adjust to the traffic environment.

These behaviors can be taught but are not necessarily learned equally well by all drivers. This is because individuals have different learning styles, cognitive and psychomotor abilities, and preferred ways of processing information about their environment. These differences are known as a person's cognitive style. Kagan, Moss, and Sigel (1963) have defined cognitive style as "stable individual preferences in the mode of perceptual organization and conceptual categorization of the external environment." By applying this process to how a person learns to drive, it is possible that a relationship exists between how a novice

driver seeks meaning in the traffic environment and his educational cognitive style.

A system for identifying educational cognitive style has grown out of a body of work undertaken by Dr. Joseph E. Hill and Dr. Derek N. Nunney (1971) which has come to be known as the "Educational Sciences."

The Educational Sciences provide a conceptual framework and scientific language for the applied field of knowledge called education. These "sciences" approach a level of precision that is found in such other derivative fields as medicine, pharmacy, engineering and law (Hill, 1976:2).

There are currently seven educational sciences:

(1) symbols and their meaning; (2) cultural determinants; (3) modalities of inference; (4) memory; (5) teaching, administrative, student, and counseling styles; (6) cognitive style; and (7) systemic analysis decision-making. All seven of these sciences have approached a high level of precision and "are designed to explain phenomena and solve problems in the practical aspects of the human situation" (Hill, 1971:2).

The educational science of cognitive style was of particular interest in this study because it was used to identify the learning styles of beginning drivers. Educational cognitive style is actually the Cartesian product^{*} of three sets of sciences, i.e.,

^{*} A mathematical equation developed by Rene Descartes which graphically displays an ordered list of three concepts or sets that are interrelated. In

symbolic mediation, cultural determinants, and modalities of inference (C.F. Definition of Terms). The product of these sets provides a graphical illustration, called a map, of the strengths, skills, or cognitive traits a person relies on in seeking meaning in his environment.

The first set of the Cartesian product, symbolic mediation, indicates preferences in learning such as listening or reading, and preferences in expressing one's self, such as speaking or writing. These preferences are known as theoretical symbols. Qualitative symbols are also included in this set. These symbols indicate dependency on different senses and social sensitivity such as empathy or ethics.

The second set, cultural determinants, provides an insight into who influences a person's acquisition of knowledge and meanings i.e., family/authority figures, associates and self.

The third set, modalities of inference, explores a person's method of drawing conclusions about the information he takes in. Included under this heading are different methods of reasoning such as inductive, deductive, categorical, comparative, and analytical reasoning.

the case of educational cognitive style, the sum of these three sets equals an individual's cognitive style.

How frequently an element in each set is used and the importance an individual attaches to it will determine if this element shows up on a person's map as a major, minor, or negligible strength in learning. An individual's educational cognitive style depends on the combination and strength of the elements which he relies upon.

Since driving behavior can be rated and cognitive styles can be identified, it is of interest to driver educators to discover if those novice drivers who have a certain cognitive style are more competent at handling dynamic driving situations than those who have another particular cognitive style. If it is possible for teachers to identify, before hand, the strengths and weaknesses in students' cognitive styles which are correlated with driving behavior, there is a possibility that the teacher could make adjustments when planning the driver education curriculum and thereby improve the students' learning of specific driving behaviors. Such a procedure could also save students time in learning driving tasks. This efficient use of time for students, and teachers as well, could be translated into financial savings for school districts through a more efficient system of teaching beginning drivers; but more importantly, a better job of instruction and learning will result.

Purpose of the Study

All three of the educational sciences which are combined in educational cognitive style, i.e., symbolic mediation, cultural determinants, and modalities of inference, could have an influence on driving behavior. However, the extent of this influence, if any, is presently unknown. The purpose of this study was to map the educational cognitive styles of a selected group of subjects. Elements from these maps were correlated with satisfactory or unsatisfactory behaviors associated with the driving task using the DPM as the criterion variable.

Before predictions can be made concerning the use of cognitive style mapping, it is necessary to first identify those factors related to behaviors which can be observed and rated. Rating of driving behavior can be accomplished through the use of the DPM. This procedure was developed by the Department of Psychology and the Highway Traffic Safety Center at Michigan State University in an effort to obtain a reliable measure of dynamic driving performance in real world situations.

The method developed is unique in that it measures dynamic driving behavior patterns in actual traffic, uses simultaneous ratings by two observers to allow evaluation of the measurements and makes possible measurement of driving performance immediately and at intervals after the subjects' completion of driver education (Forbes, 1973:1).

Driver Performance Measurement scores for 288 novice drivers, i.e., high school driver education graduates with less than one year driving experience, were available as a result of a research project conducted in the Fall of 1976 by the Highway Traffic Safety Center. This study mapped the educational cognitive styles of a selected group of participants in that project.

Educational cognitive styles maps can be produced from a subject's responses to a 224 item interest inventory developed by Dr. Joseph Hill of Oakland Community College. Through the use of a computer system, 20 factors can be identified to provide a picture of the ways a person acquires meaning in his environment.

If a relationship exists between any of the 20 cognitive style elements and driving behavior, it should be revealed by comparing the collective cognitive styles of the subjects who rank in the 25th percentile of the DPM (the better drivers) and those who rank in the 75th percentile on this procedure which was conducted in the Fall of 1976. Also, a regression model (equation) was formulated to determine what cognitive style variables can predict the driving behaviors measured by the DPM. However, with both of these procedures, generalizations cannot be made beyond the specific groups in this study.

Significance of the Study

The main significance of this study lies in its potential as a tool for high school driver education teachers. Most driver education courses are planned and scheduled long before the students arrive. Individual differences and needs of the students are difficult to meet in this type of system. However, as each student learns in his own unique way, certain phases of a driver education curriculum could present information to a student in a manner which he finds difficult to assimilate.

If certain elements of a person's educational cognitive style can be shown to be related to certain elements of driving performance, this information could be used to determine individual student needs in order to overcome deficiencies through adjustments in the driver education curriculum. For example, if a relationship exists between a driver's search behavior and his ability to perceive meaning through the senses (called Qualitative symbols in the Educational Sciences developed by Dr. Hill), a student found to be weak or have negligible strength on this element may require extra instruction in perceptual skills. Before a hypothesis of this type can be made, it is first necessary to analyze the relationship of educational cognitive style and driving

behavior. At this time, speculations beyond the original statement of the problem can only be recommended for another study.

General Questions to be Answered

This study attempted to answer the following questions:

1. What elements of the collective educational cognitive styles were common to the group which scored in the first quartile of the DPM?
2. What elements of the collective educational cognitive styles were common to the group which scored in the fourth quartile of the DPM?
3. What elements of a person's educational cognitive style were correlated at a minimum significance level of .10 with the "Pattern Concept" score of the DPM as evidenced by the regression model?
4. What elements of a person's educational cognitive style were correlated at a minimum level of significance of .10 with the "Search Behavior" score on the DPM as evidenced by the regression model?
5. What elements of a person's educational cognitive style were correlated at a minimum significance level of .10 with the "Speed Control" score on the DPM as evidenced by the regression model?

6. What elements of a person's educational cognitive style were correlated at a minimum significance level of .10 with the "Direction Control" score on the DPM as evidenced by the regression model?

Basic Assumptions

In this study the following assumptions were made:

1. The validity and reliability of the Driver Performance Measurement Procedure are sufficient for the purposes of this study.
2. The validity and reliability of the Educational Cognitive Style Interest Inventory developed by Oakland Community College and used in this study are sufficient for the purposes of this study.
3. The educational cognitive styles of the subjects have not changed appreciably since taking the Driver Performance Measurement.
4. Expressed opinions are held opinions.
5. Satisfactory driving behaviors can be taught.

Definition of Terms

To clarify terms used in this study, the following definitions have been presented:

Cartesian Product.--A mathematical equation developed by Rene Descartes which graphically displays an ordered list of three concepts or sets that are

interrelated. In the case of educational cognitive style, the sum of these three sets equals an individual's cognitive style.

Cognitive Style.--The way in which an individual seeks and acquires meaning in his environment.

Collective Cognitive Style.--Elements of an individual's cognitive style which are unique to a specific group, e.g. the cognitive style of all those within the group identified as good drivers.

Cognitive Style Map.--A computer print-out or hand drawn graph giving a pictorial display of cognitive traits which describe the way in which an individual acquires meaning from his environment. As many as 28 traits may be identified in forming a map.

Cultural Determinants.--One of the educational sciences which explains the influences affecting the way an individual derives meaning from symbols as modified by individuality, associates and family.

Associates Determinant (A).--The influences exerted by associates on an individual in his or her understanding of symbols and their meanings.

Family Determinant (F).--The influences brought to bear by immediate family or authority figures on an individual's understanding of symbols and their meaning.

Individual Determinant (I).--The influences brought to bear by the individual on the meaning of symbols.

Driver Performance Measurement.--A procedure referred to as the DPM used to measure dynamic driving behaviors under actual traffic conditions. It includes measurement of search behavior, speed control, and direction control with regard to relative timing in relation to the changing traffic and environmental conditions.

Direction Control.--A term used in the DPM to identify steering control or tracking of the vehicle. The coordination of steering and turning maneuvers with regard to proper timing in relation to changing traffic and environmental conditions.

Search Behavior.--A term used in the DPM to describe an observable behavior in which the driver looks systematically toward possible sources of traffic information. It includes the coordination of searching with regard to proper timing in relation to changing traffic and environmental conditions.

Speed Control.--A DPM term used to describe the use of the accelerator or brake to fit the traffic and driving task requirements while coordinating the timing of this behavior.

Pattern Concept.--A term associated with the DPM used to describe a series or sequence of observable driving behaviors (i.e., search, speed and direction control), that often occur together in the same order or in different orders in relation to the timing required by changing traffic and environmental conditions.

Dynamic Situation.--The driving situation created by the many and varied components of changing traffic and environmental conditions.

Educational Sciences.--A conceptual framework and scientific language for the field of human activity called education. (Definitions associated with this

concept were taken from their original source, The Educational Sciences, which can be found in Appendix A.)

Modalities of Inference.--One of the Educational Sciences which explores a person's method of drawing conclusions about the information he or she takes in. This includes the following forms of inference: Magnitude, Difference, Relationship, Appraisal and Deductive.

Magnitude (M).--A form of categorical reasoning that utilizes norms or categorical classifications as the basis for accepting or rejecting an advanced hypothesis.

Difference (D).--This element suggests a tendency to reason in terms of one-to-one contrasts or comparisons of selected characteristics of measurements.

Relationship (R).--This modality indicates the ability to synthesize a number of dimensions or incidents into a unified meaning, or through analysis of a situation to discover its component parts.

Appraisal (L).--The modality of inference employed by an individual who uses all three of the modalities noted above (M, D, and R), giving equal weight to each in his reasoning process.

Deductive (K).--This modality indicates deductive reasoning or the form of logical proof used in geometry or that employed in syllogistic reasoning.

Orientation/Strength in Learning.--How frequently a symbol is used and the importance an individual attaches to it will determine if the symbol shows up on a cognitive style map as a major, minor, or negligible strength in learning.

Major Orientation.--This is given to a particular element if it occurs in the 50th-99th percentile range of a distribution. It usually indicates above average ability in an element.

Minor Orientation.--This indicates average ability in a particular element that occurred in the 26th-49th percentile range. It is displayed on a cognitive style map as a "prime" connected to a symbol. For example, the symbol T'AL would indicate a minor orientation in that element.

Negligible Orientation.--This is given to an element if it occurs in the 25th percentile or below of a distribution of scores. Elements of negligible strength do not appear on an individual's cognitive style map.

Qualitative Cultural Symbols.--Part of the educational sciences associated with symbols which are derived from ten cultural codes created and used by individuals to acquire knowledge and gain meaning from their environments and personal experiences.

Qualitative Code Empathic (QCEM).--The capacity to derive meaning through sensitivity to the feelings of others.

Qualitative Code Esthetic (QCES).--The capacity to derive meaning through the enjoyment of the beauty of an object or an idea.

Qualitative Code Ethic (QCET).--The ability to derive meaning through commitment to a set of values, a group of principles, obligations, and/or duties.

Qualitative Code Histrionic (QCH).--Capacity to exhibit a deliberate behavior, or play a role to produce some particular effect on other persons. This type of person knows how to fulfill role expectations.

Qualitative Code Kinesics (QCK).--The capacity to understand, and to communicate by non-linguistic functions such as facial expressions and motions of the body.

Qualitative Code Kinesthetic (QCKH).--The capacity to perform motor skills, or effect muscular coordination according to a recommended, or acceptable form.

Qualitative Code Proxemics (QCP).--The capacity to judge physical and social distance that the other person would permit, between oneself and that other person.

Qualitative Code Transactional (QCT).--The capacity to maintain a positive communicative interaction which significantly influences the goals of the persons involved in that interaction.

Theoretical Symbols.--Part of the educational sciences denoting a set of four symbols which present to the nervous system, and then represent to it, something different from that which they themselves are. For example, spoken or written words can represent objects which are different from the symbol itself.

Theoretical Visual Linguistics (TVL).--The ability to take in meaning from words you see. A major in this area indicates someone who reads with a better than average degree of speed and comprehension.

Theoretical Auditory Linguistics (TAL).--The ability to acquire meaning through hearing spoken words.

Theoretical Visual Quantitative (TVQ).--The ability to acquire meaning in terms of numerical symbols, relationships, and measurements.

Theoretical Auditory Quantitative (TAQ).--The ability to find meaning in terms of numerical symbols, relationships, and measurements that are spoken.

Summary

It was shown in this chapter that both cognitive styles and driving behaviors can be identified. A need exists to determine if a significant relationship between the two can be established. If elements of a person's educational cognitive style can be shown to influence

elements of driving performance, this information could be used to predict driving behavior and identify student deficiencies. To accomplish this, it is necessary to first examine the relationship of the cognitive styles of novice drivers and their driving behavior.

This relationship has not yet been examined; however, literature related to both educational cognitive style and driving performance measurement will be reviewed in the following chapter.

CHAPTER II

REVIEW OF LITERATURE

Educational cognitive style investigations are a relatively new area of interest among educators. Most of the studies which are applicable to academic situations have been conducted within the past ten years. Cognitive style inventories have been used to predict performance in disciplines such as mathematics, language arts and vocational education. However, no studies have been found which involve cognitive style and driving behavior. Many of the studies on the prediction of driving behavior have been based on accident records or limited observation techniques. With this in mind, the review of literature in this chapter will include the following topics: (1) Driving Behavior; (2) Cognitive Style; (3) The Educational Sciences; and (4) Current Cognitive Style Research.

Driving Behavior

Any study which attempts to measure driving behavior should first identify those behaviors which comprise the task of driving. In a study by Fine, Malfetti and Shoben (1965) 1,057 traffic safety experts

were surveyed in an effort to develop a list of driving behaviors. The results included over 3,000 observable behaviors. This information was used to classify drivers as either "good" or "bad" in their operation of a motor vehicle.

The Human Resources Research Organization (HumRRO) developed a similar method to analyze and evaluate critical driving behaviors (McKnight, et al., 1970). Each aspect of the highway transportation system, i.e., driver, vehicle, roadway, traffic and natural environment, was examined. Over 1500 behaviors were identified, and then presented to a group of 100 traffic safety professionals who evaluated the behaviors for driving criticality. Out of this study came a comprehensive list of driving task descriptions.

Both of the studies presented above have emphasized that the driving task involves numerous behaviors that are often used in combination with one another.

The measurement and identification of driving behavior through different systems of observation has been the objective of many researchers over the years, with varying levels of success. An international research group, the Organization for Economic Co-operation and Development (1970:18) has identified four forms which have been used to observe items of driving behavior. They include the following:

1. remote observations from outside the vehicle;
2. measurement by electro-mechanical means;
3. recording of psycho-physiological processes;
4. multiple in-car observer techniques.

A study by Billion (1957), which compared personality factors and driving behavior, used remote observations of driving behavior by following drivers who did not know they were being observed. They were rated on speed, following distances, conduct at traffic control devices and passing. However, the test results were insignificant when compared with the measured personality factors.

In a similar study, Edwards and Hahn (1964) followed drivers (without their knowledge) and recorded behaviors on five minutes of motion picture film. The drivers averaged over nine errors each, with speeding being the most frequent error. When a comparison of measured driving behaviors was made with participants' accident records to predict future accident potential, no significant difference was found.

When observations were made from stationary positions outside the vehicle, the studies were hampered by either simulated traffic situations (Crawford, 1963) or tended to dwell on only one or two variables (OECD, 1970:30).

A number of studies (Greenshields, 1963; Safrin, 1970; and McLean, 1972) have used vehicles equipped with electro-mechanical devices to measure and record driving behavior. The results of these studies were based on three primary control movements, i.e., steering, acceleration and braking. The frequency and magnitude of these movements have been used to describe a level of skill involved with a particular driving task. Difficulties with this method existed due to changes in traffic and environmental conditions which created problems in the assessment of the results.

Most investigations in psycho-physiological testing have measured heartbeat, galvanic skin response, or pulse rate under varying levels of stress. An exception to this was a study of eye movement by Thomas (1968). This investigation found that the eyes of an average driver systematically perform patterns of observation. Both voluntary and involuntary movements were noted as drivers focused on visual attractions, such as vehicle position in relation to the road and other vehicles. The information presented in this study was of value in the identification of driver search patterns.

In-car observation techniques have been used most extensively by driver licensing agencies. A manual designed to establish criteria for road testing has been published by Northwestern University (Baker, et al.,

1960). It includes a checklist for measuring 67 driving behaviors.

Testing instruments from over 40 driver licensing agencies were reviewed in a study by McGlade (1960). From the results of this investigation, McGlade produced a checklist which could be used to rate singular, isolated behaviors.

Outside the realm of driver licensing, Quenault and Parker (1973) used a method of systematic observation of driver behavior to compare newly qualified drivers with a random sample of drivers. Two observers in the subjects' vehicles rated 15 remotely related driving behaviors. The results indicated that fewer of the newly qualified drivers were assessed as safe drivers. In this study, all the new drivers were administered a personality test and an intelligence test. The subjects were matched according to sex and age. However, mean scores were used for the groups rather than individual scores. The results indicated no significant difference between the groups with regard to the personality and intelligence test scores.

The disappointing results of studies in the measurement of driver behavior can be attributed to two factors, i.e., (1) the use of inadequate observation and rating techniques, and (2) the use of accident records

as a criterion for evaluation. According to Forbes (1974:3) observation and rating techniques need to employ a systems measurement approach which he said should include the following list:

Observing, measuring and analyzing different styles of behavior in response to complex practical situations. Measuring noncognitive behavior as well as cognitive. Taking account of alternate possible response patterns . . .

All these factors need to be present for a system of measuring driving behavior to be a valid indicator of "real world" driving ability.

The use of accident records as a criterion for evaluating driver behavior was found to be unreliable by an international research organization. In a report by the Organization for Economic Co-operation and Development (1970:40), the authors emphasized the inadequacy of accident records when they stated:

Numerous studies have shown that this criterion has little applicability to the evaluation of driving behavior. This is mainly due to insufficient reliability, or repeatability over relatively short time intervals when applied to an unselected population of drivers.

Forbes (1974:2) supported these findings when he stated that:

Accident records involve many unknown factors such as incomplete data, differences in conditions, reporting, coding and the like. Public accident records, even when most complete in the best systems, require three years or more to attain stability. On the whole, research on factors in safe driving using an accident record criterion have been disappointing.

Despite this evidence against the use of accident records, research projects are still being conducted which will use these records as the criterion for measuring driving behavior (HumRRO, 1973).

A procedure for the measurement of driver performance has been developed which was designed to avoid the problems mentioned above. The Driver Performance Measurement procedure, which is of prime importance in this study, was developed by the Highway Traffic Safety Center and Department of Psychology at Michigan State University. This procedure covered over 90 percent of the applicable "critical" or "very critical" driving behaviors identified in the Driver Task Analysis (Forbes, 1972:29). The Driver Performance Measurement procedure (DPM) was intended to provide a reliable criterion to be used in place of accident records. Trained raters made observations concerning the suitability of driving patterns in relation to traffic and environmental conditions.

In describing the DPM procedure Forbes (1973:4) stated:

This research developed an in-car driver performance measurement technique which is quite different from the ordinary road test or the usual checklist approach. The procedure involves observation and rating by specially trained observers, of actual driver behavior patterns in relation to the changing traffic situations in carefully selected and described locations and traffic conditions.

For measuring driving behavior, Forbes (1973:5) pointed out that the DPM is a highly reliable and valid system. Unlike many of the earlier studies on driving behavior, the DPM was designed to be used in "real world" traffic situations while measuring a large number of interrelated tasks. Vanosdall (1977:16) described the superiority of the DPM as a measure of driving behavior when he gave the following description:

Emphasis was placed on both situational factors and patterns of behavior, including timing. Painstaking descriptions of the many behavior patterns and how they increased or decreased hazard potential were prepared. The psychological functions required for "suitable" behaviors (behaviors that decreased or did not increase hazard) were determined for each location [where observations were noted].

Vanosdall (1977:19) further expressed his support of the DPM when he said, "The evidence indicates that there is a general factor of safe driving, and that the DPM method provides a valid and reliable measure of this factor."

Cognitive Style

Early work in the area of cognitive style was promoted when psychologists such as G. W. Allport and P. E. Vernon (1933) conducted studies on personality and motivation. Allport (1937:494) held that in the performance of various activities, individuals demonstrate a pattern of behaviors which he called "style."

With the advent of World War II, interest in the measurement and identification of individuals' cognitive

styles increased greatly (Bosco, 1978). This was due to the fact that military leaders were in need of instruments which could help identify strengths and weaknesses of personnel who were called on to serve in the armed forces before they were assigned specific duties.

In spite of all the interest in this area, problems existed in the definition of cognitive style and the identification of what needed to be measured. Even as late as the 1960's, Herman A. Witkin (1962:80), a noted researcher in cognitive style, commented on the lack of unity in this field. He stated:

In a period of extensive research on cognitive styles, it is not surprising that there should be overlap or even identity among the cognitive styles established by different investigators. There is clearly a need for studies aimed at codifying these cognitive styles.

Definitions of cognitive style have ranged from the very simple to complex. In a recent monograph entitled the State of the Art of Cognitive Style Research (1978), Dr. Witkin called it "self-consistencies which people show." In the same article, Dr. Samuel Messick of the Educational Testing Service at Princeton, N.J. defined cognitive styles as "self-consistent modes of thinking or mental functions."

Dr. Joseph Bosco (1978), a researcher in cognitive style from the State University of New York at Albany, defined cognitive style by first stating what it is not.

He said that cognitive style is not cognitive ability like I.Q., which has a value. It is the way a person prefers to learn.

While these are rather simplistic explanations of a complex concept, they serve as a starting point upon which more advanced definitions can be built.

Broverman (1960:240) expanded commonly held definitions of cognitive style by including variations in the performance of conceptual and perceptual motor tasks. The importance of sensory modalities should also be included when measuring a person's cognitive style. The senses play a vital role in the processing of information (State of the Art, 1978:13).

The complexity of the situation was summed up by Blanton (1971:277) who commented about several of the leading researchers in cognitive style:

Witkin speaks of field independent and field dependent cognitive styles. Broverman speaks in terms of conceptual versus perceptual dominance. Gardner describes cognitive control patterns such as leveling and sharpening . . . [and] Kagan, Moss and Sigel speak of three cognitive styles.

There appears to be a great deal of confusion when it comes to defining and explaining cognitive style. However, in conducting an overview of the field, there are basically twelve prominent models which identify different aspects of a person's cognitive style, and

numerous instruments to measure these models. A list of all twelve models, along with definitions, principal researchers and some measuring instruments, is contained in Appendix B.

By synthesizing concepts related to the twelve cognitive style models, Hill and Nunney (1971:10-15) developed a new framework for measuring cognitive styles called the "Educational Sciences." Students' cognitive styles were measured (mapped) through the use of a battery of six tests which comprise part of the "Educational Sciences." They saw the need for a practical testing instrument which would be the basis of individualized instructional programs. Fortunately, as college administrators, they were in a position to take their ideas a step further and apply them to an actual community college situation (Manilla, 1971).

Researchers Coop and Sigel (1971:160) lent support to the methods used by Hill and Nunney when they proposed that a "number of existing measures of cognitive style may prove to provide more sensitive data for educators as a basis for truly individualized instructional programs." They also suggested the construction of style profiles of individual students. Efforts in this direction resulted in the success of the "Educational Sciences."

The Educational Sciences

A system for identifying educational cognitive styles has grown out of a body of work studied by Dr. Joseph E. Hill which has come to be known as the "Educational Sciences." The term "educational sciences" was first used by Dr. James B. Conant (1960:120) to denote a conceptual framework describing education, not as a single science, but as a composite of several precise sciences. He stated:

I prefer not to speak of the science of engineering but of the engineering sciences. I doubt that there is or ever will be a science of medicine, yet I am sure enormous strides have been made in the medical sciences . . . It would be better [to call them] the educational sciences or educational discipline rather than the science or discipline of education.

Hill (1971:2) identified seven educational sciences which include the following: (1) symbols and their meaning; (2) cultural determinants; (3) modalities of inference; (4) cognitive styles of individuals; (5) electrophysiology and bio-chemistry of memory function; (6) teaching, administrative, counseling, and student style; and (7) systemic analysis decision-making. All seven of these sciences have approached a high level of precision in explaining educational problems. According to DeLoach (1969:5), this high level of precision was attained because the educational sciences were successful in establishing four necessary conditions, i.e., the

clarification of purposes, consistency in the interpretation of issues and information, increased reliability and validity of generalizations and predictions of associated data, and the establishment of universal terminology.

According to Hill (1971:3), "Cognitive styles are determined by the way individuals take note of their surroundings--how they seek meaning, how they become informed." To properly measure an individual's cognitive style, Hill developed an instrument combining the first three sciences of the "Educational Sciences," which includes symbols and their meanings, cultural determinants, and modalities of inference. This instrument, The Cognitive Style Mapping Interest Inventory (see Appendix C), contains 224 items which measure as many as 28 factors to provide a picture of the methods by which a person acquires meaning in his environment. Each individual's cognitive style is displayed in the form of a Cartesian product (see Definition of Terms) of the three sets of sciences mentioned above.

The first set of the Cartesian product, symbolic mediation, indicates preferences in learning such as listening or reading, and preferences in expressing one's self, such as speaking or writing. These preferences are known as theoretical symbols. Qualitative symbols

are also included in the first set and indicate dependency on different senses and social sensitivity.

The second set, cultural determinants, provides an insight into who influences a person's acquisition of knowledge and meanings, i.e., family and/or authority figures, associates, and self.

The third set, modalities of inference, explores a person's method of drawing conclusions about the information he takes in. Included under this heading are different methods of reasoning such as inductive, deductive, categorical, comparative, and analytical reasoning.

Because these three sets are so closely inter-related, with regard to an individual's cognitive style, they are presented in the form of a Cartesian product as the following model demonstrates.

$$\text{Cognitive Style} = \left\{ \begin{array}{c} \underline{\text{S}} \\ \text{T} \\ \text{Q} \end{array} \right\} \times \left\{ \begin{array}{c} \underline{\text{E}} \\ \text{I} \\ \text{A} \\ \text{F} \end{array} \right\} \times \left\{ \begin{array}{c} \underline{\text{H}} \\ \text{M} \\ \text{D} \\ \text{R} \end{array} \right\} \text{L (K)}$$

The letter S represents the first set called symbolic mediation; T refers to theoretical symbols; Q indicates qualitative symbols. E represents the second set which

is the science of cultural determinants; I indicates the influence of "individuality" on symbolic mediation; A denotes the influence of "associates"; and F stands for "family" influence. The set of modalities of inference is denoted by $\underline{H}$, under which M, L, D, R, and (K) indicate methods of reasoning. When referring to a particular profile of an individual in this form of a Cartesian product, it is usually called a map. An example of an actual computer print-out of a cognitive style map can be found in Appendix D.

Through the use of these maps, Hill (1971:9) foresaw the possibility of personalizing education. He stated:

Mapping an individual's cognitive style enables the educator to consider the individual in terms that without the map he or she might not have employed. The diagnosis of an individual's cognitive style and the modes of understanding required by an educational task can be used to match the student to the task. Through this approach it is possible to prescribe educational activities that provide a better probability of successful accomplishment by the individual than otherwise might be possible.

Current Cognitive Style Research

Research completed at Oakland Community College, combined with information gained from over eighty doctoral dissertations (see Appendix E), has contributed to the establishment of high validity and reliability indices for educational cognitive style mapping

(Scarbrough, 1976:148). A number of these studies investigated the relationship of teachers' cognitive style and the cognitive style of their students. Fragale (1969) and Wasser (1969) found that students obtained higher grades from teachers who possessed similar cognitive styles than students whose style differed from the teachers'. Witkin (1972) using his own cognitive style inventory, supported these conclusions when he found that teachers evaluated students more favorably when the students had a cognitive style which resembled their own.

Research based on collective cognitive style profiles has revealed that certain specific groups have unique cognitive styles. DeNike (1973) determined that a collective cognitive style existed for certain students categorized as achievers and another collective cognitive style for the non-achievers. These collective maps were used to identify students who were most likely to benefit from a particular instructional technique.

The relationship of letter grades and collective cognitive styles was identified by Berry (1973), who reported that students with more major cognitive style elements tend to get better grades. In a similar study that dealt with a specific academic discipline, Shuert (1970) identified cognitive style elements that were related to successful and unsuccessful mathematics

students. Lepke (1975) found "that some of the elements in Hill's construct do significantly differentiate between achievers and non-achievers" in learning Beginning German. Dehnke (1966) reported that successful English teachers had an identifiable cognitive style which was significant for elements of symbolic mediation. In a study of vocational education programs by Crowe (1975), she found that distinct collective cognitive style profiles existed for specific subject areas.

Hoogasian (1970) used collective cognitive style profiles to predict the final grades students received in freshman level English courses. The findings indicated that collective cognitive styles were useful as "gross" predictors of success or failure. DeNike's study (1973) also used collective cognitive style profiles to predict which students were most likely to learn from simulation game experiences. Beleutz (1975) identified elements of educational cognitive style which could be utilized as indicators of success in mastering computer programming. Beleutz suggested that this information be used as a tool for counseling potential computer programming students.

Summary

The studies that have been reviewed are related to this study by virtue of their application to driving

behavior and to educational cognitive style. They were intended to emphasize the value of the Driver Performance Measurement procedure and educational cognitive style mapping. The Driver Performance Measurement procedure was shown to be a valid and reliable method for measuring driving behavior. The validity and reliability of educational cognitive style mapping has been substantiated through numerous studies in the "Educational Sciences." Whereas the literature presented in this chapter suggests a broad range of problems which could be analyzed through the use of either procedure, it is of interest in this study to examine the relationship between the two.

CHAPTER III

DESIGN AND PROCEDURES OF THE STUDY

The major objective of this study was to examine the relationship of the cognitive style of selected novice drivers and their driving behavior. A second objective was to compare the collective educational cognitive styles of good novice drivers with those identified as poor novice drivers.

The preceding chapter dealt with a review of literature related to these objectives, i.e., cognitive style and driving behavior. In this chapter, the following items will be presented: (1) source of data, (2) sample employed, (3) design of the study, (4) methods and conditions of data collection, and (5) instrumentalities of data collection.

Source of Data

The subjects for this study were high school driver education graduates in the metropolitan Lansing, Michigan area who had less than three months licensed driving experience. From this population, 288 subjects agreed to participate in a driver licensing project in which the Driver Performance Measurement Procedure (DPM)

scores were collected on each driver. The sample used in this study was drawn from this specific population. A total of nine high schools were asked and agreed to cooperate.

Sample Employed

Since it was impossible to employ all driver education graduates or even all 288 participants involved in the driver licensing project which produced the needed DPM scores, a less encompassing selection procedure was used. 144 subjects were selected from the original population of 288. Using DPM scores as the criterion, 72 drivers in the 25th percentile and 72 drivers in 75th percentile were selected. This division separated the sample into two groups which were identified as the "good" or high performance drivers, and the "poor" or low performance drivers (as related to each other).

An attempt was made to contact all 144 students, however, a minimum number of fifty subjects, twenty five from each group, was sought for statistical validation. Because the nature of this study was exploratory and "hypothesis generating," a larger number was not required for statistical validation (Hill & Kerber, 1967:41). A total of fifty-six subjects volunteered to participate. Thirty-one subjects came from the lowest

quarter of DPM scores while twenty five came from the highest quarter.

Methods and Conditions of Data Collection

The procedures used for collection of data included: (1) retrieval of recorded Driver Performance Measurement scores, and (2) completion of the Educational Cognitive Style Interest Inventories.

The DPM scores and subjects names were made available through the Highway Traffic Safety Center at Michigan State University. These scores were part of the data produced as a result of a driver licensing project which was conducted during the Fall of 1976. When the names of the selected 144 subjects were obtained, an attempt was made to contact each one by telephone to ask them to participate. This procedure, conducted during the Summer of 1977, necessitated the elimination of approximately fifty percent of the qualified subjects due to their unavailability. Of those subjects who were directly contacted, approximately seventy percent took part in the second phase of data collection, i.e., completion of the Educational Cognitive Style Interest Inventory.

During the course of the telephone conversation the students were (1) told the purpose of the study, (2) asked if they would be willing to complete a cognitive

style interest inventory, (3) given an appointed time and directions to the test site, and (4) offered gift certificates to McDonalds Restaurants valued at \$2.00 per participant.

The second half of data collection was obtained by giving the selected instrument to the subjects at their own individual high schools. Permission to use a classroom in each high school was received prior to contacting subjects. The students' own schools were chosen as the test sites because the students were familiar with the building and neighborhood. This also eliminated transportation problems to and from a test site. School officials willingly granted permission to use the school facilities in the interest of driver education. The same examiner monitored all the tests.

Design of the Study

The DPM scores employed in this study consisted of four separate measured behaviors which were used as the criterion variables. The Educational Cognitive Style Maps consisted of 20 independent variables.* Therefore, each subject generated four DPM scores (dependent variables) and 20 cognitive style characteristic scores (independent variables).

*As noted in Appendix A, there are 8 additional elements. Due to limitations of the computer program, only 20 elements were analyzed.

To analyze this information, the Stepwise Regression Procedure was applied. This technique is part of a program contained in the SAS Manual by Anthony Barr and James H. Goodnight (1976). For each dependent variable, this procedure performs separate calculations to screen the independent variables which should be included in a regression model. The main objective of this procedure was to generate a linear correlation of independent variables with dependent variables. With each dependent variable (Y_n) the Stepwise procedure hypothesizes that Y_n is a function of 20 independent variables or

$$Y_n = f(20X_i)$$

Another way to represent this would be as follows:

$$Y_n = a_0 + a_1x_1 + a_2x_2 \dots$$

The variables a_1 , a_2 , a_3 , etc., are added to the model until no variable produces a significant F-statistic for predicting the dependent variable. When no independent variable made a contribution which was statistically significant at the .10 level, it was dropped from the equation. Therefore, only those elements of the educational cognitive style which made the greatest contribution to each driving behavior on the DPM remained.

This design was useful in the prediction of the criterion, i.e., driving behavior.

A second objective of this study was to compare the collective educational cognitive styles of "good" novice drivers with those of "poor" novice drivers. The quality of one's driving performance was a relative process by which the upper 25 percent of DPM scores comprised the "good" drivers while the lower 25 percent were labeled the "poor" drivers.

To determine a composite cognitive style map for both groups, a manual process was used. First, it was necessary to look at each element of the cognitive style map and to count the number of times it occurred in the group of maps. Any element which occurred 70 percent of the time was considered to be representative of that group (Martin, 1977). In this manner, a collective cognitive style profile was obtained for both groups of drivers.

Instrumentalities of Data Collection

The instrumentalities used in this study included the following: (1) The Driver Performance Measurement Procedure, and (2) the Oakland Community College Educational Cognitive Style Interest Inventory.

The DPM procedure required the novice drivers to operate a vehicle through a pre-determined route that contained twelve specific sequences. These sequences,

called BETSS (behavioral environmental traffic situational sequences), described the driving tasks required for a particular situation. A variety of typical driving situations were included within four BETSS. Each BETSS was divided into three subBETSS to provide a more manageable division for rating the numerous driving behavior patterns. An example of a test sequence found on a DPM rating form can be seen in Table 1. The entire recording form is contained in Appendix F. As each subject drove through specific BETSS or subBETSS, an observer rated the driver's performance. The observer checked the appropriate box describing the driver's behavior as "U" (unsatisfactory) or "S" (satisfactory). This was done for all four elements evaluated on the DPM, i.e., Pattern Concept, Search Behavior, Speed Control, and Direction Control. Pattern Concept was the first element to be rated because it included the relative timing of the other three driving behaviors while allowing observers to rate and observe succeeding segments which could otherwise go unobserved. Following the recording of the Pattern behavior, the elements of Search, Speed and Direction Control were rated.

Since the Stepwise Procedure requires numeric data, in this study DPM ratings were given one point

TABLE 1
Sample Rating Form

Trial No. _____	Driver Performance Rating Form		Score _____
Run No. _____			
TEST SEQUENCE	Test Segment Performance	Performance on	
		Search	Speed Control Direction Control
1. Grand River Avenue to Bailey Intersection			
U _____	_____ S _____	U _____ S _____ U _____ S _____	
Does not search, changes lanes abruptly, interferes with traffic, poor position in storage area, speed too fast Searches systematically, matches speed to traffic, turns or stops smoothly			
2. Bailey through G.R. Westbound			
U _____	_____ S _____	U _____ S _____ U _____ S _____	
Does not search right, interferes with traffic, speed too fast, fails to search ahead Searches systematically, accelerates smoothly, steers into proper lane, continues search			

NOTE: Relative timing of behavior elements in relation to the behavior pattern and to SubETSS requirements is one of the criteria for a satisfactory rating in each behavior element.

for a satisfactory performance or zero for unsatisfactory performance of a behavior. Two DPM runs were conducted for each subject, therefore each of the four dependent variables could generate a maximum of twenty-four points.

As an index of safe driving ability the DPM procedure had reliability correlations of 0.75 to 0.85. "Content validity rested on the expert opinion and experience of the project team in various fields of traffic and psychological research" (Forbes, 1973:5). Based on these findings, it is logical to assume that the validity and reliability of the DPM are sufficient for the purposes of this study. A more detailed description of the procedures used in determining reliability and validity of the DPM can be found in the Driver Performance Measurement Procedure Research.

The Educational Cognitive Style Interest Inventory, from which a map of an individual's cognitive style is produced, was developed by Dr. Joseph E. Hill, President of Oakland Community College. Permission to use this test for the purposes of this study was obtained from Dr. Hill in March of 1977. This inventory contains 224 questions which can measure up to 28 cognitive traits describing the manner in which an individual acquires meaning from his environment. A total of 20 traits were measured in this study. For each trait, eight questions

were asked. Table 2 gives examples of the questions and the 20 traits that were measured. The entire inventory and answer sheet can be found in Appendix C.

The students were instructed to decide to what degree the statement was like themselves. Their choices were "U" (usually), "S" (sometimes), or "R" (rarely).

The validity and reliability indices of Educational Cognitive Style Mapping that have been found are based on 84 doctoral dissertations in addition to the work which has been completed by Oakland Community College (Scarbrough, 1976:148). These dissertations are listed in the Appendix of this study.

Validity was determined through the use of point bi-serial correlation. By averaging all the elements of the cognitive style maps, the value of the bi-serial coefficient was:

$$r_{bis} = .783$$

To determine the value of the reliability coefficient, the Kuder-Richardson formula was used. The results of this procedure were:

$$r = .81$$

For both the validity and reliability coefficients, the data processing center at Oakland Community College was used (Scarbrough, 1976:149).

TABLE 2

Sample Cognitive Style Inventory Questions
and Elements Measured

Question	Element
1. I prefer the traditional lecture type classes	TVL Theoretical Visual Linguistics
2. I quote statistical data to others in order to prove my point in an argument	TAL Theoretical Auditory Linguistics
3. I prefer maps to verbal directions when I am going to a strange place	TVQ Theoretical Visual Quantitative
4. I solve mathematical problems more rapidly if they are written	TAQ Theoretical Auditory Quantitative
5. I try not to say things to hurt the feelings of others	QCEM Qualitative Code Empathic
6. I would go out of my way to see beautiful scenery	QCES Qualitative Code Esthetic
7. I believe that a promise should be kept	QCET Qualitative Code Ethic
8. I am able to "play a role" anywhere if I agree to	QCH Qualitative Code Histrionic
9. I use facial expressions to communicate emotions	QCK Qualitative Code Kinesics
10. I am better coordinated than most people	QCKH Qualitative Code Kinesthetic
11. Unless spoken to first, I do not speak to a teacher	QCP Qualitative Code Proxemics
12. I predict accurately if I will be able to get my work done	QCS Qualitative Code Synnoetics
13. In group discussions, I assume the leadership to move the group to reach a decision	QCT Qualitative Code Transactional
14. I make personal decisions after discussing them with my friends	A Associates
15. I consult with my immediate family before making decisions	F Family
16. I prefer to study on my own	I Individuality
17. I understand a topic better if I analyze it to learn how it differs from other topics	D Difference
18. The more I know about a problem the more I want to know about it	R Relationship
19. Life is simple if you go by the rules	M Magnitude
20. I like to see several examples before starting a new project	L Appraisal

Summary

In summary, the following procedures for the collection of the data were conducted:

1. During the Fall of 1976, 288 students participated in a driver licensing project which produced DPM scores for each subject.
2. Permission to use these DPM scores was obtained from the Highway Traffic Safety Center of Michigan State University during the Spring of 1977.
3. Permission to use the Educational Cognitive Style Interest Inventory in this study was obtained from Dr. Joseph E. Hill, President of Oakland Community College.
4. The selection of subjects was conducted by methods described in the section on Sample Employed.
5. The area high schools of each subject were contacted for permission to use a classroom as a test site.
6. Students were contacted by telephone and asked to participate.
7. 56 subjects were administered the Educational Cognitive Style Interest Inventory during July, 1977.
8. Completed tests were scored by the Oakland Community College (Michigan) Testing Center on August 15, 1977.

9. The dependent and independent variables were analyzed (using the Stepwise Procedure) on October 17, 1977 at Oakland Community College Computer Center.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this study was twofold:

1. To compare the collective cognitive styles of good novice drivers with those identified as poor novice drivers; and
2. To examine the relationship of the educational cognitive style of selected novice drivers and their driving behavior as evidenced by the regression model.

In the preceding chapter the design and procedures of the study were presented. In this chapter the analysis of data is represented. The following items are included in this section: (1) collective cognitive style profiles; and (2) the Stepwise regression procedure.

Collective Cognitive Style Profiles

One of the purposes of this study was to determine which elements of cognitive style were common to each group of drivers tested, i.e., those subjects who scored in the upper and lower quartiles of the Driver Performance Measurement Procedure (DPM). Cognitive style

elements were separated into major and minor orientation categories. Drivers with major orientation in a cognitive style element are said to have above average ability or strength in that area, i.e., at a given level of educational development these individuals realized an element score in the 50th-99th percentile range. A minor orientation indicated average ability in an element, i.e., at a given level of educational development an individual realized a score in the 26th-49th percentile range (Hill, 1971:6).

The highest scoring group of DPM subjects had twelve factors of major orientation and eight of minor orientation for its collective cognitive style. The factors in the major category were TVL (Theoretical Visual Linguistics), QCEM (Qualitative Code Empathic), QCES (Qualitative Code Esthetic), QCET (Qualitative Code Ethic), QCH (Qualitative Code Histrionic), QCK (Qualitative Code Kinesics), QCKH (Qualitative Code Kinesthetic), QCP (Qualitative Code Proxemics), QCS (Qualitative Code Synnoetics), I (Individuality), M (Magnitude), and D (Difference). The minor orientation elements included TAL (Theoretical Auditory Linguistics), TVQ (Theoretical Visual Quantitative), TAQ (Theoretical Auditory Quantitative), QCT (Qualitative Code Transactional), A (Associates), F (Family), R (Relationship), and L (Appraisal).

To give the reader a sense of the meaning of the collective map for the highest scoring group, a behavioral interpretation is provided. A person's cognitive style is comprised of three sets of elements: symbolic mediation; cultural determinants; and modalities of inference. Because of their inter-relationship, these sets are printed in the form of a Cartesian product (see Definition of Terms). For example, Table 3 shows the map of these sets for this particular group of subjects. The Cartesian product is used to display all the elements of a person's cognitive style because the three main categories of cognitive traits which describe the ways a student seeks meaning should not be treated separately.

Using the collective map of the drivers in the highest scoring DPM group as an example, the first set of the Cartesian product shows the symbols which indicate the ways individuals acquire meaning through words, numbers and the senses. Average ability, as defined above, can be seen in the following elements: (1) T'AL, the ability to listen to directions; and (2) T'VQ and T'AQ, the ability to derive meaning from both reading and hearing mathematical concepts. In this set, above average ability was revealed in the element TVL, the ability to derive meaning from written materials and comprehend what is read.

The qualitative symbols, which are included in the first set of the map, indicated average ability to interact verbally with others in a positive manner as displayed by the symbol Q'CT. However, this collective map contained eight elements where above average abilities appeared. These drivers demonstrated an above average ability in the following elements: (1) QCP, the ability to judge physical and social distance; (2) QCK, the ability to communicate by motions of the body; (3) QCS, the ability to know one's limitations; (4) QCKH, the ability to perform motor skills (such as those required to operate an automobile); (5) QCH, the ability to perceive the role expectations of a situation and act them out; (6) QCET, the ability to commit oneself to a set of principles, obligations and duties; (7) QCES, the ability to see the beauty of an idea or object; and (8) QCEM, the ability to empathize and see things from another person's point of view.

The cultural determinants of the meaning this "collective driver" derives from symbols indicate an above average orientation in individuality (I) yet he would still give consideration to the opinions of family and/or authority figures (F') and associates (A'). These three influences comprise the second set of the Cartesian product which make up a cognitive style map.

The third set shows the way in which this group of drivers reason or infer. In this set there is an above average use of categorical reasoning (M) and a tendency to contrast and compare selected characteristics when seeking meaning (D). To a lesser extent, this group would be inclined to synthesize a number of incidents into a unified meaning (R').

A collective cognitive style element in a particular group's profile was based on the strength of each individual's factors. If an element was present as a "major," or "minor" (or combination of the two as a "minor") 70 percent of the time or greater it was considered to be representative of that group (Martin, 1977). Two frequency distributions, contained in Table 4, were formed to determine group orientation on each of the twenty elements tested for the independent variables. The figures in parenthesis indicate the total number of subjects who had a major orientation in a particular element. Only five subjects had negligible orientations in an element and they are identified by a double asterisk (**). Since there was a maximum possibility of 25 subjects in the high group and 31 subjects in the low group, the remaining unidentified subjects were those having a minor orientation. For example, on the element TVQ for the high scoring DPM group contained on Table 4, eleven subjects

TABLE 4

Collective Cognitive Style Profiles

High DPM Scoring Drivers' Group Orientation (17 subjects or more needed for major orientation)		Low DPM Scoring Drivers' Group Orientation (22 subjects or more needed for major orientation)	
T VL	Major (17) *	Major (23)	
T AL	Minor (7)	Minor (12)	(2) **
T VQ	Minor (11) (1) **	Minor (11)	(1) **
T AQ	Minor (7)	Minor (10)	
Q CEM	Major (23)	Major (27)	
Q CES	Major (20)	Major (24)	
Q CET	Major (20)	Major (26)	
Q CH	Major (19)	Minor (16)	
Q CK	Major (17)	Minor (15)	
Q CKH	Major (21)	Minor (20)	(1) **
Q CP	Major (17)	Minor (19)	
Q CS	Major (24)	Major (28)	
Q CT	Minor (15)	Minor (16)	(1) **
I	Major (23)	Major (28)	
A	Minor (7) (1) **	Minor (7)	
F	Minor (13)	Minor (16)	(1) **
M	Major (21)	Major (26)	
D	Major (19)	Minor (19)	
R	Minor (12)	Minor (16)	
L	Minor (14)	Minor (18)	

* Total number of subjects per group with a major orientation.

** Total number of subjects per group with a negligible orientation.

had a major orientation, one had a negligible orientation and therefore the remaining unidentified 13 subjects had a minor orientation.

The highest DPM scoring group was composed of 25 subjects. Since an element had to be present at least 70 percent of the time to be included in a particular orientation category, that element had to appear as a major (or minor) orientation on at least 17.5 maps (rounded to 17) to be considered a major (or minor) orientation on the collective profile. Similarly, with 31 subjects in the lowest scoring DPM group, an element had to appear as a major (or minor) on 21.7 maps (rounded to 22) to be included as a major (or minor) on the collective map. In both groups, a factor that occurred in the combination of major and minor orientations in at least 70 percent of the maps was considered a minor element.

The collective cognitive style of the lowest scoring group of DPM subjects included seven factors of major orientation (see Table 4). It included TVL, QCEM, QCES, QCET, QCS, I and M. The remaining factors were of minor orientation, i.e., TAL, TVQ, TAQ, QCH, QCK, QCKH, QCP, QCT, A, F, D, R, and L. A map of this collective cognitive style in the form of a Cartesian product is found in Table 5.

TABLE 5
Collective Educational Cognitive Style Map of Students
in Lowest DPM Scoring Group

SET I				SET II		SET III		
T'AL	T'AQ	TVL	T'VQ	X	I	X	M	D' R'
QCEM								
QCES								
QCET								
QCS								
Q'CH								
Q'CK				X	F'	A'	L'	
Q'CKH								
Q'CP								
Q'CT								

G =

When a chi square was used to see if there was a significant difference between the collective cognitive styles of both groups, the only significant difference appeared with the element QCH, Qualitative Code Histrionic. On this item the highest scoring DPM group had a major orientation while the low scoring group had a minor orientation. The difference between the groups was significant at the .10 level. Based on this data, generalizations about a collective cognitive style and driving behavior cannot be made beyond the specific groups in this study.

The Stepwise Regression Procedure

The Stepwise regression procedure is a statistical term used to describe any one of five different techniques which generate regression models. These techniques include Forward Selection, Backward Elimination, Stepwise, Maximum R Square Improvement, and Minimum R Square Improvement. With all these techniques, the relative strengths of the relationship between a collection of independent variables and dependent variables is calculated. Through these procedures a regression model can be produced to identify those independent variables most likely to be related to the dependent variables on which they were regressed. These models can then be used to predict a score on each dependent variable.

The Stepwise technique chosen for this study was the Maximum R Square Improvement procedure. It is considered the best procedure because the Maximum R Square evaluates every variable before entering a new variable into a model. For each step calculated, the best model is produced. As a consequence of this, the Maximum R Square technique looks for the best one-variable model, then finds the best two-variable model by comparing and switching variables to produce the greatest increase in the R square statistic. The process continues comparing and switching to produce the best three-variable model, the best four-variable model, etc. The model reaching the highest level of significance (with all the independent variables within the specified significance level) was selected as the best all around model for predicting a score on the dependent variable. A more complete description of all five Stepwise techniques can be found in Appendix G.

Under the Maximum R Square procedure a significant model was produced for all four dependent variables investigated in this study. Included in these criterion variables were the DPM rating categories of Pattern Concept (Y_1), Search Concept (Y_2), Speed Control (Y_3), and Direction Control (Y_4).

As seen in Table 6, the best model (as defined above) for predicting the dependent variable Y_1 at the

TABLE 6

Significance Levels of Regression Models for Predicting Pattern
Concept Scores at the .10 Level of Significance

STEP 1	Variable QCKH (psychomotor ability) entered (Critical Value of F at .10 level = 2.84)	F = 7.30	Probability < F = .0092
STEP 2	Variable TVL (reading ability) entered (C.V. of F at .10 level = 2.44) TVL and QCKH	F = 6.02	Probability < F = 0.0044
STEP 3	Variable QCET (ethical code) entered (C.V. of F at .10 level = 2.23) QCET, TVL and QCKH	F = 5.15	Probability < F = 0.0036
STEP 4	Variable QCH (perception of role expectations) entered (C.V. of F at .10 level = 2.09) QCH, QCET, TVL, and QCKH	F = 4.51	Probability < F = 0.0034
STEP 5*	Variable TAQ (understanding numerical symbols) entered (C.V. of F at .10 level = 2.00) TAQ, QCH, QCET, TVL, and QCKH	F = 4.36	Probability < F = 0.0023
STEP 6	Through STEP 20 No other models met the .10 level of significance for all variables		

* The variables in STEP 5 are the "best" predictors of Y_1 .

.10 significance level occurred in STEP 5 of the statistical procedure. The models in all of the first five steps were significant. However, STEP 5 contains the model which reached the highest level of significance without a non-significant variable entering into a model. In STEP 1 the variable QCKH (psychomotor ability) alone had an F ratio of 7.30 which was significant at the .0092 level. (The Critical Value of F at the .10 level for 1 and 54 degrees of freedom = 2.84.) All the variables added to the models up to STEP 5 were significant at the .10 level. (The Critical Value of F in STEP 5 for 5 and 50 degrees of freedom = 2.00.) STEP 6 through STEP 20 contained no models which met the .10 level of significance because of the entrance of non-significant variables into the model. The steps containing the non-significant variables can be found in Appendix F. In STEP 5 the variables TAQ, QCH, QCET, TVL and QCKH formed a model for predicting Pattern Concept (Y_1) which was significant at the .0023 level with an F ratio of 4.36. The model is as follows:

$$Y_1 = 16.07 - .077TVL - .083TAQ - .069QCET + .063QCH \\ + .114QCKH$$

This means that a score for the predicted driving behavior (Pattern Concept) of Subject N can be calculated by

entering the subject's cognitive style scores for the elements in the equation. The numerical data contained in this equation, along with the R square values can be found in Appendix H.

The model developed for predicting Search Behavior (Y_2) contained only one variable which was significant at the .10 level. As seen in Table 7, the element QCH (the ability to meet role expectations) had an F ratio of 3.25 which was significant at the .0771 level. The Critical Value of F with 1 and 55 degrees of freedom was 2.84. The regression equation for predicting Y_2 was:

$$Y_2 = 8.52 + .051QCH$$

There were no other significant models developed at the specified level for this dependent variable.

The fifth step, contained in Table 8, shows the model which is most likely to predict Speed Control scores (Y_3). All four of the preceding models were significant at the .10 level, however, STEP 5 contained the best model as defined above. This model had an F value of 5.37 which was significant at the .0005 level. The elements contained in this model were TVL, QCEM, QCET, QCKH, and QCP. The Critical Value of F was 2.00 for 5 and 50 degrees of freedom. The following equation was developed to predict this dependent variable:

TABLE 7

Significance Levels of Regression Models for Predicting Search Behavior
Scores at the .10 Level of Significance

STEP 1 *	Variable QCH (ability to meet role expectations) entered		
	(Critical Value of F at .10 level = 2.84)		
	QCH	F = 3.25	Probability < F = 0.0771
STEP 2	Through	STEP 20	
	No other models met the .10 level of significance for all variables		

* The variable in STEP 1 is the "best" predictor of Y_2 .

TABLE 8

Significance Levels of Regression Models for Predicting Speed Control
Scores at the .10 Level of Significance

STEP 1	Variable QCKH (psychomotor ability) entered (Critical Value of F at .10 level = 2.84)		
	QCKH	F = 6.97	Probability < F = 0.0108
STEP 2	Variable TVL (reading ability) entered (C.V. of F at .10 level = 2.44)		
	TVL and QCKH	F = 5.97	Probability < F = 0.0046
STEP 3	Variable QCET (ethical code) entered (C.V. of F at .10 level = 2.23)		
	QCET, TVL and QCKH	F = 5.29	Probability < F = 0.0031
STEP 3	Variable TVL replaced by QCP (proximity code) (C.V. of F at .10 level = 2.23)		
	QCP, QCET and QCKH	F = 5.58	Probability < F = 0.0023
STEP 4	Variable TVL (reading ability) entered (C.V. of F at .10 level = 2.09)		
	TVL, QCP, QCET and QCKH	F = 5.79	Probability < F = 0.0006
*STEP 5	Variable QCEM (empathy code) entered (C.V. of F at .10 level = 2.00)		
	QCEM, TVL, QCP, QCET and QCKH	F = 5.37	Probability < F = 0.0005
STEP 6	Through STEP 20		
	No other models met the .10 level of significance for all variables		

*The variables in STEP 5 are the "best" predictors of Y_3 at the .10 level.

$$Y_3 = 17.75 - .069TVL - .062QCEM - .088QCET + .113QCKH \\ + .097QCP$$

The best model for predicting a score on the variable Direction Control (Y_4) at the .10 significance level contained one cognitive style element. The independent variable QCKH had an F ratio of 3.25 which was significant at the .0771 level. The Critical Value of F with 1 and 55 degrees of freedom was 2.84. The regression model (see Table 9) which best predicts Y_4 was:

$$Y_4 = 13.35 + .061QCKH$$

No other models were significant at the .10 level.

Summary

One of the purposes of this study was to compare the collective cognitive style profiles of those subjects in the highest quartile of DPM scores with those in the lowest quartile. Except for one cognitive style element, QCH (the ability to perceive the role expectations of a situation and act them out), there was no significant difference between the groups.

Also included in this chapter was a discussion of how the Stepwise regression procedure was employed. Specifically, the Maximum R Square Improvement technique was used to show the relationship of the cognitive style

TABLE 9

Significance Levels of Regression Models for Predicting Direction
Control Scores at the .10 Level of Significance

STEP 1* Variable QCKH (psychomotor ability) entered
(Critical Value of F at .10 level = 2.84)
QCKH F = 3.25 Probability < F = 0.0771

STEP 2 Through STEP 20
No other models met the .10 level of significance for all variables

* The variable in STEP 1 is the "best" predictor of Y_4 at the .10 level of significance.

of selected novice drivers and their driving behavior. Through the use of this statistical method, regression models were developed to predict driving performance. At the .10 significance level a model was produced for the prediction of all four dependent variables, i.e., Pattern Concept, Search Behavior, Speed Control and Direction Control.

CHAPTER V

SUMMARY, CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

The concluding chapter of this study will include: (1) a summation of this study including methods and findings; (2) the conclusions warranted by the resulting data; (3) a discussion; and (4) recommendations for further study.

Summary

The primary purpose of this study was to examine the relationship of the educational cognitive style of novice drivers and their driving behavior. To measure cognitive style the Educational Cognitive Style Interest Inventory of Oakland Community College (Michigan) was used. The Driver Performance Measurement Procedure (DPM) developed at Michigan State University was employed to measure driving behavior.

The subjects for this study were high school driver education graduates from the Lansing, Michigan area who had less than three months licensed driving experience. From this population, 288 subjects agreed to participate in a driver licensing project during the Fall of 1976 in which

the DPM scores were collected on each driver. A sample of 56 volunteers from this group were administered the Educational Cognitive Style Interest Inventory during the Summer of 1977. These subjects were divided into two groups, i.e., the "good" and "poor" drivers, based on their DPM scores. The "good" drivers were those subjects who scored in the fourth quartile of the DPM. Twenty-five of the volunteers came from this group. The "poor" drivers were those who scored in the first quartile of the DPM. Thirty-one of the volunteers were from this group.

To examine the relationships of cognitive style and driving behavior two procedures were used. The first was to compare the collective cognitive styles of the highest scoring DPM group with the styles of the lowest scoring DPM group. The second procedure was to formulate regression models (equations) to determine what cognitive style variables, if any, could be generated to predict the driving behaviors measured by the DPM.

Specifically, this study answered the following questions:

1. What elements of the collective cognitive styles were common to the group which scored in the highest quartile on the DPM?

In forming the collective cognitive style for this group, twelve factors of major orientation and eight of minor orientation were found. The elements in the major

category were: TVL (Theoretical Visual Linguistics), QCEM (Qualitative Code Empathic), QCES (Qualitative Code Esthetic), QCET (Qualitative Code Ethic), QCH (Qualitative Code Histrionic), QCK (Qualitative Code Kinesics), QCKH (Qualitative Code Kinesthetic), QCP (Qualitative Code Proxemics), QCS (Qualitative Code Synnoetics), I (Individuality), M (Magnitude), and D (Difference). Included among the elements with a minor orientation were: TAL (Theoretical Auditory Linguistics), TVQ (Theoretical Visual Quantitative), TAQ (Theoretical Auditory Quantitative), QCT (Qualitative Code Transactional), A (Associates), F (Family), R (Relationship), and L (Appraisal).

2. What elements of the collective cognitive styles were common to the group which scored in the lowest quartile on the DPM?

The collective cognitive style profile for the lowest scoring group of DPM subjects included the seven following factors of major orientation: TVL, QCEM, QCES, QCET, QCS, I and M. The remaining factors were of minor orientation: TAL, TVQ, TAQ, QCH, QCK, QCKH, QCP, QCT, A, F, D, R, and L. The Chi square test of significance revealed only one variable at the .10 level, QCH, which was significantly different on the two collective profiles.

3. What elements of a person's cognitive style were correlated at a minimum significance level of .10

with the "Pattern Concept" rating on the DPM as evidenced by the regression model?

The elements TAQ, QCH, QCET, TVL, and QCKH were all the factors correlated with the dependent variable "Pattern Concept" (Y_1) within the .10 level of significance. The regression equation for the predicted value of this variable was:

$$\hat{Y}_1 = 16.07 - .077TVL - .083TAQ \\ - .069QCET + .063 QCH + .114QCKH$$

4. What elements of a person's cognitive style were correlated at a minimum significance level of .10 with the "Search Behavior" rating on the DPM as evidenced by the regression model?

The only element correlated with the dependent variable "Search Behavior" (Y_2) at the .10 significance level was QCH. The regression equation in this case was:

$$\hat{Y}_2 = 8.52 + .051QCH$$

5. What elements of a person's cognitive style were correlated at a minimum significance level of .10 with the "Speed Control" rating on the DPM as evidenced by the regression model?

Five elements were correlated with the dependent variable "Speed Control" (Y_3) including TVL, QCEM, QCET,

QCKH and QCP. These elements were significant at the .10 level. The following equation was developed to predict Y_3 :

$$\hat{Y}_3 = 17.75 - .069 \text{ TVL} - .062 \text{ QCEM} \\ - .088 \text{ QCET} + .113 \text{ QCKH} + .097 \text{ QCP}$$

6. What elements of a person's cognitive style were correlated at a minimum significance level of .10 with the "Direction Control" rating on the DPM as evidenced by the regression model?

QCKH was the only element correlated with the dependent variable "Direction Control" (Y_4) at the .10 level. The regression equation most likely to predict Y_4 was:

$$\hat{Y}_4 = 13.35 + .061 \text{ QCKH}$$

Conclusions

The following conclusions are based on the findings in this study.

1. A general collective cognitive style was not found which identifies good and poor drivers.
2. Driving behaviors measured by the DPM were related to elements of educational cognitive style.

3. Regression models were found which predict driving behaviors based on cognitive style mapping scores.

Discussion

Based on the findings of this study it appears that driver education teachers have a tool available (Oakland Community College Educational Cognitive Style Interest Inventory) for predicting driving behavior. This information is valuable for the teacher who wants to identify before hand, individual student strengths and weaknesses in driving. The teacher would have to administer this cognitive style inventory to a class before any of the laboratory phases of driver education were begun. This teacher could then calculate predicted driving behaviors by applying cognitive style scores to the related equations. For example, if a teacher wanted to predict overall driving ability, which "Pattern Concept" (Y_1) measures, you would take the equation.

$$Y_1 = 16.07 - .077TVL - .083TAQ \\ - .069QCET + .063QCH + .114QCKH$$

Into this equation would be entered the corresponding cognitive style scores. In a hypothetical situation, Student A had the following scores: TVL = 50; TAQ = 30; QCET = 60; QCH = 50; QCKH = 70.

The equation then becomes

$$Y_1 = 16.07 - .77(50) - .083(30) - .069(60) \\ + .063(50) + .114(70)$$

$$Y_1 = 16.72$$

Another student, Student B, may have the following scores:

TVL = 70; TAQ = 40; QCET = 70; QCH = 40; QCKH = 50.

$$Y_1 = 16.07 - .077(70) - .083(40) - .069(70) \\ + .063(40) + .114(50)$$

$$Y_1 = 10.75$$

In interpreting these scores, it would probably be most advantageous to the average classroom teacher to arrange the scores of all the students in descending order to estimate the relative driving ability predicted for these people. For those desiring a more precise cutoff point between a satisfactory and unsatisfactory scores, researchers in the Michigan Road Test Evaluation study decided that a minimum passing score corresponded to 65 percent of the maximum total score (Vanosdall, 1977, p. 98). Since the maximum total score for actual driving behaviors in this study was 24, a student needed a score of 15.80 or higher to pass. Based on this information, a teacher could speculate that Student A would demonstrate

a higher level of proficiency in operating a vehicle than Student B.

Weaknesses that are identified can be attended to through a more intense instructional procedure. For example, students who are weak in their search behavior could be drilled in the development of perceptual skills.

Estimating a score on the dependent variable "Pattern Concept" is probably the most useful since it includes the timing of all the driving behaviors. However, the importance of each individual behavior should not be under-rated.

It is probably no surprise to driver education teachers that psychomotor skills (QCKH) play such an important role in "Speed Control" and "Direction Control." In both cases the simplest model (although not necessarily the most statistically significant) for predicting these behaviors contained the single variable of QCKH.

The dependent variable of "Search" was the only exception to this. It is interesting to note that the independent variable QCH, Qualitative Code Histrionic, was the only significant element for predicting this score. QCH indicates an ability to exhibit a deliberate behavior or to play a role to produce some particular effect on other persons. An individual with a major orientation in this element knows how to fulfill role expectations. One can only speculate on reasons why there was a correlation

between these two variables. One possibility is that when the novice drivers in this study got behind the wheel they understood what the role expectations of a driver were, especially with regard to lane changing and looking systematically for traffic information. These are procedures that do not necessarily require highly developed motor skills. However, they do require the exhibition of deliberate behaviors. Another possibility is that these novice drivers simply "acted" like good drivers because an observer was present when their driving behavior was being rated. Hopefully, the former explanation is the reason why the "Search" behavior was significant.

Even if there was no significant relationship between educational cognitive style and driving behavior, it is still a very valuable instrument for any classroom teacher. Teachers should realize that their students have varying cognitive styles. They do not all learn in the same way. However, teachers tend to present material according to their own cognitive style. As pointed out in the Review of Literature, a student's academic performance increases when a positive correlation exists between his cognitive style and that of his teacher. The student whose cognitive style differs greatly from his teacher's cognitive style actually gets lower grades. The teacher who recognizes these differences could take advantage of the students' cognitive style by varying instructional

techniques. For example, assume Student A has the following map of his cognitive style:

$$\text{Cognitive Style} = \left\{ \begin{array}{c} \text{TAL} \\ \text{TVL} \\ \text{QCEM} \\ \text{QCT} \\ \text{QCH} \end{array} \right\} \times \left\{ \begin{array}{c} \text{A} \end{array} \right\} \times \left\{ \begin{array}{c} \text{R} \\ \text{M} \end{array} \right\}.$$

The elements TAL (Theoretical Auditory Linguistic) and TVL (Theoretical Visual Linguistic) indicate above average ability in deriving meaning from both written and spoken words. QCEM (Qualitative Code Empathetic) shows a high degree of sensitivity to the feelings of others. Very good communicative skills are indicated by the element QCT (Qualitative Code Transactional). QCH (Qualitative Code Histrionic) is the element which was correlated with the driving behavior of "Search." It shows above average ability in knowing how to fulfill role expectations. The symbol A (Associates) indicates that this person prefers to "bounce" insights off peers as a means of deriving meaning from information acquired. The type of reasoning used by this person, M (Magnitude) and R (Relationships) shows a need for pre-selected categories, classifications, rules and definitions, as well as a need for a number of examples. While it is somewhat of a generalization, this person would probably benefit from the use of small discussion groups with peers.

Another example of the information a teacher can gain from a cognitive style map is the following:

$$\text{Cognitive Style} = \left\{ \begin{array}{c} \text{SET I} \\ \text{TVL} \\ \text{TVQ} \\ \text{QCET} \end{array} \right\} \times \left\{ \begin{array}{c} \text{SET II} \\ \text{I} \end{array} \right\} \times \left\{ \begin{array}{c} \text{SET III} \\ \text{M} \end{array} \right\}$$

For this person, a structured independent study program would take advantage of his preferred learning style. I (Individuality) shows that this person prefers to learn on his own. TVL (Theoretical Visual Linguistic) and TVQ (Theoretical Visual Quantitative) indicate abilities to acquire meaning of words and numerical concepts through written materials. The absence of TAL and TAQ would show that this student does not prefer to learn through listening as in lectures. However, with a major orientation in M (Magnitude) a teacher would have to tell this student exactly what he is supposed to acquire on his own.

Admittedly, these two models are over simplifications of the actual maps which were scored and printed at Oakland Community College. (An example of these maps is contained in Appendix F.) An inventory developed by Dr. Joseph Bosco of the State University of New York at Albany, Center for Curriculum and Instruction, does produce maps which are easier to administer and interpret. A copy of this inventory can be found in Appendix G. Research

has not been conducted to examine the relationship between the DPM and Dr. Bosco's inventory. Until then, the scores obtained through the use of this inventory cannot be substituted for the scores on the Oakland Community College inventory.

The regression equations developed in this study have combined several of the elements of educational cognitive style to predict driving behavior. It is interesting to note that in the prediction of the "Pattern Concept" score (Y_1) and the "Speed Control" score (Y_3) the element TVL (reading ability) and QCET (commitment to a set of values) carried negative regression weights. This means that these elements were negatively correlated with the two driving behaviors. An explanation of this phenomena could not be found.

Most students can acquire some level of learning regardless of how the teacher presents information. However, as shown in the two examples above, there are ways of enhancing the learning situation for some of the students. While individualized instruction is not always possible, a teacher who does not vary his teaching style is doing some of his students an injustice.

It is important for anyone who intends to use educational cognitive style mapping as a predictor of driving behavior to remember three points:

1. Scores from other cognitive style inventories should not be entered in the equation provided until further research is conducted using specific instruments.

2. The models produced are not guaranteed to accurately represent "real world" conditions. In the use of any statistical procedure there is always the possibility of error.

3. The DPM procedure should only be conducted under the guidelines established by Forbes (1973).

Recommendations

1. Replication of this study using only those elements of the Educational Cognitive Style Interest Inventory which were related to driving behavior.

2. The use of a larger group of subjects to determine if a collective cognitive style map of good and poor drivers would be statistically significant.

3. Replication of the study using a simpler version of educational cognitive style measurement.

4. Practical application of the regression equations combined with a follow-up use of the DPM to check the validity and reliability of a system for predicting driving behavior.

5. Replication of the study employing the qualitative symbols which indicate the influence of sensory stimuli used by an individual to acquire knowledge.

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APPENDICES

APPENDIX A

THE EDUCATIONAL SCIENCES

THE EDUCATIONAL SCIENCES



OAKLAND
COMMUNITY
COLLEGE

2480 Opdyke Road Bloomfield Hills, Michigan 48013

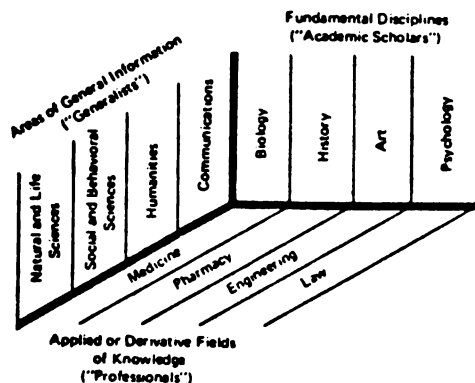
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THE EDUCATIONAL SCIENCES

Dr. Joseph E. Hill

Fundamental disciplines are bodies of knowledge generated by communities of scholars that produce pure and distinctive forms of information about phenomena which they study. Biology, history, art, psychology and mathematics are examples of fundamental disciplines.

A fundamental discipline must be either a science or an art, it cannot be both. Sciences, as bodies of information, must recognize the principles of completeness and that of closure. The arts (e.g., history, a synoptic art, and art, an esthetic art) do not need to recognize these two principles.



Complementing the fundamental disciplines are the applied or derivative fields of knowledge. These bodies of information are generated by practitioners who deal with practical considerations of the human condition. Medicine, pharmacy, engineering and law are examples of applied fields of knowledge.

The applied fields are composed of terms and methods of inquiry borrowed from the fundamental disciplines and other "cognate" fields. Their practitioners are not concerned with producing pure and distinctive forms of information. In this context, the applied fields are composed of both sciences and arts that are designed to explain phenomena and solve problems in the practical aspects of the human situation. For example, the applied field of knowledge called "medicine" is composed of the medical sciences and medical arts. Engineering of the engineering sciences and the engineering arts.

Although much of the knowledge produced by academicians in their disciplines and professionals in their "fields" is frequently beyond the comprehension of persons outside the specializations in question, and although this knowledge may appear at times to have little relevance to the immediate concerns of persons not committed to it by affiliation with these specializations, there is a great need for at least knowing about the structures and functions of such bodies of information. In order to make such information available to society, clusters of information related to such broad areas as natural and life sciences, social and behavioral sciences, humanities, and communications can be formed on the basis of representative ideas, methods of inquiry employed, and significant applications of these ideas to problems extant in the human condition.

The areas of general information provide a means for presenting the fundamental disciplines and the applied fields of knowledge in forms that will allow persons to realize the essentiality of these disciplines and fields to their own, and to contemporary society's ultimate potential and welfare. The aim of the areas of general information is to present selected characteristics in logical patterns of the fundamental disciplines and applied fields to which they pertain. The organization of ideas included in an area of general information is based upon making relevant to the education of any person, rather than to the education of the student specializing in a given body of knowledge, essential understandings of the disciplines and fields under consideration.

The Educational Sciences provide a conceptual framework and scientific language for the applied field of knowledge called education. These "sciences" approach a level of precision that is found in such other derivative fields as medicine, pharmacy, engineering and law.

With the development of the Educational Sciences, the solutions of problems and explanations of phenomena are facilitated, and educational problems accruing to inadequate communication, misinterpretation of information, and fragmentation of effort are alleviated.

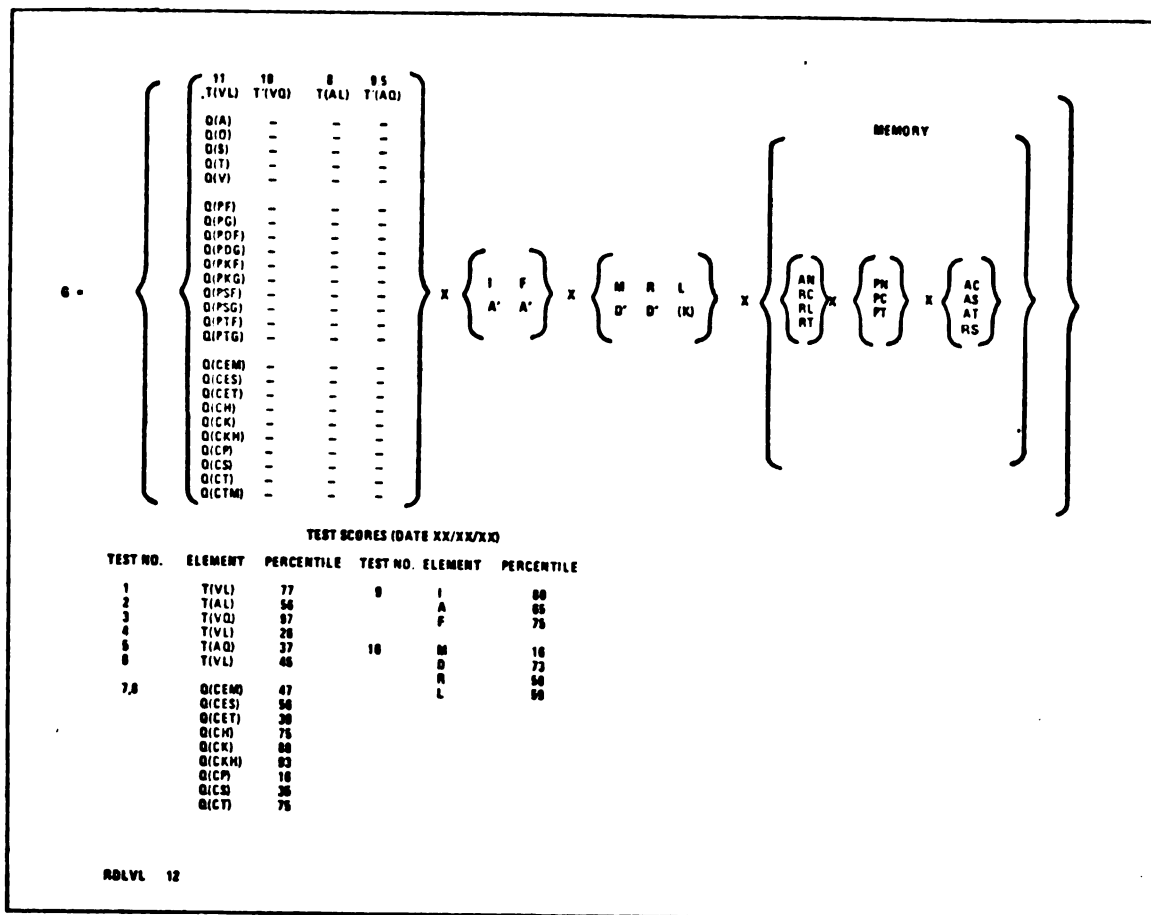
In the process of creating and developing the Educational Sciences, the following assumptions are made:

- 1) Education is the process of searching for meaning.
- 2) Thought is different from language.
- 3) The human creature is social in nature and has a unique capacity for deriving meaning from its environment and personal experiences through the creation and use of symbols.
- 4) Not content with biological satisfactions alone, humankind continually seeks meaning.

These assumptions are essential to the conceptual framework for education called the Educational Sciences.

At the present time, there are seven educational sciences:

- 1) Symbols and their meanings
- 2) Cultural determinants of the meanings of symbols
- 3) Modalities of inference
- 4) Educational memory
- 5) Cognitive styles of individuals
- 6) Teaching styles, administrative styles and counseling styles
- 7) Systemic analysis decision-making



Educational Cognitive Style

Oakland Community College accepts the premise that no two students seek meaning in exactly the same manner. We believe that 90% of the students with normal ability can learn 90% of the material 90% of the time if the teaching methods and media are adjusted to the student's educational cognitive style. The College maps the cognitive style of each student to provide a picture of the various ways in which the individual searches for meaning. Each student has a relatively unique cognitive style or way of seeking meaning or knowing.

Cognitive styles are determined by the way individuals take note of their surroundings — how they seek meaning, how they become informed. Are they listeners or are they readers? Are they concerned only with their own viewpoints or are they influenced in decision-making by their families or associates? Do they reason as mathematicians, or as social scientists, or as automotive mechanics?

These are but a few examples of the facets of human makeup that are included in a student's cognitive style. Family background, life experiences, and personal goals make each of us unique. Each map reflects each student's cognitive style. A cognitive map provides a picture of the diverse ways in which an individual acquires meaning. It identifies cognitive strengths and weaknesses. This information can be used to build a personalized program of instruction.

Results from a battery of tests and inventories are processed through the College's computer system to produce a map of cognitive traits that describe the many ways each student might seek meaning. Cognitive maps are printed out in the form of a cartesian product of three sets. The first set indicates a student's tendency to use certain types of symbols, one's ability to understand words and numbers, qualitative sensory symbols, qualitative programmatic symbols, and qualitative codes. The second set indicates influences which the student brings to bear in deriving meaning from symbols. These influences are effected mainly in terms of one's own individuality (I), or one's associates (A), or those of one's family (F). The third set indicates the manner in which the individual reasons, or the way in which one infers. Whether the individual thinks in categories (M), or in terms of differences (D), or synthesizes multiple relationships (R), or uses all three (L), one's modality of inference influences, and is influenced by, symbols and the cultural determinants that are employed in that person's style. These three sets of elements, i.e., symbolic mediation, cultural determinants, and modalities of inference, comprise the cognitive style of the individual. A maximum of 3,260 different profiles of these elements are possible in an individual's map at a given level of educational development.

Major Orientation/Minor Orientation

Major orientation is noted by capital letters. For example, T(VL) would indicate a major orientation in theoretical visual linguistic symbolic mediation. A major orientation is accorded a given element if it occurs in the 50th–99th percentile range of a distribution of that element at a given “developmental” level. The person showing a T(VL) in the cognitive style map at, say, the twelfth level of educational development would have realized a score which occurred somewhere within the range of the 50th–99th percentiles of the distribution of that element, T(VL), for persons at a twelfth level of educational development.

The symbol T'(AL), read “T prime AL”, indicates a minor orientation in this element of style. If T'(AL) were indicated in an individual's cognitive style map, it would mean that the individual had realized a score for this element that occurred in the range of the 26th–49th percentiles, inclusively, of a distribution of scores for that element at a given level of educational development.

If an individual realized a score that occurred at the 25th percentile or below of a distribution of scores for a given element, at a given level of educational development, that individual would be said to have a negligible orientation and the symbol for that element would be omitted from the individual's cognitive style map.

I. SYMBOLS AND THEIR MEANINGS

Two types of symbols, theoretical (e.g., words and numbers) and qualitative (e.g., sensory, programmatic, and codes), are created and used by individuals to acquire knowledge and derive meaning from their environments and personal experiences. Theoretical symbols present to the nervous system, and then represent to it, something different from that which they themselves are. For example, the spoken word “cup” is an auditory sensation which represents to the individual hearing it the physical object of a cup. Since this auditory sensation (the sound “cup”) presents to the individual's nervous system something different from that which it (the symbol) itself is, it is called a “theoretical auditory linguistic symbol.” In the visual dimension, the imagery resulting from the individual's observing the printed word “cup”, which would present to the awareness of the individual the same physical object that the word “cup” would produce, is an example of theoretical visual linguistic symbolic mediation.

Qualitative symbols present and then represent to the nervous system of the individual that which they (the symbols) themselves are to that individual. Meanings for qualitative symbols are derived from three sources: 1) sensory stimuli; 2) cultural codes (games); and 3) programmatic effects of objects which convey an almost automatic impression of a definite series of images, scenes, events or operations. At the present time, there are 25 qualitative symbols included in the “symbolic” set; five of them associated with sensory stimuli, ten that are programmatic in nature, and ten associated with cultural codes.

There are two main types of theoretical symbols – auditory and visual – each of which can be divided into linguistic and quantitative elements. The four theoretical symbols are defined as follows:

- T(VL) Theoretical Visual Linguistics – ability to find meaning from words you see. A major in this area indicates someone who reads with a better than average degree of comprehension.
- T(AL) Theoretical Auditory Linguistics – ability to acquire meaning through hearing spoken words.
- T(VQ) Theoretical Visual Quantitative – ability to acquire meaning in terms of numerical symbols, relationships, and measurements.
- T(AQ) Theoretical Auditory Quantitative – ability to find meaning in terms of numerical symbols, relationships, and measurements that are spoken.

The five qualitative symbols associated with sensory stimuli are:

- Q(A) Qualitative Auditory – ability to perceive meaning through the sense of hearing. A major in this area indicates ability to distinguish between sounds, tones of music, and other purely sonic sensations.
- Q(O) Qualitative Olfactory – ability to perceive meaning through the sense of smell.
- Q(S) Qualitative Savory – ability to perceive meaning by the sense of taste. Chefs should have highly developed qualitative olfactory and savory abilities.
- Q(T) Qualitative Tactile – ability to perceive meaning by the sense of touch, temperature, and pain.
- Q(V) Qualitative Visual – ability to perceive meaning through sight.

The qualitative symbols that are programmatic in nature are:

- Q(PF) Qualitative Proprioceptive (Fine) – ability to synthesize a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., playing a musical instrument, typewriting); or into an immediate awareness of a possible set of interrelationships between symbolic mediations, i.e., dealing with “signs.” While qualitative proprioceptive fine symbolic intelligence is most readily observable in seemingly automatic motor responses such as reading and playing music, certain types of theoretical symbolic mediation also require qualitative proprioceptive activity. For example, the synthesis of a number of symbolic mediations is evident when an individual upon seeing a sign of smoke immediately interprets it as evidence of fire and experiences an interplay of many sensations including smell of smoke, taste of smoke, and sensation of heat. In this instance a network of previous experiences and related associations produces the theoretical mediation of fire along with the other qualitative aspects.
- Q(PG) Qualitative Proprioceptive (Gross) – ability to synthesize a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball, skiing).
- Q(PDF) Qualitative Proprioceptive Dextral (Fine) – a predominance of right-eyed, right-handed and right-footed tendencies (a typically right-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., writing right-handed).

- Q(PDG)** Qualitative Proprioceptive Dextral (Gross) — a predominance of right-eyed, right handed and right-footed tendencies (a typically right-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball with the right hand).
- Q(PKF)** Qualitative Proprioceptive Kinematics (Fine) — ability to synthesize a number of symbolic mediations into a performance demanding the use of fine musculature while monitoring a complex physical activity involving motion.
- Q(PKG)** Qualitative Proprioceptive Kinematics (Gross) — ability to synthesize a number of symbolic mediations into a performance demanding the use of gross musculature while monitoring a complex physical activity involving motion.
- Q(PSF)** Qualitative Proprioceptive Sinistral (Fine) — a predominance of left-eyed, left-handed and left-footed tendencies (a typically left-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., writing left-handed).
- Q(PSG)** Qualitative Proprioceptive Sinistral (Gross) — a predominance of left-eyed, left-handed and left-footed tendencies (a typically left-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball with the left hand).
- Q(PTF)** Qualitative Proprioceptive Temporal (Fine) — ability to synthesize a number of symbolic mediations into a performance demanding the use of fine musculature while monitoring a complex physical activity involving timing.
- Q(PTG)** Qualitative Proprioceptive Temporal (Gross) — ability to synthesize a number of symbolic mediations into a performance demanding the use of gross musculature while monitoring a complex physical activity involving timing.

The remaining ten qualitative symbols associated with cultural codes are defined as:

- Q(CEM)** Qualitative Code Empathic — the capacity to derive meaning through sensitivity to the feelings of others; ability to put yourself in another person's place and see things from that person's point of view.
- Q(CES)** Qualitative Code Esthetic — capacity to enjoy the beauty of an object or an idea. Beauty in surroundings or a well-turned phrase are appreciated by a person possessing a major strength in this area.
- Q(CET)** Qualitative Code Ethic — commitment to a set of values, a group of principles, obligations and/or duties. This commitment need not imply morality. Both a priest and a criminal may be committed to a set of values although the "values" may be decidedly different.

- Q(CH)** Qualitative Code Histrionic — capacity to exhibit a deliberate behavior, or play a role to produce some particular effect on other persons. This type of person knows how to fulfill role expectations.
- Q(CK)** Qualitative Code Kinesics — capacity to understand, and to communicate by, non-linguistic functions such as facial expressions and motions of the body (e.g., smiles and gestures).
- Q(CKH)** Qualitative Code Kinesthetic — capacity to perform motor skills, or effect muscular coordination according to a recommended, or acceptable, form (e.g., bowling according to form, or golfing).
- Q(ICP)** Qualitative Code Proxemics — capacity to judge the physical and social distance that the other person would permit, between oneself and that other person.
- Q(CS)** Qualitative Code Synnoetics — capacity to have personal knowledge of oneself.
- Q(CT)** Qualitative Code Transactional — capacity to maintain a positive communicative interaction which significantly influences the goals of the persons involved in that interaction.
- Q(CTM)** Qualitative Code Temporal — capacity to respond or behave according to time expectations imposed on an activity by members in the role-set associated with that activity.

II. CULTURAL DETERMINANTS

There are three cultural determinants of the meaning of symbols: 1) individuality (I), 2) associates (A), and 3) family (F). It is through these "determinants" that cultural influences are brought to bear by the individual on the meanings of symbols. The "individuality" influence is frequently reflected by the individual's need to quote definitions, or explain situations, in his own words. The "associates" influence is frequently evidenced by an individual who understands that which is under consideration, but explains or discusses these matters mainly in the words of his associates who may be involved with him in the situation. The "family" determinant is frequently portrayed by the individual possessing it through examples one may use in explaining a situation or solving a problem (e.g., either parents, children, wife, husband, sibling, cousin, close friend, etc., are used to illustrate a situation analogous to the one under consideration).

III. MODALITIES OF INFERENCE

The third set of the Cartesian product indicating cognitive style includes elements which indicate the individual's modality of inference, i.e., the form of inference one tends to use:

- M** Magnitude — a form of "categorical reasoning" that utilizes norms or categorical classifications as the basis for accepting or rejecting an advanced hypothesis. Persons who need to define things in order to understand them reflect this modality.
- D** Difference — This pattern suggests a tendency to reason in terms of one-to-one contrasts or comparisons of selected characteristics or measurements. Artists often possess this modality as do creative writers and musicians.

- R Relationship** — this modality indicates the ability to synthesize a number of dimensions or incidents into a unified meaning, or through analysis of a situation to discover its component parts. Psychiatrists frequently employ the modality of relationship in the process of psychoanalyzing a client.
- L Appraisal** — is the modality of inference employed by an individual who uses all three of the modalities noted above (M, D, and R), giving equal weight to each in his reasoning process. Individuals who employ this modality tend to analyze, question, or, in effect, appraise that which is under consideration in the process of drawing a probability conclusion.
- K Deductive** — indicates deductive reasoning, or the form of logical proof used in geometry or that employed in syllogistic reasoning.

IV. EDUCATIONAL MEMORY

Educational memory is a Cartesian product of three sets of information pertaining to: 1) the memory function, 2) concern components (persons, processes, properties), and 3) conditions. The elements of the condition set of information are: Assimilation (AS), Accommodation (AC), Attendance (AT), and Repression (RS).

The Piagetian conditions of: 1) Assimilation, i.e., acquiring "new" meanings through one's currently existing elements of cognitive style; 2) Accommodation, i.e., interiorizing in terms of the new meanings directly (e.g., understanding a foreign language without first needing to translate it into one's own language); 3) Repression, i.e., repressing or dampening perseverations interfering with the interiorization processes (assimilation, accommodation); and 4) Attendance, i.e., concentration of attention on the meanings being acquired. Assimilation and Accommodation combine with those of Repression and Attendance, to form the elements, in major and minor orientations, that comprise information of the "conditions" set of educational memory. Assimilation is one of two processes of interiorization outlined by Piaget. Accommodation is the other condition of Piagetian interiorization. The processes of Repression and Attendance are the other two elements included in the condition set.

Educational memory is an essential aspect of an individual's cognitive style. Recent work by biochemists and psychobiologists provides information by which the memory function can be expressed in terms of selected biochemical elements and the electrophysiological measurements of alpha (α), beta (β), theta (θ), and delta (δ), waves, respectively. The concern components of Persons (PN), Processes (PS), and Properties (PT), respectively, are considered to contribute to the biochemical elements produced by memory activity and conditions reflected in the electrophysiological measurements, i.e., α , β , θ , and δ . For example, some individuals find it easier to remember persons (PN), thereby expending less energy (a major orientation indicating a condition of potential energy, or "easy" memory) in the memory activity than they would for, say, remembering processes, (PS). Situations in which individuals witness difficulty in exercising the process of memory are indicated by a negligible orientation (i.e., the element is not shown in the map) in either one or a combination of the processes of recognition, retention, recall and association. The minor orientation is used to indicate a

condition of "neutral energy expenditure" in one, or in a combination of the four processes of memory, when specimens of body fluids show an average count of residuals of biochemical elements considered to be at work in memory-concern activity.

Recent work by biochemists and psychobiologists differentiates between short-term and long-term memory. Short-term memory must be present, however, before long-term memory can occur. Short-term memory may become long-term memory with the production of proteins and an increase in enzymatic activity levels in the brain cells. Short-term memory is currently thought to be the result of short-lived processes.

Recent experiments with animals have shown that injection of stimulators into the central nervous system can have an effect on both short-term and long-term memory, respectively. Differential effects on memory resulting from chemical injections have also been observed between human subjects. Implications for education in the future might well lie in the use of immediate memory stimulators and other chemicals to increase the attention span and decrease protein elements which inhibit the memory-concern function.

V. EDUCATIONAL COGNITIVE STYLE

The Educational Science of Cognitive Style combines the information included in the first four "sciences," by means of a Cartesian product of these four sets, to provide a picture of the profiles distributed over the four sets that an individual employs in seeking meaning. These profiles reflect the cognitive style "strengths" of the individual, and are vehicles for determining educational prescriptions to help him in the educative process.

At the present time, individuals are being tested and inventoried for elements included in the first three sets only, i.e., symbols and their meanings, cultural determinants, and modalities of inference. Instruments for collecting information relative to the Educational Memory set are currently under construction.

VI. COUNSELING, ADMINISTRATIVE, TEACHING AND STUDENT STYLES (CATS)

Each of these three styles is represented by a Cartesian product of three sets of information pertaining to: 1) Demeanor, 2) Emphasis, and 3) Symbolic Modes of Presentation, or Communication.

Demeanor x Emphasis x Symbolic Mode

Elements in the emphasis set and the symbolic modes set, respectively, are common to each of the three styles. Differentiation between an individual's teaching style, his counseling style and his administrative style in these dimensions ("emphasis" and "mode") is affected through the change in orientations (major and minor) that might occur with each style. For example, an individual may show a major orientation in processes (PS) in his teaching style while indicating a major orientation in persons (PN) in his administrative style.

Counseling Style

The cognitive style of individuals involved in counseling situations, as in the case of teaching and administrative styles, is important but does not provide a total explanation of the behavior of counselors. The demeanor elements of counseling style expressed in terms of major and minor orientations involving: a) Directive (V,v), b) Situational (U,u), or c) Nondirective (O,o) are determined on the basis of the counselor's attitude toward who should set the goals and determine the approaches to the goals in the counseling situation. The counselor who reflects "my goals my way," regardless of the counseling situation, is given a major orientation in the directive element in the demeanor set. Counselors who are at times directive and at other times nondirective, depending upon the situation, are accorded major orientations in the situational element. Counselors who tend not to direct behavior, regardless of the counseling situation, are accorded major orientations in the nondirective element. The total counseling style of an individual is expressed in terms of profiles showing major and minor orientations distributed over the three sets of demeanor, emphasis and "symbolic mode." An example of counseling style is shown below:

$$\begin{Bmatrix} U \\ V' \end{Bmatrix} \times \begin{Bmatrix} PN & PT \\ PC' & PC' \end{Bmatrix} \times \begin{Bmatrix} OP \\ RP' \end{Bmatrix}$$

Administrative Style

Major and minor orientations in four elements of demeanor: 1) Dominant (N,n), 2) Adjustive (J,j), 3) Cooperative (C,c) and 4) Passive Custodial (X,x); major and minor orientations combined in the "emphasis elements": Persons (PN), Processes (PS), and Properties (PT); along with major and minor orientations in the elements of Symbolic Mode (QP, RP, TP), are profiles that portray the administrative style of an individual. The dominant (N) administrator reflects a "my goals my way" approach, the adjustive (J) type reflects "my goals your way, or your goals my way" approaches; the cooperative (C) employs a demeanor of "our goals our way"; while the passive custodial demeanor is one resulting from a "your goals your way" approach to administration by the individual. An example of administrative style is shown below:

$$\begin{Bmatrix} N \\ J' \\ C' \end{Bmatrix} \times \begin{Bmatrix} PT \\ PN' \end{Bmatrix} \times \begin{Bmatrix} RP \\ TP' \end{Bmatrix}$$

Teaching Style

The demeanor set of teaching style includes three elements: 1) Predominant (P_{ap}); 2) Adjustive or "Switcher" (S_{ap}); and 3) Flexible (B_{ap}). These three demeanor classifications can occur as either a major orientation in one with minor orientations in the other two, or two major orientations with a minor in the remaining element. Each of these elements is subscripted as authoritarian (a) or permissive (p). An authoritarian type is an individual who respects the wishes and decisions of persons in superordinate positions relative to his own, and expects his wishes and decisions to be respected when he assumes the superordinate role. A permissive individual is one who does not exercise this "respect," and does not expect it to be exercised by others regarding his role. The orientations in the

demeanor set are combined with those of the emphasis and the "symbolic mode" set (QP—Qualitative Predominant; RP—Reciprocity; TP—Theoretical Predominant) to form profiles indicating the teaching style of an individual. An example of a teaching style represented by a Cartesian product is shown below:

$$\begin{Bmatrix} P_a \\ S'_p \end{Bmatrix} \times \begin{Bmatrix} PT \\ PC' \end{Bmatrix} \times \begin{Bmatrix} TP \\ RP' \end{Bmatrix}$$

STUDENT STYLE

Student style is described as a Cartesian product of the three sets of: demeanor, emphasis, and symbolic mode of presentation. The elements comprising the latter two sets, emphasis and symbolic mode, are as previously described in connection with counseling, administrative, and teaching styles, respectively. The elements included in the demeanor set of student style are: 1) Innovator (IN), that student demeanor in which the individual will employ any means to attain the goal (understanding); 2) Retreatist (RR), that student demeanor portrayed by the individual who is indifferent to the means of instruction employed, and is also indifferent to the goal, i.e., understanding that which is being taught; 3) Ritualist (RI), that student demeanor in which the individual participates thoroughly in the "ritual" (instructional approach) in order to receive a good grade, but does not truly accept the goal, i.e., to understand that which is being taught; and 4) Rebel (RB), that student demeanor in which the individual alternately accepts, rejects, accepts and rejects both the means and the goal of instruction. An example of student style is shown below:

$$\begin{Bmatrix} RI \\ IN' \end{Bmatrix} \times \begin{Bmatrix} PC \\ PT' \end{Bmatrix} \times \begin{Bmatrix} TP \\ RP' \end{Bmatrix}$$

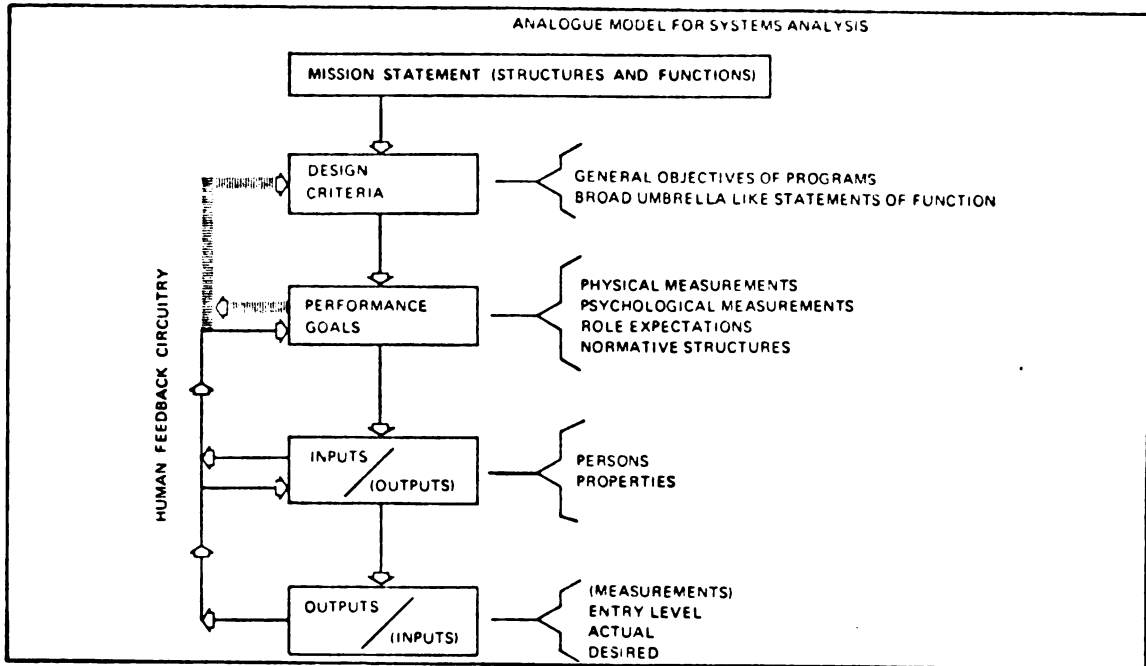
VII. SYSTEMIC ANALYSIS DECISION-MAKING

A system is a defined collection of elements with their interconnections considered over a period of time. Any aspect of education may be considered as a system.

The basic purpose of systemic analysis is decision-making resulting in a choice of options available to the decision-maker. Analysis of a system is conducted in terms of determining how well the goals of a system are being met within the constraints of the inputs of the system, combined with considerations of its mission and the main functions (design criteria) around which the system is designed.

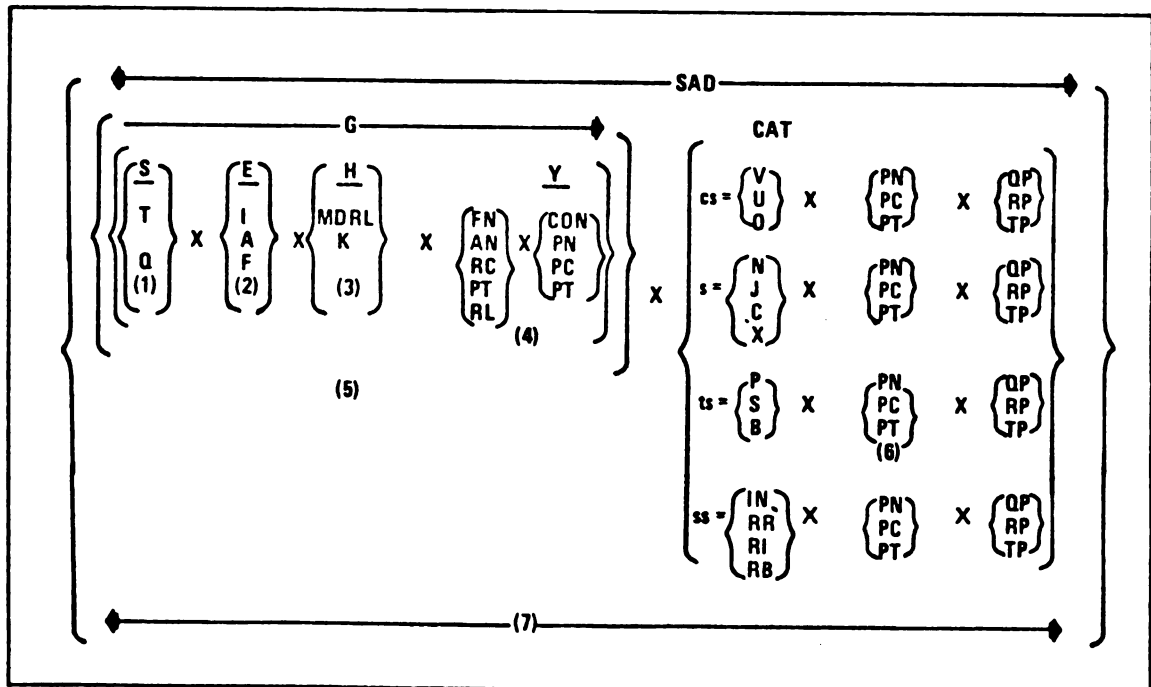
Performance goals must be stated in terms of the tasks to be accomplished, the conditions surrounding the tasks, and the minimum performance needed for successful accomplishment of the tasks. Any system may be defined, and analyzed, by means of the analogue model shown on next page.

For example, an educational program can be defined as a social system of the three generic elements: persons, processes and properties, and their interconnections considered over a period of time. This system can be defined by composing a mission statement for it, stating its design



SUMMARY OF THE EDUCATIONAL SCIENCES

Educational Sciences are summarized in the diagram shown here:



criteria, structuring performance goals for each criterion, and determining the inputs (persons and properties) necessary for achieving the tasks stated in the performance goals of the system.

The outputs of a system are measurements of performances of persons, processes, and properties within the system as support functions (support variables), and as measurements and products resulting from the performance of these three elements toward fulfilling the mission of the system (impact variables).

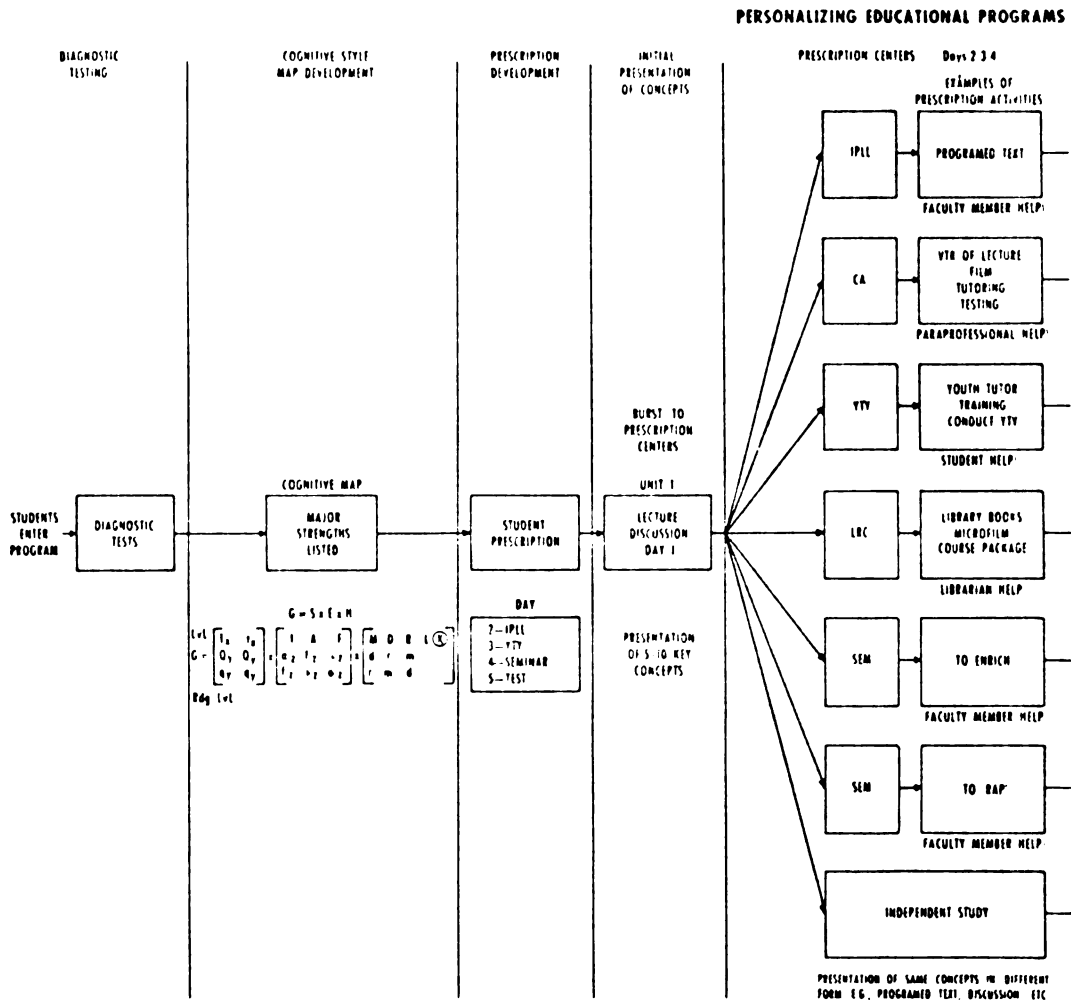
Throughout the period of operation of the system information is placed in the human feedback circuitry element, through meetings and conversations, in order to make decisions regarding possible modifications of elements and/or their interconnections to keep the system adjusted to its internal and external environments. The ultimate objective of systemic analysis is that of deriving optimal decisions, i.e., decisions that are "best" for all elements included in the decision. It should be noted that optimal decisions are not always "perfect" for each of the elements affected by the system.

PERSONALIZED EDUCATION

A student's cognitive map presents a picture of the variety of profiles one uses in his education, i.e., that one uses in the search for meaning. Mapping an individual's cognitive style enables the educator to consider the individual in terms that without the map he or she might not have employed. The diagnosis of an individual's cognitive style and the modes of understanding required by an educational task can be used to match the student to the task. Through this approach it is possible to prescribe educational activities that provide a better probability of successful accomplishment by the individual than otherwise might be possible.

PEP

Flow Chart of Personalized Educational Program (PEP) Illustrating Student Progress From Diagnostic Testing Through Successful Completion of an Instructional Unit.



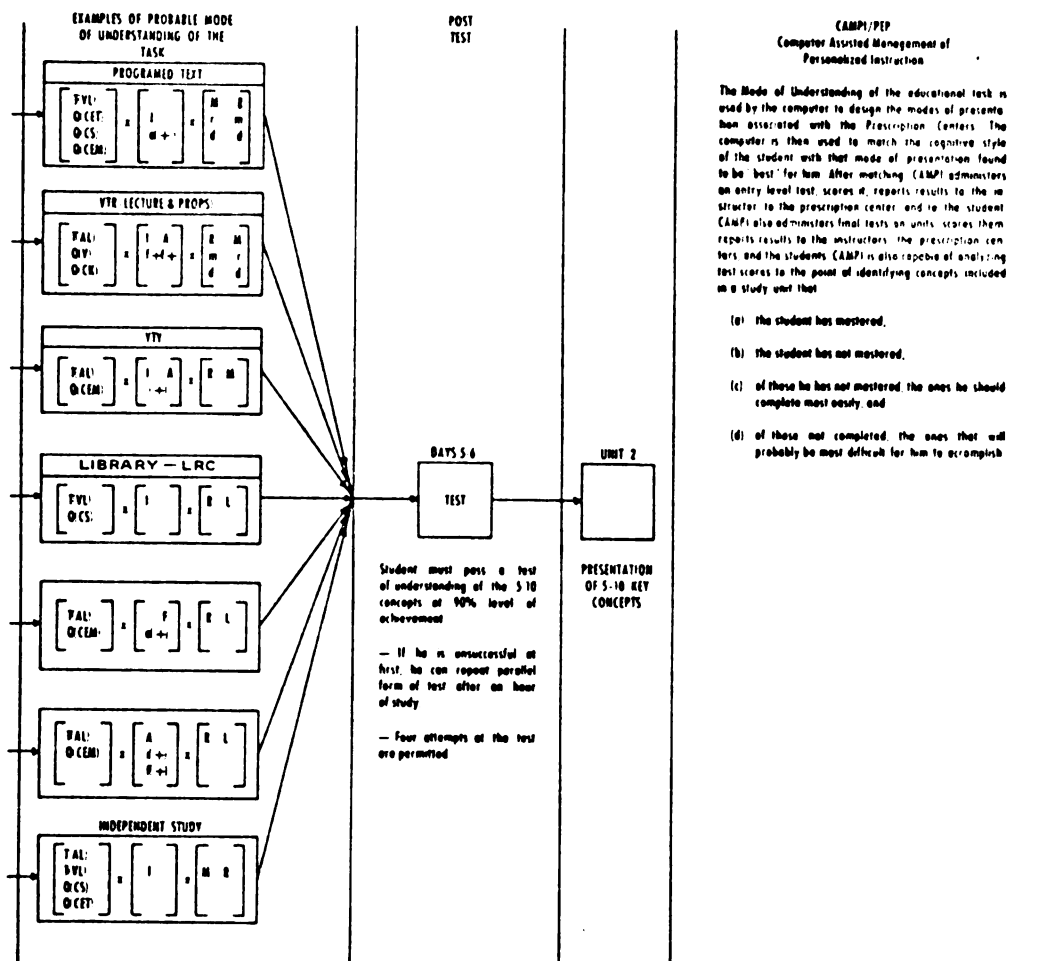
OAKLAND
COMMUNITY
COLLEGE

PERSONALIZING EDUCATIONAL PROGRAMS UTILIZING COGNITIVE STYLE MAPPING

DR. JOSEPH E. HILL, PRESIDENT
DR. DEREK N. NUNNEY, VICE PRESIDENT

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UTILIZING COGNITIVE STYLE MAPPING



APPENDIX B

TWELVE COGNITIVE STYLE MODELS

Twelve Cognitive Style Models

Model	Definition	Principal Research	Measuring Instrument
1. Field independence v. dependence	differentiated (independent) v. undifferentiated figure-ground relationships. Field independents tend to extract a figure from its ground or background. Field dependents tend to see figures only in relation to their ground; they are superior to field independents in such tasks as memory for faces and they seem to be socially more sensitive.	Witkin	Embedded Figures Test Rod and Frame Test Body Adjustment Test
2. Scanning v. focusing (defined as <u>strategies, not as attentional differences</u>)	posed a problem requiring identification of relevant as opposed to irrelevant information, scanners look for attributes and proceed in a constraint-seeking, broad to narrow fashion while focusers generate more global, self-sufficient or all-encompassing hypotheses, proceeding in a trial-and-error fashion. If a scanner makes an error, he has nonetheless learned something while a focuser cannot tell which part of his hypothesis is wrong. When the focuser is right, however, he attains solution faster than a scanner.	Menninger Foundation; Schlesinger; Bruner, Goodnow, Austin	Twenty Questions Concept Attainment Tasks (e.g., Bruner et al. in <u>A Study of Thinking</u>)

Model	Definition	Principal Research	Measuring Instrument
3. Broad v. narrow categorizing	the broad categorizer prefers a small number of categories containing a large number of items, while the narrow categorizer prefers a larger number of categories with a small number of members. The broad categorizer admits more items or ideas as similar while the narrow categorizer rejects items and differentiates concepts more thoroughly.	Menninger Foundation	Category width Tasks Object sorting Tasks
4. Leveling v. Sharpening	in taking in new information, the leveler shows greater readiness to assimilate new stimuli to previous categories while the sharpener tends to differentiate new instances from old. While categorizing style applies to free categorizing exercises, leveling and sharpening are examined in a more controlled way using successive presentation of stimuli rather than simultaneous presentation.	Menninger Foundation; Gardner; Santostephano	Schenatizing Test Wagon Test
5. Constricted v. flexible control	constricted control shows greater susceptibility to interference by irrelevant information while flexible control is evidenced by resistance to interference.	Menninger Foundation; Kleen	Stroop Color-Word Test

Model	Definition	Principal Research	Measuring Instrument
6. Tolerance v. intolerance for incongruous or unrealistic experiences	tolerance is revealed by more frequent reversals readier adaptation to unusual perceptions. Intolerance involves the demand for more information before the unusual is accepted.	Menninger Foundation	Aniseikonic lenses; reversible figures
7. Impulsive v. reflective responding	impulsivity is characterized by quick responding while reflectiveness involves considering alternate classification or responses. When he's right, the impulsive is faster; the reflective makes fewer errors.	Fels Institute; Jerome Kagan	Matching Familiar Figures; Identical Pictures
8. Analytic v. nonanalytic conceptualizing styles	analytic style entails differentiating properties or attributes while nonanalytic responses may be thematic-descriptive or relational. The analytic is more attentive to similarities in property, the nonanalytic more attentive to functional relationships.	Fels Institute; Jerome Kagan	Conceptual Style Test
9. Risk-taking v. caution	the risk-taker will take the risk when there is a low probability of a high payoff, while caution entails preferring low risk with a high probability of low payoff. In cost-payoff situations, the risk-taker tries to outwit the odds, the cautious person tries to identify the safest odds.	Kogan and Wallach	Cost-payoff games

Model	Definition	Principal Research	Measuring Instrument
10. Cognitive complexity v. simplicity	cognitive complexity is characterized by hierarchic integration while cognitive simplicity is reflected by use of dimensions of difference. Cognitive simplicity is favored when only horizontal analysis along a dimension is necessary. Cognitive complexity is favored when vertical analysis of relations between dimensions is necessary.	Kelly; Shroder, Driver, Streufert	REP Test Paragraph completion This I Believe Test
11. McKenney two-dimensional model Assimilation: Receptive v. Planning: Systematic v. Intuitive	the preceptive individual assimilates information to his concepts or categories while the receptive individual assimilates data as raw as possible. Preceptives categorize or chunk information as it comes to them while receptives can more often take a new look at the data presented, since they've stored it as data not concepts. Systematic individuals create orderly, sequential plans or strategies; if you have a good plan, you'll find a good solution. Intuitives prefer ideas, identifying the problem and skipping from part to whole analysis; a good solution for them is good because it solves the problem they defined.	McKenney, Keen, Nelson, Botkin	Tasks Assessing each mode: e.g., Identical Pictures (Receptive) Elaboration (Preceptive) Paper Folding (Systematic) Scrambled Words (Intuitive)

Model	Definition	Principal Research	Measuring Instrument
12. Convergent v. divergent thinking	Analytic as opposed to synthetic abilities. The diverger is creative in the sense of being able to generate ideas, the converger is better able to come by a solution.	Liam Hudson	Finding useful parts (convergent) Different uses (divergent)

APPENDIX C

EDUCATIONAL COGNITIVE STYLE INTEREST INVENTORY

DRIVER EDUCATION STUDY

EDUCATIONAL COGNITIVE STYLE
INTEREST INVENTORY

used with permission of

Dr. Joseph Hill
Oakland Community College

DIRECTIONS

1. Use pencil, not pen.
2. Fill in your Social Security number under STUDENT NUMBER (if you have one).
3. Each item is to be answered usually (U), sometimes (S), or rarely (R) on the answer sheet provided.
4. Read the first question on page 1.
5. Decide if this statement is like you usually, sometimes, or rarely.
6. Darken U or S or R for question 1. Be careful to cover the letter (U, S, or R) and to stay inside of the brackets.
7. Read and make decisions rapidly - consider your first answer to each question to be correct.
8. You may now begin (CAUTION! Frequently check the number of the question you are reading with the number on the answer sheet).

U = Usually
S = Sometimes
R = Rarely

1. After I write a letter, I ask someone to read it aloud to me so that I know how it sounds.
2. When taking courses in mathematics, I find it easy to "talk in formulas" with my classmates and teacher.
3. I score high on achievement tests which depend upon reading comprehension.
4. When I am in a group of people trying to solve a written problem involving numbers, I am among the first to reach the correct solution.
5. My written explanations are more understandable than my spoken ones.
6. People say I speak more understandably than I write.
7. I prefer classes which rely heavily on textbooks for information.
8. I use a written budget to account for money for which I am responsible.
9. I prefer the traditional lecture type classes.
10. I can make more sense out of what a person means when he speaks to me rather than if he writes to me.
11. I prefer maps to verbal directions when I am going to a strange place.
12. I do better on a test if it is about information I have heard rather than read.
13. If I were buying a bicycle, I would ask the salesman to write out the cost, service, and what comes with it.
14. I understand the daily news better if I hear it on the radio rather than if I read it in the newspaper.
15. I discuss "sale" prices with others before I go shopping.
16. I can remember a telephone number once I have heard it.
17. I find it necessary to write down a telephone number as soon as I hear it in order to remember it.
18. I communicate with friends and colleagues by telephone rather than by writing messages to them.
19. I prefer to read a newspaper myself rather than have someone read it aloud to me.
20. I prefer to follow verbal directions rather than written directions.

21. I prefer to read directions rather than have someone interpret them to me.
22. Verbal mathematics tests are easier for me than written mathematics tests.
23. When I go shopping, I read the price of each item and keep a running total in my head.
24. I quote statistical data to others in order to prove my point in an argument.
25. I find it comfortable to add spoken or dictated numbers mentally.
26. I understand more easily when I read information rather than when I hear it.
27. I achieve best on written mathematics tests.
28. After I tell someone how to do something, I read their notes to be certain they are correct.
29. It is easy for me to remember the numbers and formulas I have heard during a conversation.
30. I keep written records of the money I get and the way I spend it.
31. If I were buying a bike I would discuss cost, service, and what comes with it with the salesman or a friend.
32. I solve mathematical problems more rapidly if they are written.
33. I can identify music well enough to recognize a "tune" the next time I hear it.
34. I can tell "what's for dinner" by the smell when I enter the house.
35. When I tune a musical instrument, I use the piano or another source for the correct pitch.
36. My "suffering" in the dentist's chair is alleviated if he uses pleasant tasting materials in my mouth.
37. I can feel the difference between leather and metal.
38. A narrative is easier to understand in a movie than in a book.
39. I can tell if something is wrong with an engine by listening to it run.
40. Any unpleasant smell is more disturbing to me than to others.

41. When I ride a bike, I look ahead rather than at the handlebars.
42. I can recognize who is on the phone just by listening to the voice for a few moments.
43. I prefer furniture that I enjoy running my hand over.
44. I prefer to read articles which are illustrated by pictures or drawings.
45. I enjoy trying new foods in order to find new tastes that I may like or wish to learn to like.
46. The tone or inflection of a speaker's voice gives additional meaning to his words.
47. I tune the radio by sounds not by the numbers on the dial.
48. I can write legibly as another person dictates to me.
49. The "smell" is an important component of the pleasure connected with a new car.
50. In selecting a beverage, my choice is based on taste.
51. I can catch a ball that has been struck or thrown.
52. I return to a restaurant because of the taste of the food served there.
53. I can play ping pong well enough to enjoy it.
54. Random sounds interfere with my ability to concentrate on a conversation or on reading.
55. The taste of food is more important than its appearance.
56. I am certain that the customary smell of a store influences its sales volume.
57. I pick up and feel vegetables and fruits in the store before buying them.
58. When I tune a radio I use the numbers on the dial.
59. I can tell the difference between two closely pitched sounds.
60. Blindfolded, I can taste the difference between chocolate and coffee ice cream.

61. I decide that my hair needs washing by the way it feels when I touch it.
62. I have been told that I am a good dancer.
63. I enjoy looking at art work.
64. I am considered to be a "good" amateur athlete.
65. I prefer to write with a pen that "fits" my fingers.
66. I can distinguish fresh fruit from stale fruit by the smell.
67. I use my fingers to supplement my eyes to determine the quality of the finish on wood.
68. I am able to tell which instruments are playing at various times during a concert.
69. When eating, I use different spices until the food tastes "right".
70. I choose clothes for the way they look on me.
71. I can distinguish a nickel from a dime in my pocket with my fingers.
72. I can distinguish between several varieties of flowers by smelling their blooms.
73. When there are gas fumes in the car or the house, I notice them sooner than others do.
74. I can tell if milk is sour by tasting it.
75. I understand a teacher better if I can look at him as he talks.
76. The aromas in a room determine for me whether it is a pleasant or an unpleasant place.
77. I "think" in pictures and graphic models rather than in words and phrases.
78. I can button my coat in the dark.
79. When I walk downstairs, I look ahead rather than at my feet.
80. I feel better acquainted with some one if I see a picture of him rather than if I read about him.
81. I laugh with the person who laughs when he stubs his toe because I know it hurts yet he is too old to cry when he is clumsy.

82. Utility and efficiency are important but they should not be emphasized to the exclusion of beauty.
83. I work just as hard whether or not my teacher or parents are there.
84. I am a good actor in plays.
85. I shrug my shoulders when saying "I don't know".
86. I try not to say things which hurt the feelings of others.
87. I enjoy the sight of people dancing.
88. I would stop for a "STOP" sign any time even if there were no other person in sight.
89. When someone is frightened, I can be patient and calm rather than reply in anger.
90. I blush in situations where many others do not.
91. I can give the impression that I am happy and comfortable even though I am angry and uncomfortable.
92. I am able to offer criticism without offending others.
93. I greet a late arriving guest enthusiastically.
94. The values of our society are good for everyone.
95. I require beauty in my surroundings outside as well as inside buildings.
96. I am able to "play a role" anywhere if I agree to.
97. I direct my life according to moral values.
98. I can pretend to be attentive and interested even though bored when listening to a teacher or supervisor.
99. I would not agree to cheat if I were offered a bribe.
100. My friends tell me that I am understanding.
101. I can act friendly and accepting in order to acquire favors.
102. I enjoy the author's writing style as much as the story he tells.
103. Eye movements are important supplements to my conversation.
104. I "feel" the emotions of others as they do.
105. I can successfully adjust my behavior (formal or informal) according to the situations.

106. I use facial expressions to communicate emotions.
107. I would give up something I want to do now rather than sacrifice one of my values.
108. I do not permit personal affairs to interfere with completing an assignment.
109. I "talk with my hands" more than others do.
110. I enjoy listening to music when the quality of its sound is good.
111. Walking with a spring in your step gives the impression that you are happy.
112. I understand how a person feels when he is being punished.
113. I can give the impression that I am calm and comfortable even though I am angry and uncomfortable.
114. I would go out of my way to see beautiful scenery.
115. When I shake hands with someone, the handshake tells me how sincere the person is.
116. I enjoy the beauty of a well-designed structure.
117. I enjoy telling jokes and stories at a party.
118. Poetry is beautiful because of its concepts as well as its words and rhythm.
119. I interpret a person's mood by the way they sit or stand.
120. I believe that a promise should be kept.
121. When I engage in sports, I practice or warm-up first.
122. If I attempted to kiss someone, I would not be slapped.
123. I can predict my responses in many situations.
124. I can bring a group to some agreement.
125. I can tell when I am just about to blow my cool.
126. To become a good typist, I would practice correct finger movements.
127. I can predict accurately how successful I will be in a new situation.
128. Sales people find the merchandise that I am asking for.
129. I have practiced handwriting skills so that I write legible now.

130. I am better coordinated than most people.
131. I predict accurately if I will be able to get my work done.
132. When learning a new dance, I am willing to practice the steps until I can do them perfectly.
133. In social situations I am able to verbally stop arguments involving others before they go too far.
134. When it is necessary, I can repair objects without watching my hands.
135. I wait for an invitation to be seated in making a call on a supervisor in his office.
136. I prefer to ask favors of close friends rather than from teachers.
137. Peers involve me in resolving problems.
138. Learning to throw a ball the right way is important.
139. I complete my assignments because I don't "bite off more than I can chew".
140. I have enjoyed acquiring good motor skills so that I compete successfully in sports.
141. I accept criticism without feeling resentful.
142. I request permission before taking a seat near a stranger.
143. In group discussions, I assume the leadership to move the group to reach a decision.
144. I would wait to be introduced to a famous person rather than introduce myself.
145. First names are good if the other person prefers first names.
146. I know my strengths and weaknesses.
147. I am able to persuade people involved in disagreement to strive for agreement.
148. I know the physical energy that a particular task will require for me to complete it.
149. I do not borrow money from strangers.
150. I can convince others to willingly do the things that I would like them to do.

- | | |
|---|---|
| 151. Unless spoken to first, I do not speak to a teacher. | 164. I make personal decisions after discussing them with my friends. |
| 152. I am able to put people at ease in tense situations. | 165. I talk with my family before doing anything that might affect them. |
| 153. I make it a point not to let my work interfere with family plans. | 166. Before taking a new job, I would discuss it with my friends. |
| 154. I enjoy activity more if my friends participate in it with me. | 167. When given a problem to solve, I find the answer myself. |
| 155. When given a job to do, I prefer to do it myself. | 168. I prefer to study on my own. |
| 156. When shopping for clothes, I prefer having a friend along to help me make choices. | 169. I find it important to talk things over with my family. |
| 157. I make my own political choices. | 170. I am influenced by my friends political opinions. |
| 158. I consult with my immediate family before making decisions. | 171. I understand events better after discussing them with my family. |
| 159. After gathering data from many sources, I make decisions alone. | 172. I do not need others to help me make decisions. |
| 160. Family values should have lasting effects on each of us. | 173. I would join a religious group if my friends belonged to it. |
| 161. I like to share ideas with friends and associates. | 174. I learn a subject better when I can discuss it with my associates. |
| 162. I enjoy outdoor activities when I am with my family. | 175. Before voting in an election I review the candidates with my family. |
| 163. One's religion is purely a personal decision. | |

176. I would rather do things my way even if this does not conform to the expectations of my family and friends.
177. I can use jokes and humorous remarks to change the focus in many situations.
178. I find myself in the position of having to make a decision before I know enough about the situation.
179. I do not change my mind on a subject once I identify the rule which applies.
180. I work best in an organized or structured situation.
181. I like to see several examples before starting a new project.
182. I understand geometric theorems.
183. I understand a topic better if I analyze it to learn how it differs from other topics.
184. The more information you collect about a problem, the better your solution will be.
185. I have no sympathy for people who break the law.
186. Characteristics for successful people are not the same as those for unsuccessful people.
187. Knowledge flows logically from given premises.
188. I would find it interesting to discover how people behave by evaluating things which make people tick (e.g., physiological, sociological, and psychological).
189. I choose music that contrasts with my mood in order to control my feelings.
190. Holidays are different from other days of the year.
191. Life is simple if you go by the rules.
192. The more I know about a problem, the more I want to know about it.
193. I like essay questions on examinations.
194. When shopping for clothes, I buy without further comparison if I find the article I had in mind.
195. I prefer to be offered more than one choice.
196. In recreation as well as work and life in general, I find it essential to "play by the rules".
197. I "play the devil's advocate" with people to force them to look at another point of view.

198. I try to understand why people break rules.
199. A person can never know enough about the universe.
200. I find it easier to win an argument when I state a premise and give a conclusion that must be true. (This is a circle so the formula for the area is πr^2).
201. In evaluating the performances of others, I find it helpful to determine how this performance differed from a previous performance.
202. There is always a reason for a person's behavior.
203. I find the type of reasoning demanded by the rules of mathematics suits my mode of thinking.
204. I prefer working in situations where standards and rules are stated explicitly.
205. In evaluating the performances of others, I find it important to determine the standards which were set for them.
206. I enjoy the way math makes me think.
207. I take longer than others in coming to a conclusions because I want to know more about an issue than most other people do.
208. I enjoy games or puzzles in which the solution is deduced from information contained in the rules.
209. In my choice of clothing, I wear contrasting colors.
210. When looking at something constructed by someone else (a painting, a building, furniture) I like to figure out why the person created it as he did.
211. Information should be analyzed in a number of ways before a conclusion is reached.
212. I like the kinds of problems that have definite answers.
213. One cannot appreciate a problem unless he knows as much about it as possible.
214. I have no difficulty in understanding how to put puzzles together.
215. When I attack a problem, I approach it from as many aspects as possible.
216. I find reasoning like this statement helps me to clarify my thought:
 "All men are mortal;
 Socrates is a man;
 Therefore, Socrates is mortal."

- 217. I recognize the appropriate time to end a telephone conversation.
- 218. My friends can depend upon me to do something on the agreed upon time.
- 219. I know when to offer my opinion during a group discussion.
- 220. I can judge which hostess will appreciate guests who arrive late.
- 221. I hand in my homework on time.
- 222. I can select the time when a group will welcome my joining them.
- 223. I finish tests in the allotted time.
- 224. I meet agreed upon deadlines.

APPENDIX D

SAMPLE COMPUTER PRINTED

COGNITIVE STYLE MAPS

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APPENDIX E

DISSERTATIONS DIRECTLY RELATED
TO THE EDUCATIONAL SCIENCES

APPENDIX E

DISSERTATIONS DIRECTLY RELATED TO THE

EDUCATIONAL SCIENCES

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APPENDIX F

DRIVER PERFORMANCE MEASUREMENT

RECORDING FORM

MSU DRIVER PERFORMANCE MEASUREMENT RESEARCH

Subject # _____
Observer # _____
Date _____
Run No. _____

Final Rating Scale Form for Pilot Study

BETSS	SubBETSS	SubBETSS Pattern Suitability	Search	Suitability of	
				Speed Control	Direction Control

3 1--Hagadorn Northbound

U _____ S _____ U _____ S _____ U _____ S _____

Only looks ahead, Looks left, rear,
improper speed, vehicle not proper speed, centers vehicle
centered in lane, changes in lane, signals and changes
lane abruptly lane smoothly

2--Turning onto M-78 Approach Road

U _____ S _____ U _____ S _____ U _____ S _____

No search ahead, no Searches ahead, signals
signal (or too late) in advance, turns, accel.
turns unevenly; under & decel. smoothly, stops
or over or jerkily accel. smoothly at intersection
or decil.; no smooth
stop at intersection

3--Joining M-78 Westbound

U _____ S _____ U _____ S _____ U _____ S _____

No search left, accel. Searches left, accel.
jerkily, no search smoothly, searches
right, merges poorly right, merges as traffic
permits

NOTE: Relative timing of behavior elements in relation to the behavior pattern and to SubBETSS requirements is one of the criteria for a satisfactory rating in each behavior element.

MSU DRIVER PERFORMANCE MEASUREMENT RESEARCH

Subject # _____
 Observer # _____
 Date _____
 Run No. _____

Final Rating Scale Form for Pilot Study

BETSS	SubBETSS	SUBBETSS Pattern Suitability	Search	Suitability of	
				Speed Control	Direction Control

4 1--U.S.-127 South onto Trowbridge Road Off-Ramp

U _____	S _____	U _____	S _____	U _____	S _____
Fails to search right/rear, fails to adjust speed, abrupt lane change and observably interferes with traffic	Searches right & rear, adjusts speed, smooth right lane change with no observable traffic				

2--Southbound Trowbridge Off-Ramp

U _____	S _____	U _____	S _____	U _____	S _____
Fails to search right/rear, fails to adjust speed, fails to stay in lane	Searches all directions, adjusts speed, stays in lane				

3--Trowbridge Road Merger with I 496 Off-Ramp

U _____	S _____	U _____	S _____	U _____	S _____
Fails to search right, accelerates abruptly, fails to stay in lane and observably interferes with traffic	Searches all directions, adjusts speed, stays in lane				

NOTE: Relative timing of behavior elements in relation to the behavior pattern and to SubBETSS requirements is one of the criteria for a satisfactory rating in each behavior element.

MSU DRIVER PERFORMANCE MEASUREMENT RESEARCH

Subject # _____
Observer # _____
Date _____
Run No. _____

Final Rating Scale Form for Pilot Study

BETSS	SUBBETSS	SUBBETSS Pattern Suitability	Suitability of		
			Search	Speed Control	Direction Control

5 1--East Michigan Avenue

U _____ S _____ S _____ U _____ S _____

Omits systematic search; speed, search and steering inappropriate to curve
Searches all directions, matches speed, search and steering to curve and traffic conditions

2--East Michigan Avenue and Grand River Avenue

U _____ S _____ S _____ U _____ S _____

Does not search left, interferes with traffic, stops abruptly, fails to search, poor position in storage area. Aborts maneuver.
Searches all directions, lane change smooth. Good position in storage area.

3--Abbott Road through Albert Street Intersection

U _____ S _____ S _____ U _____ S _____

Does not search right. Interferes with traffic. Speed and search inappropriate for conditions
Searches systematically. Speed and direction appropriate to other traffic

NOTE: Relative timing of behavior elements in relation to the behavior pattern and to SUBBETSS requirements is one of the criteria for a satisfactory rating in each behavior element.

MSU DRIVER PERFORMANCE MEASUREMENT RESEARCH

Subject # _____
Observer # _____
Date _____
Run No. _____
BETSS SubBETSS SubBETSS Pattern Suitability Search Suitability of Speed Control Direction Control

5 2b---Grand River Avenue to MAC Intersection

U _____ S _____ S _____ U _____ S _____

Does not search, changes lanes abruptly, interferes with traffic poor position in storage area, speed too fast
Searches systematically, matches speed to traffic, turns or stops smoothly

3b---MAC Avenue through Albert Street Intersection

U _____ S _____ S _____ U _____ S _____

Does not search right, interferes with traffic, speed too fast, fails to search intersection ahead
Searches systematically, accelerates smoothly, steers into proper lane, continues search

NOTE: Relative timing of behavior elements in relation to the behavior pattern and to SubBETSS requirements is one of the criteria for a satisfactory rating in each behavior element.

MSU DRIVER PERFORMANCE MEASUREMENT RESEARCH

Subject # _____
Observer # _____
Date _____
Run No. _____

Final Rating Scale Form for Pilot Study

BETSS	SubBETSS	SubBETSS Pattern Suitability	Search	Suitability of	
				Speed Control	Direction Control

6 1--Crosses Collingwood & Butterfield

U _____ S _____ U _____ S _____ U _____ S _____

Looks ahead only, fails to reduce speed 7 accelerates abruptly, encroaches on center or strikes curb lane

2--Crosses Orchard

U _____ S _____ U _____ S _____ U _____ S _____

Looks ahead only, fails to reduce speed 7 accelerates abruptly, encroaches on center or strikes curb lane

3--Crosses Kedzie

U _____ S _____ U _____ S _____ U _____ S _____

Looks ahead only, fails to reduce speed & accelerates abruptly, encroaches on center or strikes curb lane

NOTE: Relative timing of behavior elements in relation to the behavior pattern and to SubBETSS requirements is one of the criteria for a satisfactory rating in each behavior element.

APPENDIX G

THE STEPWISE PROCEDURE

APPENDIX G

THE STEPWISE PROCEDURE^{*}

The STEPWISE procedure can apply any of five techniques to find which variables of a collection of independent variables should most likely be included in a regression model. The techniques can be useful for data screening--for promoting insight into the relative strengths of the relationships between proposed independent variables and a dependent variable. None of the techniques, however, is guaranteed to produce the "best" model (or even the model with the largest R^2 statistic), and of course no model developed by such means can be guaranteed to represent real-world processes accurately.

A MODEL statement identifies a collection of independent variables and the dependent variable or variables to be regressed on them. Any number of dependent variables may be included in a MODEL statement; any number of MODEL statements may accompany the PROCEDURE STEPWISE statement. STEPWISE will perform calculations separately for each MODEL statement. All the variables must be numeric.

Given a dependent variable and a collection of independent variables, STEPWISE can apply one or more of the following five techniques:

1. Forward Selection. This technique finds first the single-variable model which produces the largest R^2 statistic. R^2 is the square of the multiple correlation coefficient; it can also be expressed as the ratio of the regression sum of squares to the (corrected) total sum of squares. For each of the other independent variables, STEPWISE calculates an F-statistic reflecting that variable's contribution to the model were it to be included. If the F-statistic for one or more variables has a significance probability greater than the specified "significance level for entry," then the variable with the largest F-statistic is included in the model. F-statistics are again calculated for the variables still remaining outside the model, and the evaluation process is repeated. Variables are thus added one by one to the model until no variable produces a significant F-statistic.

2. Backward Elimination. In this technique, calculations are first performed for a model including all the independent variables. Then variables are deleted one by one until all the variables remaining in the model produce "partial" F-statistics significant at the specified significance level for staying in (at each step, the variable showing the smallest contribution to the model is the one deleted).

3. Stepwise. This technique is a modification of the forward selection technique. As in the forward

selection technique, variables may be added one by one to the model. A variable to be added must meet the same conditions as in the forward selection technique. After a variable is added, however, STEPWISE looks at all the variables already included in the model. Any variable not producing a partial F-statistic significant at the specified significance level for staying in is then deleted from the model. Only after this check is made and any required deletions accomplished can another variable be added to the model. The process terminates when no variable meets the conditions for inclusion in the model or when the variable to be added to the model is one just deleted from it.

4. Maximum R^2 Improvement. This technique was developed by James H. Goodnight; he considers it superior to the stepwise technique and almost as good as calculating regressions on all possible subsets of the independent variables. Unlike the three techniques above, this technique does not settle on a single model. Instead it looks for the "best" one-variable model, the "best" two-variable model, and so forth. It finds first the one-variable model producing the highest R^2 statistic. Then another variable, the one which would yield the greatest increase in R^2 , is added. Once this two-variable model is obtained, each of the variables in the model is compared to each variable not in the model. For each comparison,

the procedure determines if removing the variable in the model and replacing it with the presently excluded variable would increase R^2 . After all the possible comparisons have been made, the switch which produces the largest increase in R^2 is made. Comparisons are made again, and the process continues until the procedure finds that no switch could increase R^2 . The two-variable model thus settled on is considered the "best" two-variable model the technique can find. The technique then adds a third variable to the model, according to the criteria used in adding the second variable. The comparing-and-switching process is repeated, the "best" three-variable model is discovered, and so forth. This technique differs from the STEPWISE technique in that here all switches are evaluated before any switch is made. In the STEPWISE technique, removal of the "worst" variable may be accomplished without consideration of what adding the "best" remaining variable would accomplish.

5. Minimum R^2 Improvement. This technique closely resembles the one just described. Here, though, when a switch is to be made, the switch which produces the smallest increase in R^2 is the one actually performed. For a given number of variables in the model, the maximum R^2 improvement technique and the minimum R^2 improvement technique will usually produce the same "best" model. More models of a

given size will be considered when the latter technique is applied.

Output

For every model for which computations are done, STEPWISE prints any analysis of variance table, regression coefficients, and related statistics of it.

The table involves three sources of variation; REGRESSION (i.e., variation possibly attributable to the independent variables in the model); ERROR (residual variation, not accounted for by the dependent variable's relationship to the independent variables); and TOTAL (corrected for the mean of $\underline{Y}$ if an intercept is included in the model and uncorrected if that term is excluded). Statistics in the table include degrees of freedom ("DF"); sums of squares; mean squares; an "F value," the ratio of the REGRESSION mean square to the ERROR mean square; "PROB F," the significance probability of that F value; and "R-SQUARE," the square of the multiple correlation coefficient.

Below the table are printed the names of the independent variables included in that model; their corresponding estimated regression coefficients ("b-values"); the partial sums of squares (a partial sum of squares for a variable is its sum of squares adjusted for all other independent variables in the model); and

the F-values and significance probabilities associated with the partial sums of squares.

*Used with permission of Dr. James H. Goodnight (obtained July 12, 1978).

APPENDIX H

MAXIMUM R SQUARE IMPROVEMENT

STUDY DATA

9:45 MONDAY, OCTOBER 17, 1977

PAUL SPEECH PROJECT

SS_NO

SEX

LCN

HIGH

T_VL

T_AL

T_VC

T_AO

Q_CEM

Q_CES

Q_CET

Q_CH

Q_UCK

Q_CKM

Q_CP

Q_CS

U_CT

I

A

E

M

D

R

L

V1

V2

V3

V4

V5

V6

V7

V8

V9

V10

V11

V12

V13

V14

V15

V16

V17

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V87

V88

V89

V90

V91

V92

V93

V94

V95

V96

V97

V98

V99

V100

PAUL SPECHT PROJECT									
MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE Y1									
R SQUARE = 0.11409734									
STEP 1	VARIABLE Q-CM ENTERED	OF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	REGRESSION	1	146.36856025	146.36856025	7.30	0.0092			
	ERROR	54	1082.61358201	20.04235968					
	TOTAL	55	1228.98214226						
THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.									
R SQUARE = 0.18501104									
STEP 2	VARIABLE T-VL ENTERED	OF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	REGRESSION	2	227.37576668	113.6876334	0.02	0.0044			
	ERROR	53	1001.60637613	18.89824295					
	TOTAL	55	1228.98214226						
THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.									
R SQUARE = 0.22892112									
STEP 3	VARIABLE Q-CET ENTERED	OF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	REGRESSION	3	281.33597187	93.77995062	5.15	0.0036			
	ERROR	52	947.64217049	18.22388790					
	TOTAL	55	1228.98214226						
THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.									
R SQUARE = 0.26124351									
STEP 4	VARIABLE J-CH ENTERED	OF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	REGRESSION	4	321.6649542	80.26602380	4.51	0.0034			
	ERROR	51	907.31806744	17.80231400					
	TOTAL	55	1228.98214226						
THE ABOVE MODEL IS THE BEST 4 VARIABLE MODEL FOUND.									
	INTERCEPT	13.30255426							
	T-VL	-0.07315509							
	Q-CET	-0.06260492							
	J-CH	0.10290662							

11:53 MONDAY, OCTOBER 17, 1977 10

PAUL SPECHT PROJECT

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE Y3

STEP 1 VARIABLE Q_CKM ENTERED

R SQUARE = 0.11437926

OF

SUM OF SQUARES

MEAN SQUARE

F PROB>F

REGRESSION
ERROR
TOTAL1
54
55101.42021635
789.19878165
891.12500000101.92621635
14.61479229

6.97 0.0108

B VALUE

STD ERROR

TYPE II SS

F PROB>F

INTERCEPT
Q_CKM11.38551059
0.03036046

0.03036046

101.92621635

6.97 0.0108

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE T_VL ENTERED

R SQUARE = 0.18367104

OF

SUM OF SQUARES

MEAN SQUARE

F PROB>F

REGRESSION
ERROR
TOTAL2
53
55163.85207974
727.27292026
891.1250000081.92603987
13.72213057

5.97 0.0046

B VALUE

STD ERROR

TYPE II SS

F PROB>F

INTERCEPT
T_VL
Q_CKM14.89407250
-0.07185515
0.096628100.03392649
0.0304207361.92586338
138.448761764.51 0.0383
10.04 0.0025

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE Q_CET ENTERED

R SQUARE = 0.23376905

OF

SUM OF SQUARES

MEAN SQUARE

F PROB>F

REGRESSION
ERROR
TOTAL3
52
55208.31747898
682.80721102
891.1250000085.43515966
13.13091367

5.29 0.0031

B VALUE

STD ERROR

TYPE II SS

F PROB>F

INTERCEPT
T_VL
Q_CET
Q_CKM18.13427777
-0.06022897
-0.03811097
0.100547860.03304621
0.03157473
0.0298344254.04554058
44.66535925
149.144640344.20 0.0375
3.39 0.0714
11.36 0.0014

STEP 3 T_VL REPLACED BY Q_CP

R SQUARE = 0.24346507

OF

SUM OF SQUARES

MEAN SQUARE

F PROB>F

REGRESSION
ERROR
TOTAL3
52
55216.95780987
674.16719013
891.1250000072.31526996
12.96475366

5.58 0.0023

B VALUE

STD ERROR

TYPE II SS

F PROB>F

INTERCEPT
Q_CET
Q_CKM
Q_CP13.04346824
-0.04872436
0.02881323
0.076314520.03346033
0.02881323
0.0332037784.01546964
45.75661367
68.466251479.47 0.0115
7.32 0.0089
5.24 0.0256

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

PAUL SPECHT PROJECT									
11:53 MONDAY, OCTOBER 17, 1977 11									
MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE Y3									
STEP 4	VARIABLE T_VL ENTERED	R SQUARE = 0.31220386	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	INTERCEPT		278.212844C1	65.553161C0					
	T_VL		612.91235594	12.01788933	5.79	0.0006			
	ERROR		891.125000C0						
	TOTAL								
STEP 5	VARIABLE Q_CEM ENTERED	R SQUARE = 0.34949008	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	INTERCEPT		0.031600735	61.25443414	5.10	0.0233			
	T_VL		0.032203171	86.71138818	7.23	0.0047			
	Q_CEM		0.02905174	130.73901379	10.89	0.0018			
	ERROR		0.03167318	64.89516503	5.82	0.0145			
	TOTAL								
THE ABOVE MODEL IS THE BEST 4 VARIABLE MODEL FOUND.									
STEP 5	VARIABLE Q_CEM ENTERED	R SQUARE = 0.34949008	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	INTERCEPT		311.43934941	62.28789084	5.37	0.0005			
	T_VL		579.68555359	11.59371301					
	Q_CEM		891.125000C0						
	ERROR								
	TOTAL								
THE ABOVE MODEL IS THE BEST 5 VARIABLE MODEL FOUND.									
STEP 6	VARIABLE T_AL ENTERED	R SQUARE = 0.37375395	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	INTERCEPT		0.03112419	57.40521278	4.95	0.0306			
	T_VL		0.03111473	33.22676518	2.87	0.0967			
	T_AL		0.0202125	86.96034004	7.47	0.0086			
	Q_CEM		0.03012559	162.43132715	13.99	0.0005			
	ERROR		0.03157023	57.19173456	8.38	0.0056			
	TOTAL								
THE ABOVE MODEL IS THE BEST 6 VARIABLE MODEL FOUND.									
STEP 6	VARIABLE T_AL ENTERED	R SQUARE = 0.37375395	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	INTERCEPT		333.06158658	54.51024779	4.87	0.0006			
	T_VL		558.0631352	11.39405129					
	T_AL		891.125000C0						
	Q_CEM								
	ERROR								
	TOTAL								
THE ABOVE MODEL IS THE BEST 6 VARIABLE MODEL FOUND.									
STEP 6	VARIABLE T_AL ENTERED	R SQUARE = 0.37375395	SUM OF SQUARES	MEAN SQUARE	F	PROB>F			
	INTERCEPT		0.03101802	64.26005290	2.89	0.0215			
	T_VL		0.03101802	41.62131717	1.90	0.1745			
	T_AL		0.03101802	41.62131717	1.92	0.1723			
	Q_CEM		0.03101802	91.16667632	8.18	0.0062			
	ERROR		0.03101802	177.85371618	15.62	0.0002			
	TOTAL		0.03101802	83.47108279	7.33	0.0093			

PAUL SPECHT PROJECT									
1153 MONDAY, OCTOBER 17, 1977 104									
MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE Y4									
STEP 1 VARIABLE Q-CKM ENTERED									
R SQUARE = 0.05074510		SUM OF SQUARES		MEAN SQUARE		F		PROB>F	
DF									
REGRESSION	1		25.12442682		25.12442682		3.25		0.0711
ERROR	53		982.00414461		18.20007675				
TOTAL	55		1041.92857143						
B VALUE		STD ERROR		TYPE II SS		F		PROB>F	
INTERCEPT	13.3548231				59.12442682		3.25		0.0711
Q-CKM	0.0104344								
THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.									
STEP 2 VARIABLE Q-CP ENTERED									
R SQUARE = 0.0698302		SUM OF SQUARES		MEAN SQUARE		F		PROB>F	
DF									
REGRESSION	2		93.65188989		46.82594494		2.62		0.0824
ERROR	53		948.27688154		17.89201663				
TOTAL	55		1041.92857143						
B VALUE		STD ERROR		TYPE II SS		F		PROB>F	
INTERCEPT	10.84410895				44.34052587		2.70		0.1060
Q-CKM	0.03342083				34.52126307		1.93		0.1706
Q-CP	0.03620414								
THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.									
STEP 3 VARIABLE Q-CET ENTERED									
R SQUARE = 0.12485012		SUM OF SQUARES		MEAN SQUARE		F		PROB>F	
DF									
REGRESSION	3		130.72450452		43.36163457		2.47		0.0708
ERROR	52		911.44306651		17.53355513				
TOTAL	55		1041.92857143						
B VALUE		STD ERROR		TYPE II SS		F		PROB>F	
INTERCEPT	13.01042394				30.73321503		2.04		0.1555
Q-CET	0.05074202				31.53448816		2.04		0.0724
Q-CKM	0.03741876				59.2233025		3.39		0.011
Q-CP	0.01114648								
THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.									
STEP 4 VARIABLE Q-CEM ENTERED									
R SQUARE = 0.15221117		SUM OF SQUARES		MEAN SQUARE		F		PROB>F	
DF									
REGRESSION	4		158.59316639		39.64825160		2.25		0.0724
ERROR	51		883.33540504		17.32030206				
TOTAL	55		1041.92857143						
B VALUE		STD ERROR		TYPE II SS		F		PROB>F	
INTERCEPT	14.73001895				28.50826147		1.69		0.2053
Q-CEM	0.03815414				36.24420879		2.04		0.1555
Q-CET	0.05074202				74.44015081		4.33		0.0223
Q-CKM	0.03741876				82.90446017		4.79		0.0333
Q-CP	0.00976941								

APPENDIX I

**COGNITIVE MAP INSTRUMENT DEVELOPED BY
DR. JOSEPH BOSCO**

APPENDIX I

COGNITIVE MAP INSTRUMENT DEVELOPED BY DR. JOSEPH BOSCO*

	Always	Usually	Sometimes	Seldom	Never
A. When an important news story happens, I like to hear about it on the radio rather than read it in the newspaper.	—	—	—	—	—
B. I write things down I want to remember.	—	—	—	—	—
C. When I take a math test I like to have the teacher read the questions to me.	—	—	—	—	—
D. When adding numbers I would rather write them on paper than add them in my head.	—	—	—	—	—
E. I can tell by a person's voice what he really means.	—	—	—	—	—
F. I usually smell things before I eat them.	—	—	—	—	—
G. I can tell what is in my food by tasting it.	—	—	—	—	—
H. I like to touch things.	—	—	—	—	—
I. The way things look is important to me.	—	—	—	—	—
J. I try not to say things which hurt other people's feelings.	—	—	—	—	—
K. I enjoy listening to beautiful music.	—	—	—	—	—
L. I finish what I start.	—	—	—	—	—
M. I can act like another person.	—	—	—	—	—
N. I can make myself understood without using words.	—	—	—	—	—
O. I can do well in sports if I want to.	—	—	—	—	—
P. I usually wait for people to "make the first move."	—	—	—	—	—
Q. I know myself well enough to know how well I will do in a new activity.	—	—	—	—	—

	Always	Usually	Sometimes	Seldom	Never
R. I can be counted on to bring group discussion to some agreement.	—	—	—	—	—
S. I like to talk about my ideas with my friends.	—	—	—	—	—
T. I don't let anything interfere with family plans.	—	—	—	—	—
U. When given a problem to solve, I can come to the best solution by myself, without advice from others.	—	—	—	—	—
V. I notice changes and differences right away.	—	—	—	—	—
W. I like to make lists of how I budget my time, things I own, people I meet.	—	—	—	—	—
X. When I'm trying to understand something, I like examples.	—	—	—	—	—
Y. The rules of math are easy to understand.	—	—	—	—	—
A. I would rather listen to the writer than read his book.	—	—	—	—	—
B. I would rather read a book than hear someone talk about it.	—	—	—	—	—
C. When talking to someone, I like to use numbers if they will help me prove a point.	—	—	—	—	—
D. If I have money to spend, I like to write down the amounts I will spend for each item.	—	—	—	—	—
E. I can tell who is on the phone by hearing their voice.	—	—	—	—	—
F. The way things smell is important to me.	—	—	—	—	—
G. I like to eat many different kinds of foods.	—	—	—	—	—
H. The way things feel when I touch them is important to me.	—	—	—	—	—
I. I would rather see a movie than read the story.	—	—	—	—	—
J. Other people's feelings are important to me.	—	—	—	—	—
K. I notice when things are made well.	—	—	—	—	—

	Always	Usually	Sometimes	Seldom	Never
L. I get my work done on time.	—	—	—	—	—
M. I am able to be a good actor.	—	—	—	—	—
N. I use my hands when I talk.	—	—	—	—	—
O. I have athletic abilities.	—	—	—	—	—
P. I ask personal favors only from close friends.	—	—	—	—	—
Q. I make plans based on my own interests and what I can do.	—	—	—	—	—
R. I am able to influence others to join me in doing something.	—	—	—	—	—
S. I like to do things with my friends.	—	—	—	—	—
T. Thinking about how my family would solve a problem helps me solve my own problem.	—	—	—	—	—
U. If I have something important to decide, I would rather think about it myself than talk it over with my family.	—	—	—	—	—
V. I like to argue.	—	—	—	—	—
W. There is a right way and a wrong way to do things.	—	—	—	—	—
X. In solving problems, I know there is something else that ought to be considered.	—	—	—	—	—
Y. I like to figure out what's going to happen next.	—	—	—	—	—
A. I enjoy talking with people.	—	—	—	—	—
B. I do well on the reading and English tests.	—	—	—	—	—
C. When I took classes in math I found it easy to use numbers when talking with other people in the class.	—	—	—	—	—
D. I get a good grade on written tests of mathematics.	—	—	—	—	—

	Always	Usually	Sometimes	Seldom	Never
E. I can tell if something is wrong with a motor by listening to the sound of it. (Like a car, sewing machine.)	—	—	—	—	—
F. I can tell "what's for dinner" by the smell.	—	—	—	—	—
G. The way things taste is important to me.	—	—	—	—	—
H. I choose food to eat by the way it feels in my mouth as well as the way it tastes.	—	—	—	—	—
I. I choose clothes for the way they look.	—	—	—	—	—
J. I can understand how another person being punished would feel.	—	—	—	—	—
K. I enjoy beautiful things like art, music, films.	—	—	—	—	—
L. I keep my promises.	—	—	—	—	—
M. I can make a joke interesting.	—	—	—	—	—
N. People can tell how I feel by the sound of my voice.	—	—	—	—	—
O. I work well with my hands doing such things as woodworking, typing or sewing.	—	—	—	—	—
P. I use first names only with people I know quite well.	—	—	—	—	—
Q. I know myself pretty well.	—	—	—	—	—
R. I can make other people believe that my ideas are right.	—	—	—	—	—
S. I seem to understand my problems better when I talk with close friends.	—	—	—	—	—
T. I talk to my family before doing anything which might affect them.	—	—	—	—	—
U. My best decisions seem to be the ones I make alone.	—	—	—	—	—
V. I enjoy meeting all different kinds of people.	—	—	—	—	—
W. I like to keep everything in its place.	—	—	—	—	—

	Always	Usually	Sometimes	Seldom	Never
X. I like to find out how things fit together.	—	—	—	—	—
Y. When solving problems, I like to proceed in a very logical pattern.	—	—	—	—	—
A. I understand an idea better if someone explains it to me than if I read it myself.	—	—	—	—	—
B. I find that I understand new things easily by reading about them.	—	—	—	—	—
C. I find it easier to remember numbers which I hear.	—	—	—	—	—
D. I can use written numbers easily.	—	—	—	—	—
E. If I have heard a musical instrument before, I will recognize its sound on a record when I hear it.	—	—	—	—	—
F. I notice the smell of people's perfume and after shave lotion.	—	—	—	—	—
G. I am choosy about the food I eat.	—	—	—	—	—
H. I can tell what an object is just by touching it.	—	—	—	—	—
I. I can put things together just by looking at them.	—	—	—	—	—
J. I can understand how other people feel.	—	—	—	—	—
K. I go out of my way to see beautiful things.	—	—	—	—	—
L. I have many strong beliefs.	—	—	—	—	—
M. I am good at pretending.	—	—	—	—	—
N. People can tell how I feel by looking at my face.	—	—	—	—	—
O. My body works well when I try to do things.	—	—	—	—	—
P. I do not like to meet a person unless I feel he would like to meet me.	—	—	—	—	—
Q. In games I have played, I can tell how well I will do.	—	—	—	—	—

	Always	Usually	Sometimes	Seldom	Never
R. I am able to get people who are arguing to reach agreement.	—	—	—	—	—
S. I am able to do something better when I can discuss it with my friends.	—	—	—	—	—
T. If I have something important to decide I would rather talk it over with my family than my friends.	—	—	—	—	—
U. If I want something done right, I do it myself.	—	—	—	—	—
V. When I explain something I show how it is different from something else. (For example, a Cadillac and Volkswagon.)	—	—	—	—	—
W. I like to do things when I know exactly what to do.	—	—	—	—	—
X. I like a lot of information when I'm making up my mind.	—	—	—	—	—
Y. I think ahead.	—	—	—	—	—
A. I like to listen to someone speaking.	—	—	—	—	—
B. I enjoy reading magazines.	—	—	—	—	—
C. In solving math problems, I would rather tell someone how to do the problem than write it down.	—	—	—	—	—
D. When I work with numbers, I like to write them on paper.	—	—	—	—	—
E. I can identify things by their sound.	—	—	—	—	—
F. I can tell different places by their smell.	—	—	—	—	—
G. I can tell most food just by tasting it.	—	—	—	—	—
H. When walking in a store, I like to touch things.	—	—	—	—	—
I. I would rather read things which have pictures or drawings.	—	—	—	—	—

	Always	Usually	Sometimes	Seldom	Never
J. I can tell how a person is feeling even if he doesn't tell me.	—	—	—	—	—
K. I enjoy seeing furniture that is nicely placed in a room.	—	—	—	—	—
L. Doing what I think is right is important.	—	—	—	—	—
M. I can imitate someone else.	—	—	—	—	—
N. I shake my head when saying no.	—	—	—	—	—
O. I can keep my balance well enough to walk a straight line.	—	—	—	—	—
P. I do not discuss personal things with people who would be embarrassed by them.	—	—	—	—	—
Q. I can tell how well I will do something before I do it.	—	—	—	—	—
R. I can get others to do the things I think they should do.	—	—	—	—	—
S. If I have something important to decide, I would rather talk it over with my friends than decide myself.	—	—	—	—	—
T. I like to do things with my family.	—	—	—	—	—
U. I like to do things my way even if it is not approved by my friends or family.	—	—	—	—	—
V. I like to see people in many different styles of clothing.	—	—	—	—	—
W. I believe people should follow the rules.	—	—	—	—	—
X. If I had to, I could take something apart and put it back together. (Like a puzzle, dress, motor.)	—	—	—	—	—
Y. I try to figure out how a game works without reading the rules.	—	—	—	—	—

*Used with permission of Dr. Bosco (obtained July 12, 1978).

APPENDIX J

LETTER FROM C. BRUCE MARTIN,
DIRECTOR OF ACADEMIC AND MANAGEMENT
INFORMATION SYSTEMS,
OAKLAND COMMUNITY COLLEGE



OAKLAND COMMUNITY COLLEGE

GEORGE A. BEE ADMINISTRATIVE CENTER 2480 OPOYKE ROAD BLOOMFIELD HILLS, MICHIGAN 48013 313-647-6200

October 17, 1977

Mr. Paul Specht
Department of Safety
Humphreys Building
Central Missouri State University
Warrensburg, Missouri 64093

Dear Paul:

I have enclosed the computer printout with several regression models run. Do not let the volume frighten you. The statistical package which I used was written by Anthony J. Barr, James H. Goodnight, John P. Sail and Jane T. Helwig, of SAS Institute Inc. I ran all five modeling approaches for your four dependent variables, Y1 through Y4. Dr. Hill always preferred the method maximum R^2 improvement. I have enclosed two pages from the SAS Manual which explains briefly the five techniques.

An arbitrary choice of .05 significance level for entry into the FORWARD selections and STEPWISE techniques was made.

Oakland Community College does not have a program which does composite maps. It is a manual process whereby you look at each element of the Cognitive Style map and count the number of times it occurs in the group of maps. Any element which occurs 70% of the time is considered to be representative of that group. I have included the frequency distribution to help you in this regard.

I am sure that you will have some questions, please do not hesitate to call.

Sincerely,

C. Bruce Martin, Director of
Academic & Management
Information Systems

CBM/mac
Attachments

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