THE EFFECT OF A PROGRAMMED COURSE OF INSTRUCTION ON THE DEVELOPMENT OF INFORMATION-PROCESSING COMPETENCE AND DECISION-MAKING STYLES

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ABSTRACT

THE EFFECT OF A PROGRAMMED COURSE OF INSTRUCTION ON THE DEVELOPMENT OF INFORMATION-PROCESSING COMPETENCE AND DECISION-MAKING STYLES

By

Nancy Garrison Harries

The purpose of this study was to examine the effects of a programmed course of instruction on information-processing complexity and decision-making style, in order to determine the implications for organization of information in gradations of conceptual complexity as a training environment for complex decision making. The specific research objective was to identify the relationship between the experience of working through a programmed sequence of textile instruction and (a) level of complexity used in information processing, as defined by Schroder, et al. (1967); and (b) decision-rule complexity and (c) time orientation, defined as decision style elements in the model conceptualized by Bustrillos (1963).

The conceptual framework of this study was based on how individuals typically process information and make decisions, rather than on the content of the information or decisions. A distinction was made between what a person thinks and how he thinks. The structure of human decision

making was examined in regard to the number and connectedness of integrating rules used for organizing information for the purpose of decision making.

The three criterion variables--information-processing complexity, decision-rule complexity, and decision time orientation--were examined in relation to structure of thinking. The variables were measured before and after subjects worked through the programmed sequence of textile instruction.

The population selected for the study consisted of 150 Michigan State University undergraduate students enrolled in an introductory textile class (HED 171), which was taught using the programmed text treatment designated for the study. The students were divided into two groups to test for any effects of the pretest on posttest results. Group I, the experimental sample, consisted of two-thirds of the class; these subjects received measures designed to test the variables at the beginning and conclusion of the textile class. Group II was composed of the remaining one-third of the class, which served as a placebo sample that received only posttest measures of the variables. Personality measures unrelated to the criterion variables were given to Group II, instead of the regular pretest measures. Out of the experimental group, 50 subjects were randomly selected for purposes of data analysis, and 25 subjects were randomly selected from the placebo group. No sensitizing effects were found from pretest to posttest results; thus, the pretest and posttest measures of the 50 students in the experimental sample were used for hypothesis testing in the data analysis.

The first three hypotheses tested predicted that there would be gains in the three criterion variables after subjects worked through the programmed treatment:

Hypothesis I: The level of complexity of textile information processing will be increased after working through the textile program.

Hypothesis II: After the experience of working through the textile program, the decision rule of decision-making style will be more complex.

Hypothesis III: After the experience of working through the textile program, time reference of decision-making style will be more future oriented.

The remaining four hypotheses predicted relationships among the variables:

Hypothesis IV: Those who operate at higher levels of conceptual complexity are likely to use more complex decision rules.

Hypothesis V: An increase in complexity of information processing over time will be accompanied by an increase in complexity of decision rule.

Hypothesis VI: Those who operate at higher levels of conceptual complexity are likely to be more future oriented.

Hypothesis VII: An increase in complexity of information processing over time will be accompanied by an increasing orientation toward future time.

A multivariate analysis of gain score variance indicated that there were over-all significant gains from pretests to posttests on the measured variables. An examination of the univariate F tests for each variable indicated that the gain scores for information-processing complexity and time orientation contributed to the over-all multivariate significance level ($p<.0026$), while the gain score for rule complexity did not contribute to significant gains.

No significant correlations were found among pretest and posttest scores of information processing, time reference, or decision rule; nor among gains scores of these variables.

From these findings, there is evidence that the categorical organization of information in gradations of increasing complexity contributes to increased levels of information-processing complexity and orientation toward future time. These results have implications for the design of organizational learning environments which can help individuals process information more efficiently for complex decision making.

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Dedicated to the

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whose cooperation in taking numerous measures made the study possible.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Information can be organized in gradations of conceptual complexity to train individuals for complex decision making. The benefits of a simple to increasingly complex categorical organization of information are examined in this study, as to effect of the organization on level of complexity in processing information and decision making.

The cognitive structure used to organize the information was a programmed sequence of textile instruction, which had been developed and tested during the past three years in undergraduate courses at Michigan State University. Specifically, the research objective was to identify the effect of the experience of working through the programmed cognitive structure upon: (a) the student's level of complexity in processing information, and (b) the student's decision-making style, which was defined through the elements -- decision rule and time orientation. Decision rule, time orientation, and level of information-processing complexity were measured before and after students worked through the sequence of programmed textile instruction.

Research in this area is needed if learning environments are to be developed which contribute to an individual's ability to process increased amounts of information at higher levels of conceptual complexity. Competence in processing information and making decisions in complex environments is becoming essential in societies where masses of information are bombarding people daily.

Although high or low levels of complexity of information processing are inherently neither good nor bad, high-level conceptual functioning is more adaptive because it allows the individual to cope with greater environmental complexity, to generate and utilize conflict in his thinking, and to withstand more effectively the negative effects of stress (Schroder, 1971). In complex environments, higher levels of complexity allow for more efficient processing of information in decision making than do lower levels of complexity. At lower levels of conceptual complexity the individual typically uses very little information in forming concepts, and has difficulty in developing alternative conceptions of events.

Conceptual Framework

The conceptual framework for this study draws upon three areas of research: information-processing theory, decision theory, and related instructional theories. Information-processing theory is important to the study because it emphasizes the structure rather than the content of human thinking. Decision theory provides a basis for examining the process of decision making, which relates to how choices are made in the context of observable behavior. Last, the instructional theories of Piaget, Bruner, and Skinner establish a rationale for use of the textile programmed instructional system as the cognitive structure. Each area is discussed in turn, as to how it contributes to the conceptual formulation of the current study.

Information Processing

The information-processing approach to cognition and personality, which focuses on the structure of human thought rather than on its content (Schroder, Driver, and Streufert, 1967; Schroder, 1971), was the conceptual basis for this study. Conceptual complexity theory, or conceptual systems theory, as this approach has been called, focuses on how individuals typically process information rather than on the outcomes of such processing. The emphasis is on the number and connectedness of conceptual or integrating rules used for organizing information in thinking, valuing, judging, and decision making. A sharp distinction is made between what a person thinks and how he thinks. Thus, two classes of information are basic to this information-processing model: (1) content variables, which provide information about acquisition, direction, and magnitude of what a person thinks; and (2) structural variables, which provide a means for measuring the way a person combines information perceived from the outside world, as well as internally generated information. Information processing in a given situation involves the perception and the subsequent organization of various kinds of information.

The approach allows for the systematic relation of individual differences in information-processing ability to a wide variety of personality and task parameters. The complexity of the conceptual processes used in thinking and making judgments about a given set of stimuli is defined in terms of two sets of variables: (1) the degree of differentiation, and (2) the level of integrative complexity. Differentiation refers to the number of items of information used in a given information-processing situation, while integrative complexity is operationally defined as the number of different concepts which the individual forms on the basis of derived informational elements.

Integrative Complexity.--A central notion to the model is that different levels of integrative complexity indicate different ways of processing information. The level of information processing is viewed as ranging from a low integration index or concrete processing structure, to a high integration index or abstract structure. The level of complexity of information processing is measured in reference to a given range of stimuli, based upon how many different dimensions (a dimension is defined as a unique arrangement of stimuli) are perceived related to the stimuli, and to what extent rules are used in integrating the dimensions.

The number of dimensions is not necessarily related to the integrative complexity of the information-processing structures; but the greater the number of dimensions, the more likely is the development of integratively complex rules. Research indicates that the relationship between the number of dimensions of information presented and complexity of information processing is curvilinear (Streufert and Schroder, 1965). A low integration index is similar to a hierarchical form of integration, in which fixed rules are used; and the relationship between the dimensions (however many there may be) is relatively static. High-integration-index structures have more connections between rules, and there are more schemata available for forming new hierarchies, which are generated as alternate rule structures.

Behavioral Characteristics.--Examples of behavioral patterns generated by low integration levels of information processing include: categorical, black-white thinking; minimizing of conflict; habitual avoidance of ambiguity; a high degree of conformity; anchoring of behavior in external conditions; standardization of judgments in a novel situation; and increased susceptibility to the anxiety-producing effects of such stress variables as environmental complexity, frustration, or rapid change (Schroder, et al., 1967, pp. 43-106; Schroder, 1971). At higher levels of complexity, however, the individual moves away from this simplistic and rigid type of functioning. He uses more information in forming concepts and also develops the capacity to

conceptualize events in alternative ways, to think in multi-conceptual terms. Some of the behavioral implications associated with high-level integration include the utilization of alternative interactive processes and the ability to cope with situation change over time.

Yet, individuals operating at low levels of conceptual functioning can, in certain situations, make decisions more quickly and efficiently than those who function at such high levels of complexity that many alternatives are perceived and decision closure is difficult. Generally, however, an ability to operate at high levels of conceptual functioning has been recognized as an important stage in personality development (Piaget, 1932; Kohlberg, 1964). Thus, an objective of instruction is to increase the level of complexity of information processing.

Successful performance in most complex task environments requires: (a) sufficient performance of skills and knowledge (content), (b) a near-optimum level of interest or motivation, (c) adequate competence in interpersonal relations (since most complex task environments require group activity for decision-making purposes), and (d) the capacity to engage in complex information processing (Schroder, et al., 1967, p. 13). Research efforts should focus on developing training environments that foster these competencies; and the focus of the present research is on the development of (a) and (d) above.

Decision-Making Style

To determine how decision-making style relates to information-processing levels, an adaptation of the Bustrillos model (1963) was selected from the decision literature as the conceptual framework for this study. Bustrillos viewed decision making as a conflict-resolution process, composed of three components: movement, relationship, and discrimination. Bustrillos recognized that these components were not directly observable, but she proposed that they be identified through study and analysis of verbalized behavior.

Bustrillos defined decision-making style as the manner in which individuals pattern decision behavior. The pattern was seen as the decision maker's creative product of attempts to recognize demands from the environment and blend them with his own needs and desires. Style might vary from situation to situation, but patterns of behavior were developed which were distinctly one's own (Bustrillos, 1963, p. 5).

Three behavioral or style elements were conceptualized in the Bustrillos model as indicative of an individual's decision-making process. These interdependent elements were called mode, time reference, and decision-making rule; and each style element was described as manifesting all three process components.

Mode, which was defined as the distinctive way one develops ideas in a decision situation, was not included for study as a decision-style element; the mode component was explored through the information-processing approach developed by Schroder, et al. (1967). According to Bustrillos, mode was the expressive component of decision-making style; it represented how ideas were developed, analyzed, classified, and then related to the decision-making problem. The central feature of mode did not focus on the content of ideas, but on the structure, which is the thesis of the Schroder model. The latter two elements of style, time reference and decision-making rule, were selected from the Bustrillos model for this study.

Decision Time Orientation.--Time reference was selected as a variable to relate to information processing, since no decision is independent of time. One must be able to perceive events in a time relationship, as time gives meaning and continuity to events. Past, present, and future time orientations were specified, with future time references considered most relevant to conceptual complexity of information processing. Decisions made with thought to future orientation involve increasingly complex levels of integration and abstract reasoning. To make projections from present or past actions to future consequences, additional dimensions and rules would need to be considered.

Decision Rule.--The other element of decision style selected for study was the decision rule, which is the method by which alternative courses of action are evaluated. Rule, thus, comes after a set of alternatives has been perceived. By using a decision-making rule, an individual is able to differentiate alternatives and then arrive at a discriminatory point or decision. This element of style is comparable to the evaluation and choice phases designated in the normative, sequential model of decision process. Different labels have been used to describe various decision rules; a discussion of rules considered for this study follows, concluding with the classification decided upon for the rule variable.

Three decision rules were identified by Bustrillos: preference ranking, objective elimination, and immediate closure. Preference ranking involves the ordinal ranking of perceived alternatives. Alternatives are evaluated and placed in order from best to worst, according to a subjectively defined criterion. This rule is essentially a lexicographic ordering approach, in which the decision maker ranks or evaluates alternatives with respect to values placed on an alternative's most important attribute. If more than one alternative exhibits the same value for the most important attribute, the tie is broken by looking at the second most important attribute, and so on until there are either no more ties or no more attributes. All perceived alternatives are thus ranked according to the decision maker's preference along several dimensions. The lexicographic ordering label was selected for this study as being more description than preference ranking.

Bustrillos defined objective elimination as a situation in which no one best alternative is consistently chosen; the "best" depends on the conditions of the environment. Alternatives suggested as desirable are qualified, with phrases such as: "under these conditions ________ is best"; "but if ________ then ________." Unless forced by the situation, closure is not readily made; the decision maker does not identify personally with the possible alternatives, but rather remains detached. An objective factual approach is used, with little thought given to subjective value judgments. Objective elimination involves a recognition of the objective demands of the situation and analysis of the alternatives which are perceived to apply. However, if more than one alternative is feasible, based on the situation, the decision maker may have difficulty in making a final choice.

Simon's satisficing model (1957) is similar to objective elimination, in that it suggests that the decision maker will choose the first alternative which exceeds a set of minimal criteria. Satisficing was chosen instead of objective elimination as a rule classification in the current study. Satisficing has a widespread and precise meaning and is used more frequently in the decision literature. Alternatives are evaluated according to the satisficing model by comparing their attribute values with a set of goals or standards for these attributes; and any alternative, usually the first one discovered, which meets or exceeds all of these standards is chosen. Following a satisficing model, an individual uses fewer dimensions and perhaps operates at a lower level of complexity in processing information than with the preference or lexicographic ordering model. In the latter model, all perceived alternatives are ranked according to preference along several dimensions, which requires integration and differentiation of information.

In the last rule specified by Bustrillos, immediate closure, only one action is focused upon. The one perceived alternative is immediately selected without explicitly going through ranking or elimination. No other alternatives are mentioned at the conscious level, and the decision process is quickly executed, with little analysis occurring before choice. This rule would no doubt be associated with low levels of conceptual functioning.

In this research, the following rules were evaluated according to complexity of information processing required: (1) immediate closure, (2) satisficing, (3) lexicographic ordering, and (4) a combination of satisficing and lexicographic ordering, called SATISLEX by Russ (1971a). The use of immediate closure was considered the simplest, least complex decision rule, with each rule increasing in complexity from (1) to (4).

The use of lexicographic ordering was, therefore, considered a more complex decision rule than the use of satisficing alone. The use of both rules, i.e., when alternatives which fail to meet certain goals or standards are eliminated from further consideration and those that remain are ranked lexicographically, was considered more complex than the use of either rule alone.

Related Instructional Theories

The development of the programmed cognitive structure, used as the vehicle for this study, is grounded in several learning theories which are related to information processing.

Piaget's Development Theory.--Piaget is recognized as a leading investigator of concept formation in children; his approach is a genetic one. He attempted to distinguish levels or stages of development in the evolution of thought and to show how each stage reveals a progressive sequence from simpler to more complex levels of organization (Piaget, 1950, 1953). He believed that the individual's neural structure matures at a given rate, and that at certain stages of maturity there are "wired-in" responses, which naturally occur in an information-processing context.

Given an individual's history of processing information within the context of his neural structure, adaptation continually occurs through a series of phases from birth to maturity. The individual constructs his "cognitive map" through interaction with experiences. Piaget maintained that thought activities may be analyzed in terms of groups or systems of such operations, which appear as actions (Thompson, 1959, p. 91).

Bruner began where Piaget left off--with mature adults who have mastered all the basic operations and groupings necessary for thought. Therefore, Bruner's work has particular bearing on the development of cognitive structures for learning environments at the college level.

Bruner's Concept Attainment Theory.--Bruner and his associates have been concerned with research in the area of cognitive growth--the way in which human beings learn to represent their experience and the way in which they are affected by their cultural environment (Bruner, Goodnow, and Austin, 1956). However, Bruner researched a narrower area than Piaget; Bruner concentrated on categorizing in conceptual thinking, while Piaget covered the entire field of conceptual activity from forming of the notion of concrete permanent objects beyond the range of the subject's perceptual field to the concepts of space, time, and number (Piaget, 1952, 1953).

Bruner, et al. succeeded in showing the type of behavior which actually goes on in conceptual activity (Thompson, 1959, p. 67). They defined a concept as a category, and distinguished two categories: (1) identity classes, in which a variety of different stimuli are identified as the same object or event; and (2) equivalence classes, in which different items are treated as equivalent for some purpose or other (Bruner, et al., 1956, pp. 2-4). Their work further dealt with the means people use for categorizing, which Bruner called strategies. Bruner's strategies are somewhat comparable to Piaget's concept of groupings, which he defines as systems fulfilling certain conditions of reversibility, composition, etc. (Piaget, 1950).

Bruner defined strategies as purposive patterns of behavior used in moving toward some goal. Information was viewed as having to be acquired, retained, and used in a series of moves and countermoves with the goal of solving the problem of defining attributes of the concept at issue. Four ideal heuristic strategies were worked out from the experiments, which consisted of the most logical and economical ways of tackling the specific problem of the experiments, namely: successive scanning, simultaneous scanning, conservative focusing, and focus gambling (Bruner, 1956, pp. 83-90).

Put in a decision frame of reference, the steps involved in attaining a concept are successive decisions, earlier ones of which affect the degrees of freedom possible for later decisions. Decision strategies were not seen as fixed; rather, they altered with the nature of the concept being sought, with pressures of the situation, perceived consequences, and so forth (Bruner, *et al.*, 1956, pp. 54-55).

Bruner presumed that strategies are learned, and in later writings (1964, 1966) he took the view that human development is shaped by a series of advances in the use of the mind. He stated that growth depends upon the mastery of techniques and cannot be understood without reference to such mastery. He saw the techniques as mainly skills transmitted with varying efficiency and success by the culture, e.g., language. Three systems of processing information are identified, by which human beings construct models of their world: through action, through imagery, and through language. These systems allow human beings to represent in a manageable way the recurrent features of the complex environments surrounding them (Bruner, 1964, p. 1).

The manner in which these systems of information processing are integrated is another concern expressed by Bruner, which supports Schroder's view of integrative conceptual complexity. The means through which acts are organized into higher-order ensembles, making possible the use of larger and larger units of information for the solution of complex problems, is an important aspect of maturity (Bruner, 1964, p. 2).

Skinner's S-R Theory.--The development of programmed instruction as a prominent instructional tool has its theoretical roots in that portion of the behaviorist psychology school of thought developed by B. F. Skinner (Skinner, 1953). Skinner conceived of the human being as a "black box" in which external stimuli are input and observable behavior is output. Skinner was not concerned with hypothesizing as to what is occurring within the black box. Rather, one only need observe input-output relationships, in order to make probability statements about the likelihood of the occurrence of a specified behavior in the presence of a given stimulus array.

A consequence of inputs can therefore be structured through a program of instruction so as to increase the predictability of behavior occurrence after passing through the stimulus array called the "program." The development of programmed instruction, however, has almost exclusively been used for content purposes. Programs are designed to make content output (i.e., correct use of terms, naming, and identification of concepts) rather than to develop information processing ability. (See T. Harries, 1972, Chapter I.) There is little question that programmed instruction is an effective tool for developing content-oriented behaviors in students. However, the questions at issue in this study are concerned with what effect the structure of the program itself (rather than simply its content) contributes to the behaviors related to information processing, decision rule, and time orientation.

Explication of Conceptual Framework: The Textile Instructional System

Explication means making visible the elements of the conceptual structure in observable behavior. The textile instructional system was designed to effect change on student information-processing complexity and decision-making behaviors, in a manner that behavior could be observed and analyzed by appropriate tests. (The design and development of the instructional system are discussed in Chapter III, Methodology.)

A programmed text was selected as the cognitive structure for information transmission, rather than a conventional text, because of the difference in nature of structures. Programmed materials are highly structured, with fixed degrees of freedom set by the program. The student is led down a prescribed path, with observable behavioral outcomes traceable to the program. Further, the textile program is revised as it is developed, based upon student performance and feedback, so that its results are predictable.

Convergent thinking, rather than divergent thinking, is believed to be fostered by programmed instruction, causing the student to focus on the point at issue. Uncertainty is reduced, in that the student knows what information he is to master. The concreteness of the program structure is more visible than the structure of the typical textbook. Differential student interaction with the program can be looked at in relation to the information-processing level of the student. The effect of differences in individual information-processing complexity can be related to the program structure.

By defining the constraints within which the student must operate, alternatives for decision making are initially narrowly prescribed. Basic information of low complexity is presented first, and complexity is increased as the student is able to integrate additional information. Information is organized in gradations of increasing complexity, in which experiential referents are initially paired with textile data. As student mastery of textile concepts increases, experimental referents are phased out and replaced by an increasing hierarchy of textile symbols and referents. Such a categorical organization of information is intended to provide a framework for later use, allowing new inputs of information to be processed and decisions made, within a much broader framework than the program permits.

Bruner's work, indicating that classification reduces the complexity of the environment and makes information easier to deal with, supports the advantages of a structured environment, expecially for low-level conceptual processors (Bruner, et al., 1956). By providing all students with a prescribed structure, which leads them down the path toward greater complexity, increased predictability of successful attainment of the information by a majority of students is possible.

Using a conventional text, which is less structured than a programmed text, high-level conceptual processors would likely be able to integrate and master the information; but there is no planned means for seeing that concepts are systematically attained. Particularly, low-level conceptual processors are not as likely to succeed following unstructured environments, because an environment with fewer degrees of freedom (thus less complexity and low uncertainty) is required to optimize their level of information processing (Schroder, 1971, p. 267).

High-level conceptual processors should initially be able to integrate the textile information at higher levels of complexity than low-level conceptual processors, and perhaps demonstrate greater increases in their abilities to integrate information than the low-level processors, as the textile environment increases in complexity. By the end of the instructional sequence, complexity is purposefully increased in what is intended to be a systematic manner of developing a framework which allows for multidimensional, multiconnected combinatory rule structures of processing textile information.

Of research interest in the effect of a highly structured information environment on altering the processing levels of individuals who operate at varying levels of conceptual complexity. Past testing of the textile system has demonstrated that performance on textile exams increases for all students after working through the textile program; (see T. Harries, 1972, for a description and results of the study)--but what happens to information-processing and decision-making abilities?

Accepting the proposition that individuals disposed to process information at a given level will function optimally at a particular level of environmental complexity (Schroder, 1971, p. 267), the concern in designing training environments becomes how to structure information so that individuals can categorize and integrate information in a manner that reduces environmental complexity to <u>their</u> optimal level of coping ability.

In closing, the point should be made that a high level of information processing does not necessarily define the "best" performance for problem solving. What is "good" performance depends upon the criterion which one applies. When the situation is more or less static, and when the appropriate interpretation and strategy for achieving a particular goal are known, then single rule or low levels of information processing can achieve a high measure of "success." When the situation is changing, when the task calls for the definition of goals and means, and when alternative perspectives are meaningful, then higher levels of information processing are more effective (Schroder, 1971, p. 273).

Summary

A discussion of information-processing theory and decision theory was undertaken for the development of the conceptual framework to explain the focus of this research on information structure rather than content. Attention has typically been given in the past to what was to be learned, to the content of decisions. However, this framework takes into account how individuals differentiate and integrate information at certain levels of complexity, and the influence that this processing of information has upon selection among alternatives for the decision choice.

The instructional theories which bear upon how concepts are learned are important to the development and selection of a cognitive structure to use in presenting information. The programmed textile instructional system was selected as the vehicle of information transmission to study because of the highly structured nature of programmed instruction. The categorical organization of information, programmed with a prescribed logic which initially allows few degrees of freedom for subjects, transmits content efficiently; but what effect does information structure have on how human

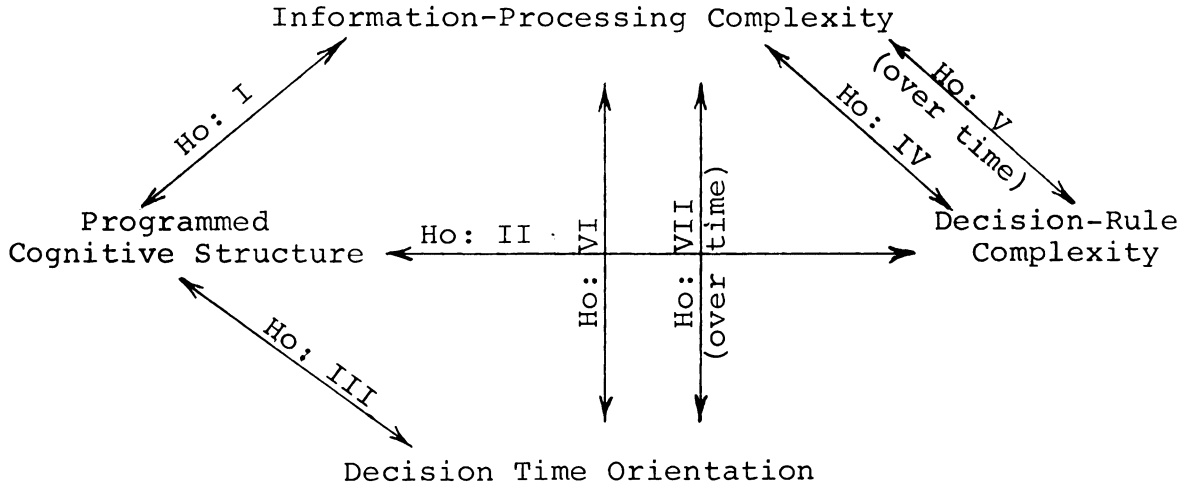
beings process the content and make decisions? What determines effective techniques which aid individuals in coping with the masses of information surrounding them? Can individuals be provided with a cognitive structure for processing diversified information input in order to transform it into useful behavioral output? How can learning environments (cognitive structures) be designed which "teach" the processing of information at increased levels of complexity, as well as teaching information content?

The intent of this study is to look at the relationships between a programmed cognitive structure and (a) information-processing complexity, (b) decision rule complexity, and (c) time orientation, in order to establish their relevance to the above questions.

CHAPTER II

REVIEW OF LITERATURE

The literature review is organized according to the hypotheses set forth for the study. The diagram below depicts the relationships examined among the three criterion variables: (1) information-processing complexity, (2) decision-rule complexity, and (3) decision time orientation, and how they are viewed in regard to experience with the programmed cognitive structure.



HYPOTHESIZED RELATIONSHIPS: Diagram of how the three variables are examined in relation to each other and to the programmed cognitive structure.

Figure 1.--Hypothesized relationships.

The first three hypotheses predict increases in each of the variables after working through the textile program. The remaining four hypotheses suggest relationships between information-processing complexity and the elements of decision style (time and rule). The literature is reviewed according to the hypothesis grouping described above: the first section contains support for Hypotheses I, II, and III, under the heading "Effect of Cognitive Structure"; the second section, entitled "Information-Processing Compexity as Related to Decision Style Elements," contains support for the variable relationships specified in Hypotheses IV through VII.

In the first section, literature in the areas of information processing and cognitive development is reviewed, as the research relates to the effects of information organization on human behavior. The human being is viewed as a cybernetic system, which transforms inputs of information into outputs of behavior, specifically decision-making behavior. Each of the following hypotheses is discussed in relationship to information organization or cognitive structure.

Hypothesis I: The level of complexity of textile information processing will be increased after working through the textile program.

Hypothesis II: After the experience of working through the textile program, the decision rule of decision-making style will be more complex.

Hypothesis III: After the experience of working through the textile program, time reference of decision-making style will be more future oriented.

Effect of Cognitive Structure

Information-Processing Complexity

Processing Models.--The information model proposed by Kuhn (1963) identifies human behavior as the product of a controlled or cybernetic system, "in which the concept-perception subsystem is the detector, the motive subsystem is the selector, and the motor and behavioral subsystem is the effector, with feedback to the detector system." The motive system is seen as dealing with preference functions and the concept system with opportunity functions (Kuhn, 1963, p. viii).

Information input is viewed in two phases. First, an individual must devise his means of coding or classifying information, which can be considered comparable to what psychologists refer to as concept learning, or what philosophers refer to as induction. The second step in processing information inputs involves perception, which could be identified with deductive processes (Kuhn, 1963, pp. 57-58).

Concepts are stored information accumulated over a period of time, and must be identified by the individual as representing certain things in his environment (Bruner, et al., 1956). Perceptions are the information about particular things currently happening; and how information is perceived relates not only to the stored concepts, but to stimuli currently received. One of the most basic communication concepts is that perception is <u>within</u> an individual. What he perceives is true to him, regardless of what someone else sees as reality. Thus, interest in perception lies in individual differences observable in the classification and interpretation of information.

Information alone, therefore, does not determine behavior, since behavior is the result of selectively processing some information inputs and not others. Human behavior is typically viewed as selective or <u>adaptive</u> behavior, meaning that the individual selectively perceives which information to process. There are many possible responses to any given set of stimuli, and adaptive behavior consists of choosing the relatively satisfactory responses in preference to the relatively unsatisfactory ones (Kuhn, 1963, p. 55).

Because there is so much information available for processing, individuals must devise their means of filtering out certain stimuli. "Information-input overload" is one of the prevalent problems of current society, interfering with the performance of most human beings. Methods of dealing with information overload discussed in communication literature include: omission, queueing (piling up unattended items for later attention), approximation, multiple channels, chunking (dealing with blocks of items), filtering, and escape (Platt and Miller, 1969, p. 295).

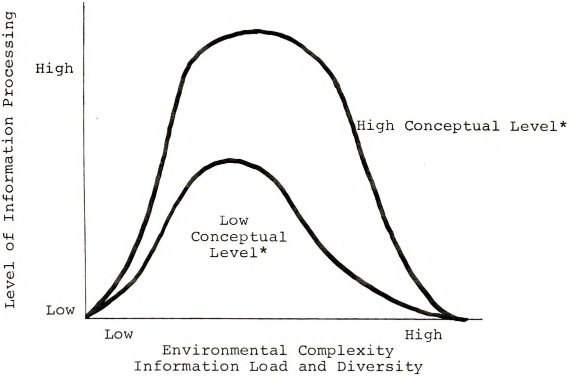
Platt and Miller suggested that queueing is used too much, while approximation not enough. Further, multiple channels might be effectively used to give greater attention to nonroutine decisions and let routine ones by handled automatically by other designated individuals. Chunking and filtering likewise are cited as being useful, and individuals need to be made aware of such means of handling overload. Training programs, i.e., educational packages, must be developed to help individuals deal with increasingly complex information inputs, or man will be overloaded beyond his capacity to process information effectively when called upon in varying problem-solving situations. Such consequences are discussed in Alvin Toffler's book, Future Shock (1970).

The experiments of Bruner's research group (1956, 1964, 1966) indicated that there is much variation in how individuals process information and adapt their learning strategies to particular problem-solving situations. Strategies were also found to vary with problem difficulty.

Other research groups have also found that the means used in processing information and solving problems vary greatly from individual to individual, and with the situation. A large body of research, much of which has been conducted by G. A. Miller, et al. at Harvard, indicates that amounts of information processed, and the complexity at which it is processed, vary considerably, but have a finite limit (Miller, et al., 1956, 1960). Yet, at any given level of processing abilities, individuals can be trained to process greater amounts of information at higher levels of complexity.

Although training environments can be designed which will increase an individual's level of complexity of information processing, individuals disposed to process information at a given level tend to function optimally at a particular level of environmental complexity (Schroder, 1971, p. 267). A family of inverted "U" curve hypotheses has been generated and researched by Schroder, et al. (1967, 1971), which supports the predisposition toward differential levels of processing: Information processing by people in general reaches a maximum level of structural complexity at some optimal level of environmental complexity. Increasing or decreasing environmental complexity from the optimal point lowers the conceptual level.

The curve representing a higher-level conceptual functioning should reach its peak of integrative complexity level in more complex environments than the curve representing lower-level conceptual functioning. As diverse input increases, the more complex structure curve begins to rise earlier than the low-level complexity structure curve; and the low conceptual curve reaches its optimum and begins to decline while the higher conceptual curve is still rising. The high-level conceptual curve would fall more slowly than the low-level curve. The levels at which individuals process information would therefore be indicative of the degrees of environmental complexity which could be adequately handled.



*Level of conceptual structure is a mediating linkage between environmental factors and information-processing characteristics.

Source: Schroder, 1971, p. 264.

Figure 2.--Relationship between environment and behavioral complexity.

Overly simple environments, which fail to present sufficiently diverse units of information, fail to stimulate the processes of integration; therefore, a low level of conceptual processing is sufficient for coping with simple environments. Overly complex environments, which provide excessively diverse units of information, reduce the generation of integratively complex rules for processing information and also reduce the levels of differentiation and integration used.

Research in educational development congruent with that of Schroder, et al. (1967, 1971, 1972) has also examined the match between the schemata within the organism, and characteristics of the environment as the conceptual foundations for understanding development. Relevant research in these areas includes: Piaget (1932), J. McV. Hunt (1961)--forerunners in the area--Grant, et al. (1963), D. E. Hunt (1966, 1968), Kelman (1961), Kohlberg (1964), Palmer (1968), and Turiel (1966).

Organizational Learning.--Schroder (1971, 1972) investigated the development of "organizational learning" through his model of information processing. The combining or organizing process is perhaps one of the most persistent and important problems in psychology. Although studied in the context of Gestalt psychology, person perception, and clinical judgment, organizational processes have been largely neglected in learning and development studies (Schroder, 1971, p. 250).

While differentiation and the learning of dimensional properties can be understood in the framework of traditional learning principles, the development of conceptual structures for organizing information depends upon the nature and extent of "organizational learning." New categories or dimensions are learned via conditioning, the selective operation of rewards and punishments, and through observation and language. How already acquired information is organized is a product of the type of environment provided for organizational learning (Schroder, 1971, p. 260).

The integrative complexity of conceptual structures used in human information processing is the index for defining organizational processes proposed by Schroder, _et al_. (1967). Schroder's integrative complexity refers to precise organization properties, i.e., the number and connectiveness of combinatory rules, which can be measured with the Paragraph Completion Test (Schroder, _et al._, 1967; Phares and Schroder, 1969).

One type of environment commonly used for organizational learning is characterized by: (1) training-agent determination of combinatory rule and the goal to be reached using the dimensions learned, (2) agent determination of criteria for evaluating child's responses when using the rule, and (3) agent administration of punishments and rewards depending on the degree to which the child's responses match the standards of the agent. This unilateral environment rests on the principles of agent determination of combinatory rule and agent "control of behavior" (Schroder, 1971, p. 260). The child learns a more or less stable dispositional tendency to look externally for a fixed rule for combining information; he learns to avoid ambiguity and to think by the application and modification of a single perspective.

On the other hand, another type of training for organizational learning is characterized by the development of an environment (1) in which the child generates combinatory rules and goals which are relevant to the dimensions or categories previously acquired; (2) which feeds back information relevant to the perspectives, strategies, and goals generated; and (3) which is intrinsically interesting and encourages the generation of different uses of the same information. This interdependent environment rests on the principles of the self-generation of combinatory rules and of environmental control (Schroder, 1971, p. 260). Of course, there are many gradations between these two extreme environments for learning organizational properties.

Experimental studies of organizational learning which indicate that organizational training environments can influence conceptual complexity include: Schroder and Rotter (1952), "Rigidity as Learned Behavior"; Gardiner (1971), "Complexity Training and Prejudice Reduction"; and Krohne and Schroder (1971), "Anxiety Defense and Complex Information Processing."

The less an individual is exposed to organizational training in an inductive interdependent environment, the more conceptual organization becomes arrested at a lower stage of development. Given an optimal interdependent environment, organizational development proceeds through universal stages in any stimulus domain--from categorical single-dimensional valuing and thinking, through multidimensional single rule structure; multidimensional multirule (unconnected) structure; to multidimensional, multiconnected combinatory rule structure. More unilateral, overpowering, or stressful environments lead to arrestation at some lower stage of development. Such long-term training effects in a particular area, what Schroder called a domain, result in the development of a more or less stable dispositional information-processing structure in that domain (Schroder, 1971, pp. 262-263). However, extreme caution should be followed in generalizing from level of complexity of information processing from one stimulus domain to another. The degree of generalization will depend upon the similarity of the learning conditions across domains (Schroder, 1971, p. 255).

The previous discussion supports Hypothesis I: The level of complexity of textile information processing will increase after working through the textile program. The ability to integrate and process textile information (one stimulus domain) at higher levels of conceptual complexity should result after exposure to a cognitive structure consisting of a specially designed training environment composed of textile stimuli. The textile instruction system was based on organizational learning techniques, in that concepts embedded in a simple environment were presented first, with the same concepts later presented in progressively more complex environments to stimulate integrative processes. The flexibility of integration involved in information processing would be expected to increase as the environment became richer and presented more diverse information, until an optimal level of functioning was reached (Streufert and Castore, 1968; Suedfeld and Streufert, 1966). If the complexity of the environment were increased beyond this optimal point for individuals, their level of complexity of information processing would tend to decrease.

Decision Rule Complexity

Decision rule complexity should also increase after working through the textile program, as hypothesized, based on Schroder et al.'s information-processing research concerning decision making in complex environments.

A simulated war game was used as a complex problem-solving situation in several studies to test these "U" curve hypotheses in relationship to decision making (Brooks, 1962; Driver, 1962; Karlins, et al., 1965, 1967; Lawrence, 1962; Streufert, et al., 1965a; Suedfeld, et al., 1966). Each team in the game was given the task of making decisions regarding an invasion, and teams were told they were playing against another team. However, all the functions of the opposing team were programmed in order to achieve experimental control over such factors as complexity of feedback and success. Team members could arrive at hypotheses about the enemy and develop strategies on the basis of feedback. One objective index of level of information processing was defined as the number of different connections made between different kinds of feedback and the number of integrations or perspectives generated from a given set of observations in arriving at decisions.

In order to vary the complexity of the environmental input, each team was exposed to seven differing load conditions. The "U" curve relationship between environmental load and diversity and level of information processing was supported. In informationally restricted environments, the integrative processes remained unstimulated. Conceptual properties increased in complexity until reaching an optimal point, and further increases in environmental load beyond this point led to inability to process information effectively (Schroder, 1971).

Using a similar experimental situation, the same relationship was demonstrated to hold between variations in team success and failure and level of information processing when environmental complexity was held constant (Streufert and Streufert, 1967). This finding demonstrates the significance of motivation and affective factors in the environment on conceptual structure. In this experiment two groups of 40 subjects, differing in conceptual level, were selected on the basis of performance on Schroder's Paragraph Completion Test. Individuals in the high conceptual level group used connected multiple rules, while the low conceptual groups were judged to use single or unconnected single rules in responding to the paragraph completion stems in the domain of interpersonal conflict and uncertainty. The results again showed that differences in dispositional conceptual level may be expressed as a family of "U" curves which define the function relating information load and level of information processing in performance. Although not expected, the optimal environmental complexity was the same for both dispositional groups; but in keeping with expectations, differences in information processing between groups were at a maximum in the central ranges of environmental complexity and decreased as the extremes were approached (Schroder, 1971, p. 265).

The results of the experiment do not necessarily imply that dispositional organizational properties generalize from the interpersonal domain (Paragraph Completion Test) to problem solving in a complex strategy game. In setting up the teams and in structuring the situation as a team game, the level of information processing in decision making was a direct function of such interpersonal factors as (1) team members' openness to another's perspectives; (2) the number of perspectives generated; (3) the tendency to study, understand, and use others' perspectives; and (4) the tendency to support others' perspectives (Schroder, 1971, p. 266). Independent studies supported the contention that such tendencies are significantly higher in high dispositional conceptual level teams (Schroder, et al., 1964; Lee, 1968). Another experiment (Suedfeld and Hagen, 1966) showed that high conceptual level subjects were better at solving complex verbal problems, but not at solving simple ones.

In related studies using different experimental settings, it has been shown that high dispositional conceptual level teams, as compared to low conceptual level teams, (1) discover more information about competing teams in intergroup, international, and business simulations (Tuckman, 1964;

Driver, 1962); (2) exhibit higher levels of information processing under stressful competitive conditions in a simulated international simulation situation (Driver, 1963); and (3) engage in more complex information processing when presented with conflicting attitudinal information in a stimulus-social deprivation situation (Streufert, et al., 1965b; Suedfeld, 1963). Sieber and Lanzetta (1964) also noted a tendency for more "abstract" subjects to entertain more conflicting hypotheses in a problem-solving task. Abstract persons were found to be more sensitized to the conflicting cues inherent in complex and uncertain stimuli, and were therefore more highly motivated than concrete persons to resolve uncertainty.

In another related set of studies, Driver (1962) investigated the effect of involvement on information-processing performance resulting from attitudes developed in an international simulation situation. He found that the amount of different and conflicting information integrated in decision making and the level of information processing were highest at a moderate level of involvement. As involvement became either increasingly intense, or decreased from the optimal point, the level of information processing decreased. Evidently, too little involvement fails to stimulate organization processes and reduces the conceptual processes for structuring stimuli. Too much involvement in an issue can reduce the connectedness between and the number of combinatory rules for organizing stimuli (Schroder, 1971, p. 268).

Of the studies in other fields which have investigated the possibilities for developing proficiency in problem solving, one home management investigation was relevant to the current research. Peterson (1963) investigated a ninth grade home economics course which was designed around problem-solving situations. The pupils appeared to gain in ability to recognize important aspects of problem situations, and Peterson proposed that repeated experiences in problem-solving learning experiences would assist students in developing skills of thinking and problem solving. Since programmed instruction capitalizes on the value of repetition in learning, the textile program would presumably aid students in problem solving. Again, there is the consideration of how much repetition is "optimal" for individuals with varying levels of conceptual complexity; a high-level conceptual thinker could possibly become bored.

Although individuals can no doubt benefit from being taught to use decision procedures which lead to satisfactory results, a crucial aspect to improved decision making is the quality, availability, and use of information (Magrabi and Paolucci, 1970, p. 19). The significance of information points to the importance of determining the means by which information can be organized to allow for efficiency in complex decision making.

Brim, et al. found that general values and orientations toward life, together with the cultural background of the respondents, seemed to account for more variability in decision making than the more traditional personality traits (Brim, 1962, p. 234). These findings suggest that environment (information input) does influence decision making, and training environments can be designed to teach individuals to cope with increased conceptual complexity. This research also suggests that people differ in the kinds of problems they are good at solving (Brim, 1962, p. 19), which no doubt relates to the optimal degree of environmental complexity at which an individual can operate, i.e., the "U" curve hypothesis, even with organizational training.

Thus, there is support in the literature for Hypothesis II: After the experience of working through the textile program, the decision rule of decision-making style will become more complex.

Decision Time Orientation

Information-processing theory emphasizes the importance of the structure of information--in McLuhan's terms, "the medium is the message" (1964). The textile program is structured with a future orientation in a manner that students continually are required to project themselves into future time. For example, the objectives are stated from the stance of what the student will be able to do after completing the program; the hypothetical decision situations require future considerations about textile serviceability and end use, and specific frames in the program frequently ask: if________, then________.

As stated at the beginning of this chapter, man is viewed as a controlled behavioral system with inputs of information and outputs of behavior. When information is input in a future frame, behavioral output likewise follows. The view of human behavior as a cybernetic system supports this theory.

In a cybernetic system, human behavior is considered the product of a controlled feedback system. A controlled system implies the presence of a governor (decision maker), and the human being governs or selects responses to information input from among perceived opportunities. When human beings are perceiving, selecting, and controlling, which includes conscious management and decision-making processes, the effects of selected responses are fed back into the system so as to maintain a level of equilibrium. A controlled human system produces a particular quality of equilibrium, not just an equilibrium. The complexity of inputs and outputs is a functional component between the system and its environment, and an adaptive human system is capable of changing goals as it acquires new information about its environment. (This process of coping with changing stimuli and still maintaining balance is known in systems terms as equifinality, rather than as a homeostatic type of equilibrium.) The cybernetic or controlled system, thus, is a primary tool for analyzing goal-directed behavior, which includes management and conscious decision making (Kuhn, 1963, p. 43).

Miller, Galanter, and Pribram (1960) conceptualized another cybernetic model based on the postulate that human beings organize their behavior according to plans. Planning implies consideration of the future. Their notion of a plan is a TOTE model, which represents the simplest type of feedback loop: test-operate-test-exit (Miller, et al., 1960, p. 26).

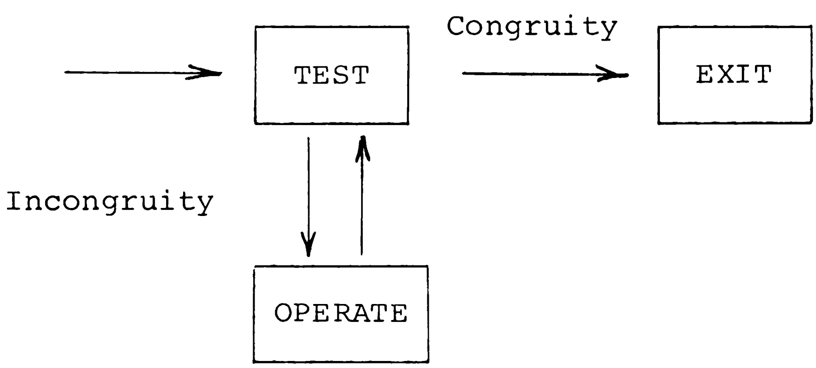


Figure 3.--The TOTE unit.

The plan sequence includes: test for a discrepancy between what appears to be and what should be. If no discrepancy exists, then exit; if there is discrepancy, operate to reduce it; test again, and so on. This TOTE unit is based on what has been called the "cybernetic hypothesis," namely that the fundamental building block of the nervous system is the feedback loop (Miller, et al., 1960, p. 26). Flows in the TOTE unit include energy, information, and control, which

can be related to the view of human behavior as the product of the controlled system presented previously.

Miller, <u>et al.</u> (1960, p. 168) indicated that all people are "cognitive gamblers" to some extent, generally more than is realized. Heuristic plans, rather than systematic or algorithmic plans, are typically followed by individuals in processing information and adapting to environmental stimuli. When a systematic plan is possible, it is sure to work but many take too long, cost too much, or are dull and inefficient (Miller, <u>et al.</u>, 1960, p. 160). Thus, searches for information or a set of alternatives for problem solving are usually heuristic, which may fail to produce the most optimum results, but are quicker and less costly than algorithmic plans.

Simon's satisficing model, in which the first acceptable alternative is followed, would be comparable to following an heuristic plan. Simon stated in one of his reviews of problem solving that "human problem solving, from the most blundering to the most insightful, involves nothing more than varying mixtures of trial and error and selectivity" (Simon, 1969, p. 97). He further indicated that selectivity derives from various rules of thumb. He equated selectivity with some kind of feedback of information from the environment. Two kinds of selectivity were cited: (1) trial and error or heuristic means, where various paths are tried out, the consequences noted, and this information used to guide further search; and (2) that based on previous experience, where the problem to be solved is similar to one solved before.

By viewing the human being as a cybernetic system that processes selectively perceived inputs of information, which result in certain types of behavioral outputs, one could hypothesize that information inputs are related to environmental complexity. Cognitive growth and the manner in which concepts are attained and information processed for future use are related to information organization.

Although no studies were found which examine ways of increasing orientation toward future time, information-processing theory and cybernetic models would indicate that if the information structure is organized in future terms, behavior can be altered to focus on planning and looking toward the future.

Past research which has examined time orientation has supported the value of increasing one's orientation toward the future. Results of the Elgidaily study (1971) of time orientation and activity patterns indicated that individuals who were more future time oriented performed resource-conserving activities more frequently than those who were present or past time oriented; and that younger, more highly educated homemakers tended to be more future time oriented than those who were older and less educated (Elgidaily, 1971, pp. 164-65).

Therefore, the need to design organizational learning environments to increase future time orientation is indicated, and information systematically presented which requires that students consider future consequences would support Hypothesis III: After the experience of working through the textile program, time reference of decision-making style will be more future oriented.

Information Processing Complexity as Related to Elements of Decision Style

This section contains literature about the decision process and how it relates to cognitive and environmental complexity. The discussion is presented in two parts: First, the relationship between information processing and rule complexity is included in support of Hypotheses IV and V; second the relationship between information-processing complexity and time orientation is reviewed in support of Hypotheses VI and VII.

Information-Processing and Decision-Rule Complexity

Hypotheses IV and V concern the relationship between information-processing complexity and decision-rule complexity:

Hypothesis IV: Those who operate at higher levels of conceptual complexity are likely to use more complex decision rules.

Hypothesis V: An increase in complexity of information processing over time will be accompanied by an increase in complexity of decision rule.

Several approaches have been utilized in studying choice and attempting to relate specific decision situations to a broader framework applicable to recurring decision problems. Choice can be studied relative to the <u>decision context</u>, to the <u>characteristics of the decision maker</u>, or to the <u>cognitive processes</u> used in organizing information for problem solving (Magrabi and Paolucci, 1970). Emphasis in this section of the review will be on the last approach, with decision-making behavior viewed in terms of information-processing abilities.

Decision making has been described from many different perspectives in various frameworks, and ambiguities exist in distinguishing decision process from product. Decision making has typically been treated as a sequential process, in which there are clearly distinguishable phases or steps which may overlap and develop simultaneously or at different rates. The following delineation of phases in the decision process is representative of the many listings found in the literature:

(1) Recognize and identify the problem or issue.

(2) Search for information in the problem field (delineate alternatives).

(3) Analyze and sort out the various alternatives perceived (weigh alternatives).

(4) Make choice and execute action.

(5) Justify or legitimize choice has been included as a final stage by some authors.

Research in the area of decision making has typically focused on aspects other than the process, except in the field of home management. In that discipline, however, behavioral theory has received attention, which has yielded research about the decision process that may be compared with information-processing research.

Schomaker (1961) investigated financial decision making, using a rational, sequential model with farm families. She found the steps in decision making were not necessarily sequential, in that the phases were often combined or eliminated. The indication that there is variance in how individuals progress through decision phases using rules of varying complexity, supports the previous body of literature about the differences in how individuals process information.

The process of decision was not conceptualized by Bustrillos (1963) in the traditional manner as a sequential process. Rather than considering phases in the decision process, three elements--mode, time, and rule--were defined as influencing the process. The Bustrillos model, explained previously, was chosen as the framework for this research, since decision-making behavior was viewed as the creative product of an individual's attempt to recognize demands from the environment and blend them with his own needs and desires. The relationship between environmental factors and information-processing levels is of importance in this current research, and a decision model that could be related to complexity was required.

Findings from the Bustrillos study indicated that the elements of style were identifiable in the decision protocols, and the styles varied much more than was predicted. The styles varied with individuals and with the situation; however, the facutal mode, present time orientation, and preference ranking rule recurred at least twice, in responses of more than half of the sample consisting of 16 Mexican homemakers. Results further suggest that the nature of the decision problem might affect the use of elements and therefore, the resulting style (Bustrillos, 1963, p. 122).

Rivenes (1964) replicated the Bustrillos study, using written reports of 36 students enrolled in a college decision-making course. Students were assigned to reconstruct recent decision situations by writing a paper as an outside class assignment. Factual mode and present time reference were the two elements reported most frequently, as with the Bustrillos study. However, the decision-making rule did not appear frequently enough to be analyzed by Rivenes.

Another study was conducted by Hogan (1965) using this behavioral approach to decision style. Results from this study are not entirely consistent with the other findings, perhaps due to cultural differences between the samples. Hogan obtained data on decision-making style from 42 homemakers in two socioeconomic levels and found that decision style of the lower socioeconomic group most frequently consisted of action-suggestive mode, past time reference, and preference ranking rule. Homemakers in the upper socioeconomic

group typically used objective elimination as the most frequent decision rule with a factual mode and past time reference (Hogan, 1965, p. 68). The Bustrillos study indicated that homemakers in lower socioeconomic levels most frequently used decision-making styles which were factual, present time oriented, and based on preference ranking.

Researchers have often preferred to focus on specific phases or steps of the decision process, e.g., the evaluation stage, rather than attempting a holistic approach to studying the entire process. In such process studies, attention has been devoted to studying the behavior associated with various phases of decision making in order to reduce the complexity of the unit of analysis. The advantage of such an approach would perhaps be supported by the findings of Bruner, et al., which suggest that information is more manageable when analyzed or classified in smaller units. However, at some point in time, there is benefit in examining the various phases together, to determine the complexity of information-processing activities involved in decision making.

One phase of the decision process often studied is the way in which individuals claim to evaluate alternatives. Evaluation Process (EP) models, which are based on the assumption that an individual's preference among alternatives will be some function of his preference for the various attributes of each alternative and how important these attributes are to him, have frequently been used for such purposes. EP models are numerous in the normative literature (MacCrimmon,

1968), and they occur also in the descriptive literature sometimes, typically in simulation models.

EP models are useful in analyzing multiple-attribute decision making, and the major EP models which have been generated to date are based on one or more of three notions about the way evaluations are made: additive weighting, lexicographic ordering, or satisficing (Russ, 1971). Bustrillos developed her decision rules, which she considered as only one of the three decision-style elements, from these latter approaches. Yet, the largest portion of the research in the area of evaluation of multiple-attribute alternatives has focused on some form of the additive model, which requires that the decision maker choose the alternative which has the best score on some weighted additive evaluation function.

Recent research, however (Russ, 1971a), indicated that individuals tend to use satisficing, lexicographic ordering, or a combination of the models, rather than additive weighting in evaluating consumer products. Furthermore, "it was clear that subjects were more comfortable and less likely to be irritated when required to provide ranking rather than ratings" (Russ, September, 1971b, p. 5), which are required with the additive weighting model. Although Russ was primarily concerned with predicting consumer preferences, as are most marketing researchers, his findings, as well as those of other researchers in the consumer decision-making area (e.g., Alexis, Haines, and Simon, 1968), support the selection of satisficing, lexicographic ordering, and a

combination of the two, SATISLEX, as decision rules to identify in the current research.

Magrabi (1960) studied cognitive aspects of the decision process using concepts from economic literature. University students were asked to make hypothetical choices concerning the purchase of a second family car, and responses were coded according to the decision rules: satisficing and lexicographic ordering. Ninety-five per cent of the respondents made choices which were consistent with either satisficing or lexicographic ordering, and 14 per cent used the most complex lexicographic rule.

Other examples of behavioral studies related to phases of the decision process include: Bross's (1953) reference to decision "systems" of action; Simon's (1960) "decision-making activities"; and Brim's (1962) studies on the evaluation and strategy phases of the decision process as related to personality characteristics.

Bross studied phases of the decision process as "systems," and he described the deliberating step or weighing of alternatives as the "value system." This system includes evaluation of alternatives in terms of the desirability associated with the outcomes. The final choice phase of the decision process involves the "decision criterion," which serves to integrate knowledge and permit the selection of appropriate action (Bross, 1953).

Simon (1960) described and studied the behavior in the first phase of the decision process as "intelligence

activity," which includes the searching of the environment for conditions that define the problem. His "design activity" characterizes the decision maker's action in the determination of alternatives. This designing results in the invention, development, and analysis of possible alternatives.

Simon believed, however, that decision makers cannot cope with the numerous alternatives in the environment in terms of "optimal rationality." An individual faces an impossibly complex problem if he is completely rational, carefully weighing and evaluating all possible alternatives. The necessity of ignoring enough elements to allow a decision to be made is known as "bounded rationality." As Simon stated (1957):

> The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world --or even for a reasonable approximation to such objective rationality. (p. 198)

Simon believed that the environment possesses properties that simplify a human's choice mechanisms by filtering out certain stimuli. Put in Schroder's model, a concrete processor would tend to filter out more alternatives from his environment than would an abstract processor. Other writers have also expressed this point of view that it is rarely possible to become aware of all alternatives relevant to the decision to be made (Tannebaum, 1958; Shackle, 1961; Wilson and Alexis, 1962).

Problem solving has often been described as a search through a vast maze of possibilities, a maze that describes the environment; and successful problem solving involves searching the maze selectively and reducing it to manageable proportions (Simon, 1969, p. 26). Further, the more difficult and novel the problem, the greater the chance of an increasing amount of trial and error required to find a solution (Simon, 1969, p. 95).

A large part of the literature of decision rationality is not relevant to understanding processing since it concerns classification of decision as to its degree or type of rationality. However, Halliday's (1964) study of the rationality of the decision procedure is of relevance. She defined rational decision making as "a reasoned, information-using way of determining positive guides to action" (Halliday, 1964, p. 9). This concept of rationality applies to the decision process; not to the "goodness" of the choice among alternatives, but whether the choice was determined through a reasoning, weighing process based upon utilized information. Essentially, this approach to rationality relates to the conceptual level of information processing and how environmental complexity is handled. The findings of Halliday's study indicated that those homemakers who evidenced a more rational procedure in their decision making tended to perceive themselves as being able to exercise control over their environments, while those individuals using a less rational approach perceived themselves as being more subject to chance

or fate. The importance attached to the situation, however, was the most significant influence on the amount of reasoning, weighing, and information using done by the respondents in thinking through the hypothetical decisions presented to them.

Although high-level conceptual processors could be expected to exhibit a greater amount of reasoning, weighing, and information-using than low-level processors, the perceived importance of the situation may be a determining factor in how much complex processing is done about a given decision. Since the hypothetical decision situations in the current research study are not "life-changing" or irreversible, complex processors may not be operating at their full conceptual complexity level.

Yet, the potential of high-level conceptual processors to differentiate and integrate increased amounts of information would accompany the use of more complex decision rules which involve evaluation, elimination, and ordering of alternatives. An increase over time in ability to process information at higher levels of conceptual complexity would likewise support an accompanying increase in complexity of the decision rule.

The research reviewed in this section on <u>how</u> decisions are made indicates that individuals use decision rules of varying complexity, based on how information input is selectively perceived and processed.

<u>Information-Processing Complexity and Decision Time Orientation</u>

Hypotheses VI and VII concern the relationship between information-processing complexity and decision time orientation:

Hypothesis VI: Those who operate at higher levels of conceptual complexity are likely to be more future oriented.

Hypothesis VII: An increase in complexity of information processing over time will be accompanied by an increasing orientation toward future time.

Research studies using the Bustrillos model of decision style elements have revealed several significant correlations between mode (the element relating to <u>how</u> ideas are developed) and time reference, which support Hypothesis VI. Rivenes (1964) found significant correlations frequently, between factual mode and present time reference; and between action-suggestion mode and future time reference. In fact, all of the studies which have included the Bustrillos mode of decision style (e.g., Bustrillos, 1963; Velasco, 1964; Hogan, 1965) have supported the relationship between factual mode and present time reference; however, only the Rivenes study had enough future time references to establish any intercorrelations with future time.

The findings of the Elgidaily study (1971) that younger, more highly educated individuals used more future time references than older, less-educated subjects, provides an explanation of why only the Rivenes study contained

significant references to future time. Subjects in the Rivenes study were from a college study population, while subjects from the other studies were homemakers of varying ages, many with limited education.

Nonetheless, from these studies it can be hypothesized that those who operate at higher levels of conceptual complexity are likely to be more future oriented. The recurring relationship between factual mode (which indicates that ideas are stated conclusively with no explicit or verbal relationship between ideas or actions, nor any consequences given) and present time indicates that individuals who think in the present are not processing information at high levels of conceptual complexity. On the other hand, the action-suggested mode, which was found to be associated with future time, indicates that individuals are adaptive and capable of increased conceptual complexity in changing environments.

Hypothesis VII concerning increases over time in complexity of information processing and future time orientation is also supported by the Elgidaily study mentioned above. Since higher educational levels are associated with orientation toward future time, organizational training environments which can increase level of processing complexity (Schroder, 1971) should be accompanied by increased orientation toward future time references.

Further, Kuhn stated (1963, pp. 254-55) that decision making, of which time orientation is an element, is not different from cognitive development and information processing, except that it is an extension of psychological processes into unfamiliar and more complex environments. He maintained that complexity in decision making excludes any stimulus situation to which a reliable response has already been learned. Once an activity has been learned, the identification and selection of response are not complex in the sense involved in decision making. Simple decisions that are made automatically do not require consideration of future consequences, as do complex decisions.

Neisser's distinction between two types of human thinking (1963, p. 2): (1) rational, controlled, and routine, as opposed to (2) irrational, uncontrolled, and creative, can also be tied to greater projections into future time as complexity of decision making and processing increases. The simpler the decision-making situation, the more routinized the process tends to be, making possible a single sequential process for rational thinking; whereas in complex and uncertain environments, there are typically multiple paralled processes interacting with each other, allowing for creative thinking and future projections. As environments increase in complexity and there is the need for increased levels of conceptual complexity in processing information, planning with consideration of future consequences would likely increase.

Planning becomes more apparent and critical as human beings organize their behavior in complex situations. Miller, et al.'s (1960) TOTE unit, introduced earlier in the literature review, considers the benefit of developing Plans in complex problem-solving situations. They maintained that individuals must have ways to generate alternatives, develop Plans; and then to operate on them, test and evaluate (Miller, et al., 1960, p. 169). As did Simon, Miller felt that the more complex the problem, the more likely a heuristic (rather than algorithmic) plan will be used that allows for selective trial and error. The task of an adaptive organism is to find the difference between the state of affairs and the desired state of affairs, and then to find the correlating process that will erase the difference (Simon, 1969, p. 99).

Problem solving requires a continual translation between the state and process description of the same complex reality. Planning is a way of integrating information and decisions on a time dimension--the more complex the information, the more complex the decision process, with attention given to how the future will be affected. There is a growing body of research indicating that human problem solving is basically a form of means-ends analysis that aims at discovering a process description of the path that leads to a desired goal (Simon, 1969, p. 112). To the extent that goal direction is necessarily future oriented, there is a logical relationship between future time orientation and goal-directed behavior.

The condition of any goal-seeking system is that it is connected to the outside environment through two kinds of channels: the sensory or afferent channels, through which the system receives information about the environment, and the motor or efferent channels, through which it acts on the environment. Individuals must have means of sorting memory information, both sensory information and information about actions (motor information), concerning states of the world. This ability to attain goals depends on building up associations, which may be simple or very complex, between particular changes in states of the world (future projection) and specific actions that will bring these changes about (Simon, 1969, p. 66).

In order to study and analyze further how human beings strive to obtain goals in complex environments, computer problem-solving programs have been developed. Perhaps some of the most significant computer simulations in recent years on the processes underlying goal-directed thought are the General Problem Solver (GPS) developed by Newell, Shaw, and Simon (1958, 1960), Newell and Simon (1961); the Geometry-Theorem-Proving machine developed by Gelernter, et al. (1960); and Argus, an information-processing system, formulated by Reitman, Grove, and Shoup (1964).

The GPS system was the forerunner of these types of programs, which were designed to model some of the main features of human problem solving. GPS is a system that searches selectively through an environment, possibly quite large and complex, in order to discover and assemble sequences of actions that will lead it from a given situation to a desired solution. To represent the relation between the sensory and motor worlds, the GPS is conceived as moving through a large maze (Simon, 1969, pp. 66-67).

Simon maintained that man, ". . . viewed as a behaving system, is quite simple. The apparent complexity of his behavior over time is largely a reflection of the complexity of the environment in which he finds himself" (Simon, 1969, p. 52). He continued further, that most of the complex structures found in the world are enormously redundant, and that this redundancy can be used to simplify environmental complexity.

Until complexity is simplified, decision making is not routine. As the environment calls for increased conceptual complexity in processing information for complex decision making, increased orientation toward future time follows. Future consequences are inherent considerations when nonroutine plans and decisions are made.

Summary

A review of the literature in the areas of information processing, cognitive development, and decision process and environmental complexity indicates that there is support for the hypothesized relationships set forth in this study. When man is viewed as a cybernetic system that transforms inputs of information into behavioral outputs, the cognitive structure of the information influences how that information is processed.

Therefore, the programmed cognitive structure used as the information-transmission vehicle in this research would be expected to alter subject behavior in the three variables of interest: (1) information-processing complexity, (2) decision-rule complexity, and (3) decision time orientation. An increase in complexity of information processing and decision rule and an increase toward future time orientation are predicted after working through the programmed cognitive structure, based on past research which indicates that the categorical organization of information in increasing gradations of complexity (i.e., organizational learning) contributes to the efficiency with which information is processed and decisions made.

Relationships among the variables are likewise supported by the literature. Information-processing complexity is hypothesized to be related to decision-rule complexity and time orientation, since past research supports that the conceptual complexity used in processing information contributes to complexity evident in the decision process.

CHAPTER III

METHODOLOGY

College students enrolled in an introductory textile course at Michigan State University were tested at the beginning and conclusion of an academic quarter to determine any changes in (a) information-processing complexity, (b) decision-rule complexity, and (c) decision time orientation. Treatment for this descriptive study consisted of a textile programmed cognitive structure, which was used in conjunction with two multimedia mass lectures per week, and one small-group recitation section.

The development of the textile instructional system is explained in this chapter, followed by a description of the research design and sample for the present study, and the procedures used for examining decision style and information-processing levels.

Treatment: The Textile System

Background

The design of a systems approach to information transfer was initiated in 1968 at Michigan State University as the foundation for development of an introductory textile course. This method of instruction is described as a systems approach because of the carefully organized and tested presentation of information, and because more than one means of developing appropriate student behaviors was used. Three phases of the system have been identified to effect learning behavior: (1) Phase I: the programmed text, which has been developed and tested during the past three years, is the only completed phase and is currently in press with a national publisher (Harries and Harries, 1973); (2) Phase II: a series of film loops, which is planned to provide single-concept illustrations for certain basic textile principles and processes, is scheduled for production in 1973; and (3) Phase III: an instructional game or simulation, which is intended for instructors to use as a teaching tool, is currently under development.

These communication techniques selected to convey the appropriate textile information were developed in cooperation with agencies of the Michigan State University Instructional Improvement Service. A grant of $7,000 was obtained from the Educational Development Program at Michigan State University for the design and development of Phase I of the system, which is the programmed cognitive structure used as the treatment in the current research.*

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*A discussion of the rationale behind selecting the highly structured programmed method for transmitting the information-rich textile content is presented in Chapter I, with the conceptual framework for the study.

Evaluation of Programmed Cognitive Structure

To determine the effectiveness of the sequence of programmed instruction as a learning tool, two groups of students were compared over several quarters: (1) classes studying textiles via multimedia mass lectures, recitation small-group discussions, using a traditional text; and (2) classes studying textiles via the experimental method using the programmed cognitive structure, in conjunction with the multimedia lectures and recitation small-group discussions. Rigorously developed final exams, designed to measure to what extent behavioral objectives of the course were met, were used as a criterion of student performance. Difficulty and discrimination scores from several terms of question usage and development were taken into account in selecting the 50 identical questions that students in both groups answered.

An analysis of covariance was the statistical procedure followed, based upon: (a) grade-point average (covariant) of students prior to their enrollment in the textile course, and (b) performance of students on the final exam in the course. For the purpose of the study, a student's exam score was recorded as the number of correct responses recorded out of the 50 identical questions on both tests. The hypothesis that the "Performance of the Experimental Group will be greater than the Performance of the Traditional Group" was supported beyond the .02 level of significance (T. Harries, 1972).

Since the significantly increased performance of the experimental group was attributable to the programmed cognitive structure, the program is the treatment of interest in this study. The multimedia mass lectures and recitation sessions were structured essentially the same for both groups, and are being used as a part of the textile system only until Phases II and III, the film loops and game, are ready for classroom use.

Since fall quarter, 1969, 75 per cent of the 1500+ students using the programmed materials have earned a 2.0 or better, with more than 40 per cent regularly scoring above a 3.0, when tested against the established performance measures. Less than 10 per cent of the students using the program have made a grade below 1.5. This performance record of students using the systems approach to textile instruction with the programmed cognitive structure is in comparison to the "normal" curve performance record of students who have taken the course via the lecture/traditional textbook method.

Improved performance on exams was not the only benefit; student evaluations demonstrated that over 80 per cent of the class were approving of the system, with less than 5 per cent overtly negative. Student ratings of the course increased significantly over ratings taken when a conventional text was used. A detailed study has been conducted of student attitudes and personality factors (locus of perceived control and intrinsic/extrinsic motivation), as related to information-processing levels and to this particular method of instruction (T. Harries, 1972).

Assumptions

Assuming that the textile programmed cognitive structure increases the number of correct decisions on exams in an introductory textile course, based on past experience with the program, the manner in which decision styles and information-processing levels are altered is the research question of interest. A review of past behavioral studies in the area of decision making (Magrabi and Paolucci, 1970) and information processing (Schroder, et al., 1967, 1971) supports the feasibility of the current study, in that the effect of information organization can be analyzed and evaluated. Therefore, the following assumptions were accepted and underly the design of the study:

1. The programmed sequence of textile information improves student performance on textile exams.
2. Valid and reliable measures exist to determine levels of complexity of information-processing and decision-making styles.

Research Design

All students enrolled in an introductory textile course were exposed to the same treatment, a programmed cognitive structure, since past research has indicated that the textile system of instruction is a more effective means of transmitting information content than the traditional method of instruction.

Pretests and posttests were designed, using both textile and nontextile stimuli, to measure the three criterion variables of interest: (1) information-processing complexity, from the Schroder, et al. information-processing model; (2) decision time reference and (3) decision-rule complexity, elements from the Bustrillos model of decision style. The measures were differentially administered to two groups of students:

Group I, which contained two-thirds (90 students) of the 150-member class in the study, received both pretest and posttest measures.

Group II, which consisted of one-third (60 students) of the class, received posttests only, to determine if the pretest measures had a sensitizing effect on posttest results.

The two groups were assigned according to recitation sections;* three recitation sections were assigned to Group I, and the remaining two recitation sections to Group II. The Group II students, who were designated to take only the posttest measures for evaluating decision style and information-processing level, received a placebo pretest consisting of personality measures which were unrelated to the measures used to examine the criterion variables. The design for the data collection is represented in Figure 4.

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*Recitation sessions are the smaller subdivisions (30-35 students) of the large class, which meet once weekly to allow for discussion of content presented in the two mass lectures per week and of the programmed cognitive structure the students have worked that week.

		PRETEST						POSTTEST					
		Information-Processing Complexity		Decision Style				Information-Processing Complexity		Decision Style			
				Time Reference		Decision Rule				Time Reference		Decision Rule	
		Nontextile	Textile	Nontextile	Textile	Nontextile	Textile	Nontextile	Textile	Nontextile	Textile	Nontextile	Textile
Group I (Experimental Sample)	S_1, S_2, S_3, . . . S_{90}												
Group II (Control)	S_{91} . . . S_{150}	PLACEBO TREATMENT											

Figure 4.--Design for the data collection.

Selection of the Sample

Students enrolled in an introductory textile course at Michigan State University (HED 171) were selected as the population for this study, since successful performance in the course requires that decisions be made based on information input of increasing complexity. The subject matter in the course progresses in complexity from simple, basic terminology presented first, to the consideration of various component factors which comprise textile products, through to the final level where integration of components is required in making textile decisions for maximum serviceability in specific end uses.

Further basis for selecting this particular group of subjects was the programmed cognitive structure systematically developed and tested over the past several years (as explained previously), which has the following characteristics: (1) highly structured environment; (2) rich in information content; and (3) information organized in gradations of increasing complexity, in which experiential referents are paired with textile data initially, with experiential referents phased out and replaced by an increasing hierarchy of textile symbols and referents. A carefully designed system of information organization, which has potential for organizational or process learning, was required to determine possible educational practices that influence how individuals think.

Lastly, this sample was deemed appropriate for study because the 150 students in the course provided adequate subjects for sampling and analysis. Of the 90 Group I students receiving pretest and posttest measures, a random sample of 50 was drawn for data analysis; and of the 60 Group II students receiving only the posttest measures, 25 were randomly selected for analysis. A description of demographic characteristics of the sample follows.

Description of the Sample

Demographic data were collected from all subjects to establish the constituency of the textile class. (See Appendix A for "Background Information" cover sheet used with the pretest measures.)

Comparison of Groups I and II

To determine how comparable the samples were from Groups I and II, chi squares were run on the nominal descriptive data, and a multivariate analysis of variance on the continuous descriptive data. The results in Table 1 and Table 2 indicate that the two groups were similar on all descriptive characteristics.

Since the two groups of subjects were comparable with respect to demographic data, and because Group I was used for hypothesis testing, frequency counts of demographic characteristics are presented only for Group I. Group II, composed of subjects who took only posttest measures of the criterion variables, was included in the research design to determine if pretests were sensitizing posttest results; these subjects were not suitable for the hypothesis testing, which required the use of gain scores for part of the analysis.

TABLE 1.--Chi square test of nominal descriptive data.

Variable	Chi Square Value	C at .01 Significance	DF
Class in School	2.178	11.345	3
Major	9.121	18.475	7
Marital Status	1.562	9.210	2
Student's Occupation	2.114	15.086	5
Father's Occupation	14.675	20.090	8
Mother's Occupation	8.558	20.090	8
Has Completed FE 331 (Decision-Making Course)	.309	6.635	1

TABLE 2.--Multivariate analysis of continuous descriptive data.

F-ratio for Multivariate Test of Equality of Mean Vectors = 1.4672; D.F. = 6 and 65.0000; P<0.2035

Variable	Univariate F	P<
Grade-Point Average	0.204	0.653
Age	0.527	0.470
Hours Employed/Week	0.103	0.749
No. in High School Graduating Class	1.252	0.267
Credit-Hour Load	5.637	0.020
Hours Sleep in Past 24	0.022	0.882

Degrees of Freedom for Hypothesis = 1
Degrees of Freedom for Error = 70

Demographic Characteristics of Group I

The demographic data of the random sample of 50 from Group I are included to provide the reader with the general characteristics of subjects used for hypothesis testing; however, there is no design over subjects in this particular study, and the data are not analyzed according to these descriptive characteristics.

Class in School, Age, Sex, Marital Status.--Of the 50 students randomly selected for Group I, a majority of them were the typical types of students enrolled in lower-level, undergraduate courses in the Department of Human Environment and Design. Freshmen and sophomores accounted for 88 per cent of the sample, with 42 per cent from the freshman class and 26 per cent from the sophomore class. Juniors and seniors accounted for 24 and 8 per cent, respectively. Most of the sample fell in the normal age range for college students: 56 per cent were 17-19 years old, 34 per cent were 20-21, and 10 per cent were 22 and over. Table 3 illustrates the distribution by age and class in school.

TABLE 3.--Age and year in college.

Year in College	Age							Total
	17	18	19	20	21	22	23 or more	
Freshman	2	15	3	..	..	..	1	21
Sophomore	..	..	8	3	1	1	..	13
Junior	..	..	..	10	..	1	1	12
Senior	..	..	..	1	2	..	1	4
Totals	2	15	11	14	3	2	3	50

The sample was primarily female, with only one male. Ninety per cent were unmarried, with the single male in the unmarried category, and 5 per cent were married females. Juniors and senior accounted for four of the five married students. (See Table 4.)

TABLE 4.--Marital status and class in school.

Class in School	Marital Status		
	Married	Single	Total
Freshman	1	20	21
Sophomore	..	13	13
Junior	2	10	12
Senior	2	2	4
Totals	5	45	50

Major and Grade-Point Average.--Majors represented in the College of Human Ecology are itemized separately, while "no preference" and "other majors" are the remaining grouped categories. Seventy-four per cent of the students in the sample are majors in the college, and the other 26 per cent have named majors outside the college or indicated "no preference." In Table 5 the percentages by major are presented, with the average grade-point average of subject by major. Table 6 shows the grade-point average by class in school.

TABLE 5.--College major and average GPA by major.

Major	Number of Students	Per Cent of Sample	Average GPA by Major
Retailing Clothing and Textiles	14	28	2.66
General Clothing and Textiles	5	10	2.89
Interior Design	9	18	2.70
General Home Economics (Human Ecology)	3	6	3.08
Community Services	4	8	2.78
Home Economics Ed.	2	4	2.90
No Preference	6	12	3.20
Other Majors (Outside College)	7	14	3.30
Totals	50	100	

TABLE 6.--Average GPA by class in school.

Class in School	Number of Students	Per Cent of Sample	Average GPA
Freshman	21	42	2.93
Sophomore	13	26	2.89
Junior	12	24	2.74
Senior	4	8	3.12
Totals	50	100	

Student Occupation.--The number of credit hours a subject was enrolled in and hours of employment per week were obtained to gain insight into how time was allocated, and possibly to determine if fatigue or "overload" were a factor in completing measures. The largest proportion of the sample, 64 per cent, was in the full-time student, unemployed category. A breakdown of student occupations and average credits enrolled in is presented in Table 7.

TABLE 7.--Student occupation.

Student Occupation	Number of Students	Per Cent of Sample	Average Credit-Hour Load
Full-time Student Unemployed	31	62	15.4
Full-time Student Employed On Campus	10	20	15.7
Full-time Student Employed Off Campus	5	10	14.8
Part-time Student Unemployed	1	2	11.0
Part-time Student Employed Off Campus	1	2	10.0
Part-time Student Housewife	2	4	7.5
Totals	50	100	

Only four students were enrolled for less than 12 credits, the minimum load for regular or full-time student status. The largest number of students was enrolled for

14 credits, with 15 and 16 credits accounting for a sizeable proportion, too. The credit loads are represented in Table 8.

TABLE 8.--Student credit-hour load.

Student Credit Hour Load	Number of Students	Per Cent of Sample
7-11 Hours	4	8
12-13 Hours	2	4
14 Hours	14	28
15 Hours	10	20
16 Hours	10	20
17 Hours	6	12
18-20 Hours	4	8
Totals	50	100

Environmental Factors.--The occupation of the parents and size of the subject's high school graduating class are reported herein to provide the reader with information about the environment in which the subject was raised, and to provide a basis for comparison with other university student populations. (See Tables 9 and 10.)

Instrumentation: Development of Measures

Measures for determining decision-making style were adapted from the Bustrillos hypothetical decision situation techniques (1963) and related follow-up research. Schroder,

TABLE 9.--Parent's occupation.

Occupations	Father's Occupation: Number of Subjects	Father's Occupation: Per Cent of Sample	Mother's Occupation: Number of Subjects	Mother's Occupation: Per Cent of Sample
Professional	3	6	1	2
Public Education/ Service	2	4	4	8
Agriculture	5	10	0	0
Housewife	0	0	31	62
Skilled Worker	11	22	4	8
Semi-skilled Worker	1	2	1	2
Unskilled Laborer	0	0	1	2
Clerical	2	4	5	10
Business--Sales	8	16	3	6
Business-- Management	15	30	0	0
Totals	47*	94*	50	100

*Three fathers deceased.

TABLE 10.--Size of sample's high school graduating class.

Number in Graduating Class	Number of Subjects	Per Cent of Sample
1- 99	5	10
100-299	12	24
300-499	14	28
500-599	11	22
600-999	6	12
1000+	1	2
No Data	1	2
Totals	50	100

et al.'s Paragraph Completion Test (1967) was used to determine level of integration of information processing. Both procedures were modified to include opportunity for textile decision making and for textile information processing, since past research has indicated that decision making tends to be situation-specific and information-processing levels are related to subject-matter domains.

In addition to the textile measures used, nontextile decision situations and paragraph completions were included to determine if any increase in information processing or decision-making complexity carried over into cases which were not specifically covered in the programmed cognitive structure. Further, nontextile stimuli have been used in the above-mentioned studies, and were a more direct replication of past research.

The measures used in the study were revised and decided upon, based on the extent to which they:

1. Elicited responses which reveal or display characteristics intended to be measured.
2. Yielded a level of the characteristic which does not vary or fluctuate across responses as a result of:
    a. Order of presentation of stimuli (measures are to be administered randomly).
    b. Age of respondent within range of 17 to 30.
    c. Mood or immediate past experiences of respondent: fatigue.

3. Elicited responses which discriminate among subjects.
4. Could be adequately responded to in less than 50 minutes per test session.

Pilot Study to Test Measures

Fall quarter, 1971, preliminary versions of all measures were administered to determine the extent to which the above criteria were met. Decision style and information-processing measures were administered at the same time and under the same conditions to two groups of students: (1) to 48 students who had never had any college-level textile courses (to represent the population in the pretest situation of the study), and (2) to 50 students just completing HED 171 (to represent the population in the posttest situation).

Paragraph Completion Test Pilot.--The Paragraph Completion Test (PCT) developed by Schroder, et al. (1967) has been successfully replicated in numerous studies using high school and college student populations, and found to be a reliable measure of level of integration of information processing in the interpersonal uncertainty domain. Schroder reported that scorers familiar with the theoretical variables can be trained in about four days of concentrated work to reach satisfactory reliabilities of .80 - .95 (Schroder, et al., 1967, p. 190).

Six of Schroder's paragraph completion stems were exactly duplicated to represent nontextile stimuli, and six textile stems very similar to Schroder's stimuli were developed. Each subject was asked to respond to six stems at a given test situation (three textile and three nontextile stimuli).

The stems were slightly modified, based on coding results; samples of the finalized pre and post PCT used in the study are included in Appendix A.

Decision Measures Pilot.--Six hypothetical decision situations were developed for pretesting, three nontextile situations and three textile situations. The situations used in previous decision-making studies (Bustrillos, 1963; Halliday, 1964; Velasco, 1964; and Hogan, 1965) were evaluated and adapted to suit the college student population under study, composed primarily of nonmarried female, undergraduate students.

Variations in the previously used hypothetical situations were required, since subjects in related past studies were homemakers rather than college students. Further, low-incomes, limited formal education, and ethnic considerations (Bustrillos' population was composed of Mexican homemakers and Velasco's of Filipinos) were factors considered in revising former hypothetical decision situations, which were not appropriate to the current population. Probe questions were also revised and developed to generate responses which would be relevant enough to generate codable responses from the college student population.

Each subject participating in the pilot study responded to two decision situations: one involving textile information, and the other, nontextile information. Six situations were tested in all, three textile and three non-textile problems, with the intent of selecting the four situations (two in each subject category) which elicited the most-codable responses. The four hypothetical decision situations selected as yielding the most-codable results are included in Appendix A, in the format used in the test situation.

Data Collection

The revised Pilot Study measures, included in Appendix A, were administered during winter quarter, 1972, to students enrolled in an undergraduate textile course (HED 171) at Michigan State University. The pretest and posttest data collection periods are described below.

Pretest Situation

During the first recitation period of the quarter, subjects responded to a designated set of measures. Students in the three recitation sections designated as Group I received paragraph completion stems designed to measure information-processing complexity, and hypothetical decision problems designed to determine decision rule and time reference. Students in the two recitation sections designated as Group II, established as a type of control, received placebo measures relating to personality factors.

The recitation periods, in preference to the mass lecture section, were chosen for administering the pretests and placebo measures, since the PCT required 120-second interval timing and the personality measures did not. To prevent any Hawthorne or sensitizing effects, the subjects were not to know that different measures were administered.

The entire 50-minute recitation period was devoted to the pretest data collection. The development and history of the textile system of instruction were briefly explained to the class, and students were told that they would be participating in a study winter term to evaluate further the programmed sequence of instruction. They were encouraged to answer all measures as thoroughly as possible. However, they were assured that there were no right or wrong answers, and that grades would not be assigned to the responses. Further, it was emphasized that the grade they received in the course would not be influenced by their performance on the measures.

Before timing for the test began, the students were asked to use all the time allowed for completing each phase of the measure, and they were asked to remain in their chairs until the papers were collected at the end of the period. The measures were then distributed, and five minutes were allotted for students to read the instructions. Questions were called for, but none was asked. The subjects were then requested to fill out the "Background Information Sheet," which was the first page of the pretest.

All subjects who took the decision style and information processing pretest measures responded first to the paragraph completion stems, and second to the decision situations. However, ordering within the stems series and of the decision situations was systematically varied so that no one stem nor decision situation consistently occurred first, and each arrangement occurred an equal number of times.

Each subject responded to six paragraph completion stems, three containing textile stimuli and three with non-textile stimuli. One half of the sample received the "Y" series, and the other half received the "X" series (subjects received the opposite series on the posttest); there were no stems duplicated from one series to the other, and order of the stems was rotated. For example, the stems were sequenced according to the following format: X-1, X-2, X-3, X-4, X-5, X-6; then X-2, X-3, X-4, X-5, X-6, X-1, and so on.

Each subject responded to Part Two of the test, the Decision Style Measure, by answering the four probe questions for both a textile and a nontextile hypothetical situation. One-half of the subjects received an A-1 textile situation, the other half the A-2 textile situation; likewise, half of the students received the B-1 and the remainder the B-2 non-textile situation. (Again, situations were reversed for all subjects on their posttest.) "A" and "B" situations were combined and ordered in all possible ways; for example, an equal number of subjects received the following ordered combinations: A-1, B-1; A-1, B-2; A-2, B-1; A-2, B-2; B-1, A-1; B-1, A-2; B-2, A-1; B-2, A-2.

Posttest Situation

The last class meeting winter quarter of the mass lecture period was selected for administering the posttest measures. Since all subjects were receiving similar measures that required the same timing, the mass lecture period was used rather than the five small-group recitations, in the interest of keeping the situation similar for the group.

Students were directed to sit by recitation sections at the posttest session, and were told the reason was to make distribution of tests efficient. All students received a test package with their student numbers on the cover sheet. This procedure was necessary to insure that no subject received a repeat decision situation or paragraph completion stem. For example, if a subject received an "X" PCT series on the pre-test, he received "Y" series on the posttest. If he received an A-1, B-2 combination and ordering on the pretest, a B-1, A-2 arrangement was administered on the posttest. The students who received the personality measures for the pretest were systematically assigned an equal number of situation combinations and processing series.

Make-up Measures

All students enrolled in the course were required to take all measures. For those who were absent when the class took the measures, make-up sessions were established. However, subjects who took the make-up measures were not included in the population when the random sample was drawn for data analysis.

Coding Procedures

Information-Processing Coding

Scoring Manual.--A structural scoring manual (Schroder, et al., 1967, 1969), developed and validated for coding responses to the Paragraph Completion Test (PCT), was available to use in determining level of integration of information processing. Since the manual is based on the scoring of processing structure in the uncertainty interpersonal domain, rather than content, there were no manual revisions necessary for scoring the textile stems added to the original PCT for this study. See Appendix B for a representative sample of the PCT Scoring Manual.

Coders.--There was no need to train and familiarize coders with the theoretical framework and structural scoring procedures, because experienced coders trained by the Schroder Group at the University of Southern Illinois agreed to score the paragraph completion responses.

Scoring.--Each subject was asked to respond to six paragraph completion stems on the pretest, and a different six on the posttest. All twelve of the paragraph completions were scored on a one to seven scale, representing level of integrating of information processing. The lower the score, the lower the level of complexity of information processing. Each of the seven designated levels is explained in detail in the Scoring Manual (Schroder, et al., 1967, pp. 186-196; Phares and Schroder, 1969).

Three stems in each set of six paragraph completions were textile stems, and three were nontextile stems, as can be observed from the sample protocol in Appendix A. Following Schroder's procedures for determining the final score representing level of information processing, the top two values given each set of stems were summed. Thus, to determine level of textile information processing on the pretest, the top two out of three textile scores were summed and the top two out of three nontextile scores were summed.

Schroder recommends taking the top two scores in a set of paragraph completion stems, due to the repetitive and somewhat boring nature of the Paragraph Completion Test (Schroder, et al., 1967, p. 195). Further, he now recommends adding scores rather than averaging, to broaden the range of scores (Phares and Schroder, 1969).

Each subject, therefore, ended up with four summed scores representing the level of integration of:

Pretest--Textile Information Processing

Pretest--Nontextile Information Processing

Posttest--Textile Information Processing

Posttest--Nontextile Information Processing

Decision-Style Coding

The Coding Manuals developed for scoring time orientation and decision rule are found in Appendices C and D. The procedures used for selecting and training decision-style coders, and for developing the coding manual are described in this section.

Coders.--Two coders were selected for this study, with the understanding that they would code both decision time and rule variables for the pretests and posttests. They were told that several days of training were required for each variable, and that the same individuals needed to stay with the project and code all data.

The coders were further chosen based on varying backgrounds and experience, since one purpose of this study was to develop a coding manual which could be used to allow:

1. Any researcher trained in use of coding manual procedures to classify responses in the same way.
2. Resulting classifications which display the characteristics intended to be measured.
3. Resulting classifications which are independent of situations or content used as stimuli.
4. Resulting classifications which adequately discriminate between levels of characteristic.

Descriptions of the two coders further illustrate the "test" of the manual for use by varied researchers:

1. Coder One was 65 years old and just retired from a long and varied teaching career, including experience with numerous subjects from grade school through college. She had two Masters degrees and several years

of post-graduate work. She was from the South and had a conservative orientation to life.

2. Coder Two was 22 years old and a recent college graduate, with an undergraduate multidisciplinary social science degree. She had not yet been able to obtain regular employment, and had little work experience, with no teaching experience. She was from the North and had liberal views.

A general orientation to introduce the coders to the study involved their reading Chapter I of the present thesis, and discussing the research with this writer to clarify and examine further the coders' roles. Both coders were extremely competent, dedicated to the project, and quick to internalize what was expected of them.

An intercoder reliability of 90 per cent was set as a goal to reach before beginning to code the sample data, and the goal was reached after three days of intensive training on each variable. Although a high intercoder reliability was obtained, there continued to be some recurring difficulties based on the backgrounds of the coders; the problems specific to coding each variable are discussed in the following two sections.

Time-Orientation Scoring. After reviewing manuals which had been used in past studies and reading descriptions of problems encountered, a preliminary coding manual delineating eight categories of time orientation was developed to use in training coders. Former manuals typically included provision for categorization of only past, present, or future time orientations. From working with the pilot study data and reading research reports of problems in not having categories which allowed a combination of those three categories, the following scale was initially proposed to allow for finer discrimination in time coding: (1) Distant Past, (2) Recent Past, (3) Past/Present, (4) Present, (5) Present/Future, (6) Near Future, and (7) Distant Future. Criteria for coding in each category are explained in detail in the Time-Orientation Coding Manual, included in Appendix C.

Additions were made to the manual to describe further the various time categories, based on coder training and their work with the pilot data. An eighth category was deemed necessary, and was developed to include those time references to future occurrences based on past experiences. The coders quickly progressed to the degree that they could agree on a particular time orientation, <u>if</u> they used the same unit of analysis.

The next phase of training was, therefore, devoted to determining the "smallest unit of analysis which had a time referent," as was specified by the manual. A word, phrase, clause, or even a sentence was sometimes found to be the smallest analyzable unit, and a final description of how the coders arrived at their breakdowns is included in the manual instructions, included in Appendix C.

A coding sheet was devised after the pilot data were coded, to provide a uniform format for coding and to allow the averaging of time scores separately for the textile and nontextile situations. A sample of the coding sheet is also included in Appendix C, immediately following the Time-Orientation Coding Manual.

With the revised coding manual and the coding sheets, the coders then scored 20 additional protocols, this time from the actual population but not the sample selected for analysis. Discrepancies in coding were discussed, and agreement was so close that scoring of time orientation for the 50 pretest papers was begun on the fourth day of work.

Time coding of the pretest protocols went smoothly, except for some differences encountered throughout, about how past experience was evaluated in determining final score. Coder One had a somewhat different view of past experience references than did Coder Two, no doubt due to variance in age. They did reconcile differences, though neither was completely convinced of the other's stand on the relationship between past experiences and present or future decisions. Further, Coder One was somewhat troubled by giving "low" time orientations to individuals she thought were making "good" use of the past experiences in making decisions. Her years of experience as a teacher continued to show through, in that she associated a low score with low grading. Repeatedly, it was emphasized that the students were <u>not</u> being graded or even scored on the "goodness" of content of the protocols, but rather on the <u>process</u> used. The end result of pretest scoring, however, still yielded high intercoder reliability between the coders: the average difference of time scores for the textile situations was .261, and nontextile situation scores averaged a .276 discrepancy.*

Upon completion of pretest coding of time orientation, training for coding rule was initiated. The pretest and posttest protocols were scored for decision rule before returning to the scoring of time orientation for the posttest. To check that the coders were still together before beginning posttest time scoring, three protocols were scored by each coder, and discussed among the coders and the researcher. The coders continued to be within the same range as on the pretest coding; thus, posttest coding was begun and proceeded very smoothly, even more so than coding of the pretest data. At the conclusion of posttest coding, the average difference between coders on the textile protocols was .247, and the nontextile situations were scored to within .217; both average differences, therefore, totalled less on posttest coding than on pretest coding. The total average discrepancy between the two coders for all of the time coding was .244.

To check further the reliability of coding, later time scores were compared with earlier ones, and pretest and posttest scores were compared under masked identification. At no time were the respondents identified or grouped according to any characteristic.

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*Formula for computing average time scores:

$$\frac{\text{total of all time scores for a decision situation}}{\text{number of clauses or phrases coded in that situation}}$$

Decision-Rule Scoring.--A preliminary coding guide was developed for classifying a subject's decision rule, again building upon coding manuals which had been used in the past. As was done with the time variable, additional categories beyond those used in former manuals were incorporated into the rule coding manual. The following categories were specified for rule coding at the beginning of coder training: (1) Immediate Closure, (2) Satisficing, (3) Lexicographic Ordering, and (4) SATISLEX. Criteria for each category are included in the rule section of the Coding Manual, included in Appendix D.

After the coders mastered the different types of decision rules and completed the first round of practice coding, they suggested separating the lexicographic ordering rule into two categories to differentiate between an ordering involving many alternatives and one involving few alternatives. Both coders had difficulty in giving a score of "three"--both to a subject who had used some ordering words, but had not generated alternatives, and to a subject who had generated many alternatives, comparing and ranking them, too. Thus, an additional category was added, changing the scale to: (3) Lexicographic Ordering of Few Alternatives, (4)Lexicographic Ordering of Many Alternatives, and (5) SATISLEX, which remained the most complex rule.

The unit of analysis for rule coding was the entire protocol, with question four, "If you were making this decision, how would you choose among your generated alternatives?"

developed to focus specifically on the rule used in the decision process. However, if the subject did not indicate the "how" under question four, the coders studied responses to the preceding questions to uncover any evidence of rule in how the subject generated alternatives, compared or ranked them, and selected among them. In only two protocols were there so few evidences of rule that the subject received a zero, indicating an unclassified, noncodable response.

A Rule Coding Sheet was developed to provide a uniform format for coding decision rule, which allowed space for an explanation of why a certain rule was designated. A copy of this sheet is included in Appendix D, immediately after the Rule Coding Manual.

During three days of intensive training sessions for coding rule, the coders scored all of the protocols available except the actual sample. A small group of protocols was scored by each coder and then the protocols exchanged. Discrepancies were then examined and discussed between the coders and with the researcher, and differences reconciled. As a result of discussion and clarification, additions were made in the manual, further delineating criteria for the different rules.

A problem occurred of coders viewing decision making from different perspectives, as was the case with time coding. However, there were increased problems in resolving rule scoring than time scoring. With time scoring, the two scores could be slightly different, and averaged for the data analysis. However, the rule scores were not averageable, and agreement had to be reached.

Scoring difficulties appeared to revolve around the concept of "grading" a subject. Coder One continued to feel that a "good" job of satisficing deserved a higher score than a "bad" or "weak" job of lexicographic ordering. Again, the concern with decision process in this study, rather than content, was stressed. Due to this problem, there were some discrepancies occurring between a score of two versus three. The differences were generally reconciled through discussions, and the discrepancies lessened as coding progressed.

Another problem area was with the SATISLEX rule. Coder Two had difficulty in perceiving a protocol which rated a five, although she would see the reasoning after discussions. She was more likely to score the protocol a three or four, picking up the ranking, but not the elimination of certain alternatives before ranking. On the other hand, Coder One saw some fives as a result of a subject's clear statement of preference for one alternative over the others; she felt that in some instances (depending on wording) low preference alternatives were, in fact, eliminated, though the subject did not always clearly state an elimination.

When agreement was consistently reached in nine out of ten protocols, coding of the sample data began. Pretest and posttest protocols were mixed to increase coding reliability, and later scores were compared with earlier ones to insure that scores continued to be consistent. As with time, respondent identity was masked.

The coders scored the sample data independently, and then discussed the instances in which discrepancies occurred. In a majority of situations, they reached agreement; in the remaining cases, the researcher made a judgment.

Data Analysis

After scoring was completed, data from the measures and demographic data on each subject were transferred to data-processing cards for use in statistical analyses. A summary chart of statistical treatment is presented in Table 11.

Multivariate procedures were selected for hypothesis testing in this study, since such an analysis allows examination of multiple variables which have potential relationships. Advantages of multivariate methods are that they address general questions of relationship and discrimination, and that they consider several measures simultaneously and can, therefore, ask a somewhat broader question than univariate conterparts. Further, if a series of univariate tests were run, an inflated alpha level would result. The multivariate approach is reported to be profitable when the theoretical constructs benefit from being broken down into their components, and when the interactions among dependent as well as independent variables are of interest (McCall, 1970).

TABLE 11.--Summary of statistical treatment of data.

Purpose of Analysis	Sample	Data	Statistical Test	Results Reported
<u>Sample Description</u>				
Comparison of characteristics of experimental sample with placebo group	Groups I and II	Demographic Data	Chi square*,**	p. 69
			Univariate analysis of variance†	p. 69
Description of experimental sample	Group I	Demographic Data	Frequency count, percent, mean*,**	pp. 70-75
<u>Test for Effect of Pretest</u>				
Check to see if pretest measures influenced posttest results	Groups I and II	Posttest scores of information processing, time orientation, and decision rule of both experimental and placebo samples	Multivariate analysis of variance of posttest scores†	p. 97
<u>Hypothesis Testing</u>				
Hypotheses I, II, III	Group I	Gain scores from pretests to posttests on information processing, time orientation, and decision rule	Multivariate analysis of gain scores†	p. 98
Hypotheses IV, VI	Group I	Pretest and posttest scores of information processing, time orientation, and decision rule	Pearson Product-Moment Correlation†	pp. 110, 113
Hypotheses V, VII	Group I	Gain scores from pretests to posttests on information processing, time orientation, and decision rule	Pearson Product-Moment Correlation†	pp. 112, 116

*Leighton A. Price and James L. Peterson, A New CISSR Library System, A Preliminary Report on the Overlay II System, Technical Report 70-2 (East Lansing, Mich: Michigan State University, 1970); A File Building Routine for the New 6500 CISSR Library System, A Preliminary Report, Technical Report 70-3 (East Lansing, Mich: Michigan State University, 1970); Control Cards for Programs on the New 6500 CISSR Library System, A Preliminary Report, Technical Report 70-4 (East Lansing, Mich: Michigan State University, 1970).

**Alan M. Lesgold, Bob Zerby, and Glenn Foster, Analysis of Contingency Tables, ACT II, Technical Report No. 14.1, Computer Institute for Social Science Research (East Lansing, Mich: Michigan State University, 1969).

†David J. Wright, Jeremy D. Finn's Multivariance--Univariate and Multivariate Analysis of Variance and Covariance: A FORTRAN IV Program, Occasional Paper No. 8, Office of Research Consultation, College of Education (East Lansing, Mich: Michigan State University, 1970).

The results of the data analysis of sample characteristics were presented earlier in this chapter under Description of the Sample"; the remaining statistical results used to answer the hypothesized relationships are reported in the next chapter.

CHAPTER IV

RESULTS AND DISCUSSION

<u>Time orientation</u> and <u>decision rule</u>, two elements of decision style, and <u>information-processing level</u> of college students enrolled in an introductory textile course at Michigan State University were measured at the beginning and conclusion of an academic quarter. A multivariate analysis of variance procedure was used to test Hypotheses I, II, and III, to determine if there were significant gains at the end of the quarter in (1) information-processing complexity, (2) decision-rule complexity, and (3) orientation toward future time. A correlational analysis was used to test Hypotheses IV, V, VI, and VII, to determine if there were significant relationships among the variables.

The results are reported and discussed in this chapter by hypothesis, under three sections: (1) Test for Effect of Pretest; (2) Gain Scores of Information Processing, Time Orientation, and Decision Rule; and (3) Correlations Among Information Processing, Time Orientation, and Decision Rule.

Test for Effect of Pretest

The class population of 150 students was divided into two groups to determine if pretest measures were influencing posttest results. A multivariate analysis of variance was run on the posttest scores of the 50 randomly selected students from Group I, the experimental sample, and the 25 randomly selected students from Group II, the sample receiving placebo pretests.

The null hypothesis that: Posttest results of the experimental sample will be comparable to posttest results of the placebo sample was accepted (p<0.3266). The results, depicted in Table 12, indicate that the pretest did not sensitize subjects' responses on the posttest.

TABLE 12.--Multivariate analysis of posttest scores.

F-ratio for Multivariate Test of Equality of Mean Vectors = 1.1815; D.F. = 6 and 68.0; P<0.3266

Variable	Univariate F*	P<
Textile Processing	2.1054	0.1511
Nontextile Processing	1.1853	0.2799
Textile Time	0.5233	0.4718
Nontextile Time	4.2152	0.0437
Textile Rule	0.4081	0.5250
Nontextile Rule	0.0560	0.8137

Degrees of Freedom for Hypothesis = 1 N = 50
Degrees of Freedom for Error = 73

*The univariate tests have inflated alpha values, but do show contributors to over-all multivariate analysis probability level.

Gain Scores of Information Processing, Time Orientation, Decision Rule

The results of the multivariate analysis of gain scores indicate that there were over-all gains on posttest scores over pretest scores, with a reported probability of less than 0.0026. Thus, the general null hypothesis that gain scores were not significantly different from zero was initially rejected.

To determine which variables were contributing to the over-all significance of gain scores, the univariate tests were examined, realizing that they had inflated alpha levels. Table 13 shows that the over-all significance in gain scores was attributable to the information-processing and time-orientation variables, whereas the rule variables did not contribute significantly to over-all gain levels.

TABLE 13.--Multivatiate analysis of gain scores.

F-ratio for Multivariate Test of Equality of Mean Vectors = 4.0583; D.F. = 6 and 44.0; P<0.0026

Variable	Univariate F	P<
Textile Processing	6.4936	0.0141
Nontextile Processing	5.6538	0.0214
Textile Time	5.9833	0.0181
Nontextile Time	12.1054	0.0011
Textile Rule	0.2258	0.6368
Nontextile Rule	0.0479	0.8278

Degrees of Freedom for Hypothesis = 1 N = 50
Degrees of Freedom for Error = 49

The cell means of the gain scores further demonstrate the more significant gains in level of information processing and time orientation than do the gains of complexity in decision rule. The means represent the gains of pretest scores subtracted from posttest scores. See Table 14.

TABLE 14.--Cell means and standard deviations of gain scores.

Variable	Cell Mean	Standard Deviation
Textile Processing	0.56	1.55
Nontextile Processing	0.60	1.78
Textile Time	0.17	0.49
Nontextile Time	0.19	0.38
Textile Rule	0.10	1.49
Nontextile Rule	-0.04	1.29

N = 50

The above mean table illustrates the gains in each of the variables; however, relative position on the variable scales is not shown. Thus, the cell means for the raw pretest and posttest scores are presented in Table 15 to indicate where subjects are in regard to the variable values. The scoring schemata for each variable is shown in Figure 5 to make the pretest and posttest mean scores meaningful. (See Chapter III for additional information on scoring procedures, and Appendices B, C, and D for scoring manuals.)

TABLE 15.--Cell means and standard deviations of pretest and posttest scores.

Variable	Cell Mean	Standard Deviation
Pretest Textile Processing	4.82	1.32
Posttest Textile Processing	5.38	1.18
Pretest Nontextile Processing	4.10	1.37
Posttest Nontextile Processing	4.70	1.18
Pretest Textile Time	5.03	0.40
Posttest Textile Time	5.20	0.37
Pretest Nontextile Time	4.73	0.30
Posttest Nontextile Time	4.92	0.37
Pretest Textile Rule	3.12	1.06
Posttest Textile Rule	3.22	1.09
Pretest Nontextile Rule	3.34	1.04
Posttest Nontextile Rule	3.30	0.89

N = 50

Each of the variables is discussed according to the hypothesis represented, in the remaining sections under gain scores.

Information Processing: Hypothesis I

The null hypothesis--The level of complexity of textile information processing will remain the same after

Variable	Scoring Continua	Value Recorded Per Subject
Information-Processing Complexity	1------2------3------4------5------6------7 low — moderately low — moderately high — high	The sum of the top two out of three scores was recorded for textile and non-textile processing, for pretest and posttest results
Decision-Rule Complexity	0--------1--------2--------3--------4--------5 No evidence rule — Immed. Closure — Satisficing — Lexicog. Ordering — SATISLEX	The actual scored value of rule complexity was recorded for the four rule variables
Decision-Time Orientation	1-----2-----3-----4-----5-----6-----7-----8 past — present — future	The actual scored value of time orientation was recorded for the four time variables

Figure 5.--Scoring schemata for criterion variables.

working through the textile program--was rejected in favor of the research hypothesis: The level of complexity of textile information processing will be increased after working through the textile program.

The univariate F tests of information processing contributed to the over-all significance of the multivariate F test for gain scores. As was expected, the textile information-processing gain was of greater significance ($F = 6.4936$, $df = 1, 49$, $p<.0141$) than the nontextile information-processing gain ($F = 5.6538$, $df = 1, 49$, $p<.0214$).

Increased levels of information processing after working through the textile program support previous research relating to the influence of information organization and organizational learning as reported in the Review of Literature chapter. A categorical organization of information of increasing complexity, such as the textile programmed text, does appear to contribute to increased levels of complexity of information processing.

Since the programmed cognitive structure is directed toward the transmission of textile information, a greater increase in level of textile information-processing complexity than nontextile information-processing complexity was anticipated, as the gain score results indicate. Yet, the evidence that there is some transfer of level of information-processing complexity to nontextile areas indicates that training in one content area can increase processing complexity in other areas. The nontextile measures in this study are, however, still related to consumer decision making and do not deal with a totally different domain of information processing.

The pretest means of textile information processing (4.82) and nontextile information processing (4.10) indicate that subjects, on the average, were operating at low to moderately low levels of complexity in their information processing upon entering the textile course. Conversations with experienced scorers of the Paragraph Completion Test (from Southern Illinois University, Edwardsville) revealed that summed scores of four to five were about the national average for college students on this measure. The posttest means of 5.38 for textile processing and 4.70 for nontextile processing indicated an increased level of complexity of information processing, though still at the moderately low end of the information-processing continuum.

Decision Rule: Hypothesis II

The null hypothesis--After the experience of working through the textile program, the decision rule of decision-making style will not change--was accepted. Although the over-all multivariate analysis of gain scores was significant ($p<.0026$), an examination of the univariate F tests clearly showed that the rule variables did not exhibit significant gains (textile rule: $F = .2258$, $df = 1, 49$, $p<.6368$; nontextile rule: $F = .0479$, $df = 1, 49$, $p<.8278$). Therefore, the research hypothesis--After the experience of working through the textile program, the decision rule of decision-making style will be more complex--was rejected. The mean gain scores were so slight (textile mean = .10 and nontextile mean = -.04) that chance alone accounted for the difference scores from pretests to posttests.

There are several possible explanations for the non-significant results relating to decision rule: (1) The measures used to classify rule were not sufficiently discriminating or valid; (2) the measures were acceptable, as Assumption 2 would support, but increase in rule complexity did not occur after the relatively brief experience of working through the textile program. In light of the results, this writer takes the position that the measures did not prove adequate to elicit subject responses which reflected the total decision-making process used in making the final choice. Therefore, Assumption 2--Valid and reliable measures exist to determine levels of complexity of information-processing and decision-making styles--needs re-examination.

Past researchers have had difficulty in coding decision rule, and both the Bustrillos (1963) and Rivenes (1964) studies lacked evidence of the rule element to the extent that the data could not be thoroughly analyzed. Hogan (1965), however, was able to code a majority of responses according to rule, and the scores in the current study were codable in all but two situations as to rule. Although the coders for the present study were able to score responses for most of the variables, the rule variable was by far the most difficult to determine and reach agreement on. The different dimensions along the rule scale probably did not discriminate discretely enough to reflect slight gains which might have occurred in decision-rule complexity.

Perhaps the major reason that decision rule is so hard to code relates to the problem of getting subjects to verbalize all of the mental processes and reasoning used in arriving at a decision. Verbal responses about decision process are hard enough to secure, and written responses are perhaps even more abbreviated by respondents than oral responses. Further, the decision situations in this study were hypothetical and subjects did not always show evidence of seriously trying to complete the protocols as thoroughly as requested. Thus, in real life situations, the subjects may actually use more complex decision rules than were indicated on the written, hypothetical decision protocols.

Pretest and posttest mean and frequency scores of the decision-rule variable indicate that subjects were, on the average, following a simple, lexicographic ordering rule, which is of moderate complexity on the rule scale (textile rule $\overline{X}$: pretest = 3.12, posttest = 3.22; nontextile rule $\overline{X}$: pretest = 3.34, posttest = 3.30). Past research does not really allow for comparison as to how these results relate to decision-rule usage of comparable subjects. However, since the subjects in this study were near the national average of level of information processing, which is at a moderately low level of complexity, the moderate complexity predominating with decision rule was perhaps reasonable. The complexity of information processing, based on (1) degree of differentiation (which refers to the number of items of information used in a given information-processing situation) and (2) integration of information, conceptually would seem to contribute to increased complexity in weighing and evaluating alternatives, allowing for increased complexity in the decision rule.

The conceptual relationship between decision rule and information-processing complexity seemingly broke down when the level of complexity of information processing was found to increase significantly after working through the textile program, while rule complexity did not increase. Since the Paragraph Completion Test used to measure processing complexity has been tested and validated to a much greater extent than the decision measures, an even stronger case might be made for the lack of validity or discrimination of the decision measure, which showed no gains in rule complexity.

Another unanticipated result of the analysis of rule complexity scores was the slightly higher rule score recorded for the nontextile situations than the textile situations. This result can perhaps be attributed to the fact that the students appeared to be more familiar with the nontextile decision situations involving automobile and apartment selections than with the textile selections required in the textile decision situations.

Time Orientation:
Hypothesis III

The null hypothesis--After the experience of working through the textile program, time reference of decision-making style will not change--was rejected in favor of the research hypothesis: After the experience of working through the textile program, time reference of decision-making style will be more future oriented.

The univariate F tests on the time variables indicated that there were significant gains toward future orientation, which contributed to the over-all multivariate significance of gain scores ($F = 4.0583$, $df = 6, 44.0$, $p<.0026$). Considering that the univariate alpha levels are inaccurate and inflated, they are still useful in showing the greater gain in nontextile time reference ($F = 12.1054$, $df = 1, 49$, $p<.0011$) than in textile time reference ($F = 5.9833$, $df = 1, 49$, $p<.0181$).

Actually, a greater increase toward future time reference was anticipated in the textile area than the nontextile area, though the univariate results above and the gain score time reference means (textile = .1705 and nontextile = .1861) showed just the opposite. Perhaps the relatively short-term time constraint associated with studying textile decisions in a college course for one term affected the smaller gains in future time references of textile decisions rather than nontextile decisions.

However, an examination of the pretest and posttest raw mean scores indicated that subjects were initially more future oriented in the textile areas than the nontextile areas. With career interests related in many cases to textile areas, it would appear that textile time orientation is more future oriented than nontextile time references. Both pretest and posttest mean scores in the textile area fall within the present/future range on the time-orientation continuum (pretest textile time mean = 5.0326 and posttest textile time mean = 5.2031), while the pretest and posttest mean scores in the nontextile area were slightly lower on the time scale (pretest nontextile time mean = 4.7306 and posttest nontextile time mean = 4.920).

In the current study a tendency toward more future time orientations was found than in past research on the time element of decision-making style. Both Bustrillos (1963) and Rivenes (1964) found that evidences of the present dimension dominated the future and the past. However, Bustrillos in her study of Mexican homemakers found that the past dimension ranked second and future third, whereas Rivenes with a population of college students found that future was second and past third.

Hogan (1965) achieved still different results in her comparative study of decision-making styles of two socioeconomic groups of homemakers, in the finding that both groups used the past dimension of time reference most frequently. A more recent study of time orientation of selected rural homemakers (Elgidaily, 1971) showed that present time references predominated the conversations of the homemaker subjects.

Further comparisons were made in the Elgidaily study to determine characteristics of individuals identified with the various time orientations, since there was some evidence in the literature of a relationship between time orientation and age (Fink, 1953). Elgidaily (1971, pp. 142-145) found some evidence that younger, more highly educated subjects were more future oriented; and older, less-educated subjects were more past oriented. Although not all past research indicates these age/time/educational-level relationships, the results of the current study of college students provide further support that younger, more-educated subjects tend to be future oriented. The tendency for younger people to be more educated today than in the past might also account for the tendency toward future orientations of this population of young college students.

Correlations Between Information-Processing Complexity and Decision-Rule Complexity

No significant correlations were found between information-processing complexity and decision-rule complexity. Thus the following null hypotheses were accepted:

Null Hypothesis IV: There will be no relationship between level of conceptual complexity and decision-rule complexity.

Null Hypothesis V: <u>An increase in complexity of information processing over time will not necessarily be accompanied by an increase in complexity of decision rule</u>.

<u>Information-Processing Complexity and Decision-Rule Complexity: Hypothesis IV</u>

Hypothesis IV--Those who operate at higher levels of conceptual complexity are likely to use more complex decision rules--was rejected because of the following correlation values:

Pretest Textile Rule and Pretest Textile Processing	= .0885
Pretest Nontextile Rule and Pretest Nontextile Processing	= -.1953
Posttest Textile Rule and Posttest Textile Processing	= -.0187
Posttest Nontextile Rule and Posttest Nontextile Processing	= -.0876

The correlation value must have been greater than .3541 to be significant at the .01 level, which is the level necessary to represent a meaningful correlation with this many variables; obviously, none of the variables of interest was close to being significantly related.

The lack of relationship between decision-rule complexity and information-processing complexity may be due to the previously explained difficulties with the rule measure. However, findings which provided some support for the validity of the rule measure were the significant correlations at the .01 level between the pretest textile decision rule and the pretest nontextile decision rule (.3864), and between posttest textile and posttest nontextile decision rules (.4359).

The significant gain scores for processing complexity, but nonsignificant gains for rule complexity, further indicate the lack of a directly observable relationship or sensitivity of the variables to the same treatment. Since, conceptually, the manner in which individuals process information would appear to be related to how that information is used in making decisions, other potential relationships might exist that did not surface through the examination of the subjects as a group. A design across subjects, with individuals grouped by the type of decision rule they used, would provide insight into how complexity of information processing and decision rule were related. There could be low and high information processors within each rule group; for example, there may be concrete and abstract processors who exhibit satisficing behavior. Then as processing complexity was increased, so might the ability to integrate and differentiate information in a manner which would "improve" a satisficing decision style, but not necessarily change it to an ordering rule. Of course, determination of the validity of the decision-rule measure would be a first step prior to examining how decision-rule categories might relate to processing complexity; further, means would need to be determined as to how to evaluate an improvement in the use of a given decision rule.

Additional research is necessary to determine if, and how, information-processing complexity might be related to decision-rule complexity.

Gains in Information-Processing Complexity and Decision-Rule Complexity: Hypothesis V

Hypothesis V--An increase in complexity of information processing over time will be accompanied by an increase in complexity of decision rule--was rejected because of the following correlation values:

Gains in Textile Rule and Textile Processing	= -.1218
Gains in Nontextile Rule and Nontextile Processing	= -.2282

Neither of these correlation values was close to the .01 level of significance of >.3541.

Since there were significant gains in level of information processing, but no significant gains in rule complexity, it is logical that there was no correlation between the processing and rule gain scores. As has been discussed previously, the rule measure may not have been sensitive enough to determine rule complexity and/or increases in complexity; or perhaps the programmed treatment did not contribute to training in the use of more complex decision rules.

Correlations Between Information-Processing Complexity and Decision Time Orientation

No significant correlations were found between information-processing complexity and decision time orientation. The following null hypotheses were therefore accepted:

Nyll Hypothesis VI: <u>There will be no relationship between level of conceptual complexity and decision time orientation</u>.

Null Hypothesis VII: <u>An increase in complexity of information processing over time will not necessarily be accompanied by an increasing orientation toward future time</u>.

<u>Information-Processing Complexity and Decision Time Orientation: Hypothesis VI</u>

Hypothesis VI--Those who operate at higher levels of conceptual complexity are likely to be more future oriented--was rejected because of the following correlation coefficients (value had to be >.3541 to be significant at the .01 level):

Pretest Textile Time and Pretest Textile Processing	= -.1218
Pretest Nontextile Time and Pretest Nontextile Processing	= -.0531
Posttest Textile Time and Posttest Textile Processing	= .0521
Posttest Nontextile Time and Posttest Nontextile Processing	= -.0950

Decision time orientation was not significantly related to information processing, based on these correlation values. The only significant correlations at the .01 level relating to decision time orientation were the correlations between pretest and posttest nontextile time orientation (.3758) and between posttest textile and nontextile time

(.4350). There appeared to be no particular problems in coding time orientation, and there were some significant correlations between different time variables; thus, the time measure does not appear to present the same measuring difficulties as did decision rule.

Given that both the time orientation and information-processing measures appear to be valid indicators of the variables, the conclusion is that time orientation and processing complexity are not, in fact, directly correlated. Since past research (Schroder, et al., 1967, 1971) has indicated few relationships between age and educational levels (intelligence) and information-processing complexity, and there are some indications that future time orientation may be related to younger, more highly educated individuals (Elgidaily, 1971), perhaps time and processing are not directly related or influenced by the same environmental treatments.

A future time orientation was hypothesized to accompany higher levels of conceptual complexity, because looking toward the future does require consideration of uncertain and disparate types of information, which must be integrated and projected in order to make decisions about the future. The ability to use and combine alternative rule structures, which is a characteristic of high levels of information processing, would seem to be fostered by a future time orientation. One of the behavioral implications associated with high-level integration of information processing includes the utilization of different interactive processing and the ability to cope with situation change over time--which implies coping with future considerations.

Since these findings, nonetheless, did not support a direct relationship between high levels of information processing and future time orientation, perhaps individuals differentiate and integrate information based on the number of stimuli at a given time, regardless of the time reference. For instance, an individual who operates at high levels of complexity of information processing may be able to differentiate and integrate numerous present stimuli, if a present decision is at issue, or numerous past stimuli to use in making a future decision. Different educational experiences may be needed to develop complex information-processing skills and orientations toward future time.

In many decision-making situations in complex environments, a high level of complexity of information processing is considered desirable, and a future time perspective; thus, additional research is needed to determine how these characteristics can be fostered, and if there are common dimensions to both.

Gains in Information-Processing and Time Reference: Hypothesis VII

Hypothesis VII--An increase in complexity of information processing over time will be accompanied by an increasing orientation toward future time--was rejected because of the following correlation values:

Gains in Textile Time and Textile Processing	=	.0407
Gains in Nontextile Time and Nontextile Processing	=	-.0172

Time orientation was not significantly related to information processing, based on these correlation values. This was not as expected, especially since both time and processing showed significant gain scores. Thus, the subjects who increased in complexity of information processing were not the same ones who became more future oriented after working through the textile program.

Perhaps in the relatively short time constraint of one academic quarter, increases in all variables were too much to anticipate. The treatment may well be effective, as the correlation results indicate, in increasing one variable at a time. Apparently the processing structures of some subjects were affected by the programmed means of information categorization, while the programmed treatment altered time reference in other subjects.

Additional research is needed to determine what accompanies and causes gains in information-processing complexity and gains in future time orientation, since increases in each are believed to be desirable in information-rich environments.

Summary of Results

Significant gain scores were found with two of three variables, measured before and after subjects worked through a programmed sequence of textile instruction. The categorical organization of information appeared to contribute to significant increases in level of complexity of information processing, and in orientation toward future time reference; but there were no significant increases found in decision-rule complexity after subjects worked through the programmed cognitive structure.

Further, there were no significant correlations among any of the three variables--information-processing complexity, decision-rule complexity, and decision time orientation--on pretest and posttest scores, nor among gain scores of the variables.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

The results of this study indicate that the organization of information in gradations of conceptual complexity can increase level of complexity of information processing and orientation toward future time. The three criterion variables of interest--information-processing complexity, decision-rule complexity, and decision time orientation--were measured before and after college students worked through a programmed course of textile instruction.

Conclusions from the findings are presented in the first two sections of this chapter under (1) Effects of the Programmed Cognitive Structure and (2) Relationships Among the Variables, followed by (3) a discussion of limitations of the study. The final section (4) of this thesis includes consideration of educational research implications which point to areas for further study and application.

Effects of the Programmed Cognitive Structure

Information Processing

There were significant gain scores in level of complexity of information processing, measured before and after subjects worked through the programmed sequence of textile instruction. The gains in processing level were significant in both textile and nontextile areas; however, as expected, the gains in complexity of textile information processing were greater than those recorded for nontextile information processing.

Although no cause/effect conclusion can be drawn, there appears to be evidence that the categorical organization of information presented in increasing degrees of integration and differentiation (i.e., the programmed cognitive structure) does increase the level of complexity at which information is processed, especially in the content area at issue.

Decision Rule of Decision Style

There were no significant gains in decision-rule complexity measurable from pretest to posttest. Rather than concluding that information organization does not affect the process of decision making, additional refinement of the rule measure is recommended. There were problems in coding the decision rule, which appeared to stem from difficulties in getting subjects to verbalize their total thought processes used in making the final choice. An initial assumption that valid and reliable measures exist to determine levels of complexity of information processing and decision-making styles requires re-examination in regard to decision-rule measures. The rule measure possibly did not discriminate discretely enough between the decision rules specified, to reflect any gains in rule complexity which might have occurred.

Time Orientation of Decision Style

Significant gains toward future-oriented time references were found in both the textile and nontextile areas after subjects completed the textile program. These results suggest that the modification of time orientation toward the future can be achieved by the organization and presentation of information in increasing degrees of complexity, in a manner to encourage subjects to consider future consequences of given textile decisions.

Relationships Among the Variables

No significant correlations were found among pretest and posttest scores of information-processing complexity, decision-rule complexity, and decision time reference; nor among gain scores of any of the variables.

Information Processing and Decision Rule

There was no evidence that individuals who operate at higher levels of conceptual complexity are likely to use more complex decision rules. The rule measure may not have reflected the true level of complexity used in finalizing choice, due to the problems presented previously of determining the actual thought processes used by the decision maker. Individuals perhaps were operating at higher levels of complexity than they recorded in their written responses to hypothetical decision problems. Thus, this writer does not conclude from these results that no relationship exists between complexity of information processing and complexity of decision rule.

Even considering the difficulties observed with the rule measure, there may be relationships not tapped with the method of data analysis used. A design over subjects in which individuals were grouped according to the type of decision rule recorded, might show how different levels of processing relate to specific levels of decision-rule complexity.

Information Processing and Time Orientation

The correlations did not indicate, either, that individuals who operate at higher levels of conceptual complexity are likely to be more future oriented. Since the measures used to determine decision time reference and information-processing levels were believed to represent accurate scores, the conclusion was reached that processing complexity was not directly correlated with orientation toward future time. Apparently, there are high and low processors within each time reference; i.e., individuals who operate at high levels of information-processing complexity integrate and differentiate information in regard to past, present, or future time reference, based upon their time orientation.

Gains in Information Processing and Decision Rule

With no significant gains in rule complexity, it followed that there were no significant correlations between gains in information-processing and rule complexity. The hypothesized relationship that an increase over time in information processing complexity should be accompanied by an increase in decision-rule complexity was not rejected. However, since there is some evidence that the rule measure was not sensitive enough to pick up slight gains in rule complexity, further study is needed.

Gains in Information Processing and Time Orientation

Although there were significant gains in processing scores and in orientation toward future time, the programmed treatment did not produce gains in both variables in the same subjects. The treatment apparently influenced individuals differently; a tentative conclusion from these findings is that over a relatively short time period, significant gains in complexity can be expected in only one variable for a given subject.

Limitations of the Study

The following factors limited the research findings, and should be considered when interpreting results:

1. The sample was selected from a class of 150 textile students at Michigan State University, which is not representative of the general population, nor necessarily even of college students. Further, the subjects were primarily female.

2. Gains scores are not always considered a reliable measure, and the relatively short time constraint of one academic quarter from pretest to posttest measurement was a limiting factor.

Implications of the Study

The two major implications from the findings of this study are that information can be organized to produce:

1. Increases in the level of complexity of information processing.
2. A more future-oriented time reference.

Implications of these findings are discussed in this section according to educational applications and indications for future research.

Educational Applications

The results are particularly applicable to the design and organization of information in educational training environments. Providing means for individuals to cope more effectively with information-rich environments is critical to decision making in an industrialized society. The past legacy of formal education has emphasized the acquisition of information *content*, rather than information processing, or how to use the information. The static model of education (memorize, describe, and analyze given structures), which is a part of this legacy, is appropriate only when man's environment changes very slowly and has a low level of symbolic referents, such as in primitive or nontechnological societies. The twentieth century human being cannot exist compatibly with the high-information external environment unless his neural structure (internal map) is specifically trained in the techniques of information acquisition analysis. This research indicates that a programmed structure of information presentation can provide structure for processing information at increased levels of complexity.

Although content is important and must accompany training in information processing, a structure must be provided so that individuals might selectively process a variety of types of content for given purposes. Information content changes so rapidly, and there is so much of it, that learning volumes of content seems neither practical nor possible. The ability to process information at high levels of conceptual complexity has been demonstrated to be an asset in complex environments which demand complex decision making (Schroder, et al., 1967, 1971). There is too much "information overload" now. Thus, training in the "how" of information integration and differentiation in increasingly complex environments is going to become increasingly critical.

Specific examples of educational applications are now considered. First, the way these results can be applied to classroom instruction is discussed, followed by implications for general education in the areas of management and consumer decision making.

Classroom Instruction.--Although an increase in level of information-processing complexity resulted after subjects worked through the programmed treatment, the implication should not be that such a structured type of information organization is the answer. In fact, programming is highly structured and leads toward convergent thinking, which can create rigid, concrete behavior in students. When programming is the type of information organization used, therefore, it should allow as much flexibility as possible. Perhaps a less structured type of organization would contribute to even greater increases in level of complexity of information processing. Though the gains in processing were statistically significant, the subjects, on the average, were still processing information at the moderately low end of Schroder's continuum (1967, 1971).

The categorical organization of programmed instruction, and the highly structured presentation of information from simple to increasingly complex concepts are probably the advantageous by-products of programming. They contributed to subjects' ability to integrate information better (process at higher levels of conceptual complexity) and to consider future consequences after working through the textile program. However, to allow for increased flexibility of student interaction with instruction, programmed instruction might be used in conjunction with other methods of transmitting information.

Simulation and gaming techniques are one promising means of allowing individuals to input diverse types of information into an instructional system, and come up with creative ways of using it. Also, the student-centered instructional systems allow individuals to define their own structure for dealing with information.

Therefore, the design of total instruction systems is called for, perhaps including programming techniques as the delivery system for certain types of information content. The current emphasis on process curriculums in educational literature (e.g., Berman, 1968; Schroder, et al., 1972) illustrates the greater awareness of need for training in information processing. Research such as the present study provides insight into organizational learning environments which give students content, as well as a structure for processing information and thinking in terms of the future.

General Education.--A main concept of management is based on the fact that individuals can imagine alternatives and consequences, and project abstractly into the future. Presenting information in a framework which aids individuals in differentiating and integrating alternatives, and in evaluating them as to future consequences, would help families manage their lives. This research suggests that programmed units of instruction might be developed for adult, continuing education programs designed to train individuals for complex decision making.

For years, literature on decision making has suggested that attention be given to the decision-making process, typically viewed as a sequential one composed of steps or phases. As early as 1910, Dewey was discussing the "steps of reflection" (1910, p. 12), which were necessary in formulating plans about future decisions. Yet, there has been little progress made in how to help individuals organize information into a framework for decision making.

Other writers have also considered the internal or cognitive map of individuals in terms of how information is perceived. For example, the internal plan has been likened to an image (Boulding, 1956), which can be cast in a time frame, or a processing structure for handling information. The nature of the individual's image exercises constraint upon the decision-making process, and broadening the perspective of the internal map is a task of learning environments. Until recently, past or present content-oriented time frames functioned adequately in coping with environmental stimuli. However, in the present high-information, high-flux environment, such orientations are becoming increasingly dysfunctional.

The current research indicates that training environments can be designed in specific content areas to influence behavior; for example, information can be structured to aid consumers in decision making. The textile program was designed to help students select from among textile alternatives, and implications are promising for designing programs in a variety of content domains for general education.

Training is particularly needed in evaluating consumer information, as is indicated by the current consumer movement which has developed out of frustrations and dissatisfactions occurring in the consumer arena. Technology has increased the alternatives available for consumption to such an extent that a structure for processing the constantly changing information inputs is needed. Granted, the wide variety of options from which the consumer may choose are readily attainable by a limited number of people due to economic factors; yet those individuals with limited resources are the ones to which training environments should be directed which can help consumers evaluate information.

Individuals benefit from a structure for processing diverse units of information, and this research indicates that programmed techniques do provide a structural framework which can be used in transmitting information to consumers.

Future Research

Follow-up research which gives insight into how information can be structured to foster complex decision making can be explored relative to (a) cognitive processes used in decision making, (b) the decision situation or context, or (c) characteristics of the decision maker (as suggested by Magrabi and Paolucci, 1970). Implications for research in each of these areas are suggested in the remainder of this chapter.

Cognitive Decision Process.--Research studies need to get at what triggers choice--i.e., information organized in a particular fashion? a series of environmental factors? a combination of both?

In the present study, decision rule was intended to get at what triggers choice. However, additional study is required of behavioral aspects of decision making, to refine the means of evaluating an individual's decision rule. After more discriminating measures are developed, research designs other than the one used in this study should be selected. A design that groups subjects according to the type of rule they used in a particular decision situation might provide new insights into potential relationships between how conceptual complexity relates to decision-making processes.

Further research should also explore the effect of different training environments on the decision process. Although this study indicated that programming techniques aid in developing processing skills, there are other delivery systems which might be as effective, or even more effective in developing cognitive processes for decision making. Particularly, delivery systems which are less structured than programming may be very beneficial, used in conjunction with programmed instruction. A study of total instructional systems which train individuals in complex decision making should be designed and systematically evaluated as to the effectiveness of component parts of the instructional system. Systems which build in adaptive behavior are particularly desirable; thus, the structure should allow for flexibility.

Also, the influence of information organization during the developmental stages is an area ripe for research. The type of structure required for preschool organizational learning environments through graduate education learning environments would give additional insights into how adaptive processing behaviors are developed. Specifically, further research is needed to determine how choices are made, under varying conditions. How do individuals react to organizational learning environments designed to increase the ability to cope with many alternatives available in complex decision making? The processes used in decision making have, in the past, been found to be situation-specific; therefore, research must follow which allows examination of the decision situation.

Decision Situation or Context.--The current research included decision situations which could be classified as routine, sequential, repetitive types of consumer decisions; as compared to central, unique, irrevocable types of decisions which occur frequently in life and perhaps require the most complex processing of all. Critical, life/death types of decisions which are irrevocable may really be the kinds of decisions in which the highest levels of conceptual complexity operate. These decision situations need researching as to how information can be organized to aid processing; yet, these areas are very difficult to explore, except hypothetically.

However, future research should include a wide array of managerial decisions of varying consequences. Potential relationships may be uncovered between certain decision situations and levels of information-processing complexity, which have implications for designing training environments for use in family crisis intervention, as well as for training in the routine types of day-to-day decisions (which are the types of decisions attended to in the textile program).

Decision Maker.--Lastly, research is needed concerning individual personality characteristics and how they influence information processing and decision making. Do individuals with particular personality characteristics exhibit particular decision-making styles? Do they respond more favorably to certain types of organizational training environments?

Individuals could be categorized according to personality variables, such as locus of perceived control (e.g., internal versus external control), intrinsic versus extrinsic motivation, and then researched for common decision-style characteristics which surfaced with certain personality variables. Also, consideration of the decision maker's environment is open for research. How might family environment, parental influences, living conditions, rural versus urban surroundings, influence the way in which information is processed for complex decision making?

The interaction of the organism with his environment is perhaps the most fruitful approach for future research. This approach requires an ecological thrust, in which the interface between the organism and the situation is examined. For instance, do genetic characteristics of the individual override ethnic or environmental factors of the situation in which the individual makes decisions?

Actually, information-processing and decision-making styles cannot be fully explored by examination of the decision process, the decision situation, or the decision maker in isolation. Rather, all factors should be considered in the context of an ecological system. This type of integrative research is no doubt difficult to pursue, requiring special research techniques and statistical tools, which need to be developed through future research endeavors.

Summary

There is evidence that structured learning environments can raise the level of complexity of information processing and contribute to an increased orientation toward future time. Based on the findings of this study, a programmed course of instruction, designed with the information presented in gradations of increasing conceptual complexity, has the potential to increase levels of conceptual complexity and future time orientation.

These findings can be applied to the design of education training environments in order to improve individuals' abilities to integrate and differentiate large amounts of diverse information for complex decision making. Additional research which takes into account the decision maker in his environment is needed to investigate thoroughly the cognitive process a decision maker uses in varying situations. An ecological research approach which brings together the organism and his environment is the type of research ultimately to strive toward.

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APPENDICES

APPENDIX A

SAMPLE PRETEST AND POSTTEST

SAMPLE PRETEST

BACKGROUND INFORMATION

Student Number______________ Class in School________________

Major__________________________________ GPA________________

Age_________ Marital Status__________ Number Children_____

Number of hours employed per week ________

Your occupation ____

Father's occupation ____

Mother's occupation ____

Number of students in your high school graduating class_____

Number of credits you are enrolled for this term____________

Check the courses you have previously taken:

______ HED 171 (or 170)

______ HED 143 (or 140)

______ FCS 261

______ FE 331

Number of hours sleep you have had in the last 24 hours_____

INSTRUCTIONS TO PARTICIPANTS

I. Part One: PARAGRAPH COMPLETION

On the following pages you will be asked to complete certain sentences and write a short paragraph.

On each page you will find the beginning of a sentence, and your task is to complete it.

For example: I like....

When you are given the signal turn to Page 1. Complete the sentence given and write at least three additional sentences. You will be given 120 seconds. After 100 seconds I will say "Finish your sentence," and at 120 seconds I will ask you to turn to the next page. Make sure you complete your last sentences. There are 4 sentence completions in all.

Write your sentences as quickly but as clearly as possible.

Do not turn this page until you are given the signal.

When others criticize me it usually means....*

Rules....

When I am in doubt about a garment purchase....

When someone disagrees with my textile selections....

Confusion....

When a fabric purchase proves inappropriate....

---

*In the actual test situation, each sentence stem is on a separate page.

INSTRUCTIONS TO PARTICIPANTS

II. Part Two: PROBLEM SITUATIONS

On the following pages you will be asked to respond to questions about two problem situations.

A brief description of each situation will be presented and your task is to answer these questions about both situations:

1) What factors would you consider in this situation before recommending specific alternatives?

2) What recommendations would you make?

3) What other alternatives might you recommend?

4) If you were making this decision, how would you choose among your generated alternatives?

When you are given the signal, turn the page. You will have approximately 15 minutes to respond to the four questions for each situation.

Please think through your answers and write responses as clearly and fully as possible. Use the back of the pages if you need additional space.

Do not turn this page until you are given the signal.

A-1. The Smith Family (husband, wife, son age 9, daughter age 13) is considering how to redecorate their large family room, perhaps re-upholstering a couch and lounge chair, and selecting new carpeting and draperies. They want to keep down costs and yet have an attractive room that will hold up under constant use.

1) What factors would you consider in this situation before recommending specific alternatives?

2) What recommendations would you make?

3) What other alternatives might you recommend?

4) If you were making this decision, how would you choose among your generated alternatives?

B-1. The Smith Family (husband, wife, son age 9, daughter age 13) is considering the purchase of an automobile. They would like an all-purpose family car for routine use and for travel, at moderate cost.

1) What factors would you consider in this situation before recommending specific alternatives?

2) What recommendations would you make?

3) What other alternatives might you recommend?

4) If you were making this decision, how would you choose among your generated alternatives?

SAMPLE POSTTEST

INSTRUCTIONS TO PARTICIPANTS

I. Part One: PARAGRAPH COMPLETION

On the following pages you will be asked to complete certain sentences and write a short paragraph.

On each page you will find the beginning of a sentence, and your task is to complete it.

For example: I like....

When you are given the signal turn to Page 1. Complete the sentence given and write at least three additional sentences. You will be given 120 seconds. After 100 seconds I will say "Finish your sentence," and at 120 seconds I will ask you to turn to the next page. Make sure you complete your last sentences. There are 4 sentence completions in all.

Write your sentences as quickly but as clearly as possible.

Do not turn this page until you are given the signal.

When I am criticized about a textile purchase....*

When I am confused about which carpet to recommend....

When I am in doubt....

Parents........

When someone disagrees with me....

Nonserviceable textile selections....

---

*In the actual test situation, each sentence stem is on a separate page.

INSTRUCTIONS TO PARTICIPANTS

II. Part Two: PROBLEM SITUATIONS

On the following pages you will be asked to respond to questions about two problem situations.

A brief description of each situation will be presented and your task is to answer these questions about both situations:

1) What factors would you consider in this situation before recommending specific alternatives?

2) What recommendations would you make?

3) What other alternatives might you recommend?

4) If you were making this decision, how would you choose among your generated alternatives?

When you are given the signal, turn the page. You will have approximately 15 minutes to respond to the four questions for each situation.

Please think through your answers and write responses as clearly and fully as possible. Use the back of the pages if you need additional space.

Do not turn this page until you are given the signal.

A-2. You are assigned as a designer-consultant to make recommendations on how to redecorate dormitory lounges. Carpeting, furniture upholstery, draperies, etc. are to be considered. University personnel want to keep costs down and yet have an attractive room that will hold up under constant use.

1) What factors would you consider in this situation before recommending specific alternatives?

2) What recommendations would you make?

3) What other alternatives might you recommend?

4) If you were making this decision, how would you choose among your generated alternatives?

<u>B-2.</u> A student couple (age 20 and 22) is seeking an apartment to rent for the college school year. They are on a tight budget, but want an apartment that is attractive and comfortable.

1) <u>What factors</u> would you consider in this situation before recommending specific alternatives?

2) <u>What recommendations</u> would you make?

3) <u>What other alternatives</u> might you recommend?

4) If you were making this decision, <u>how would you choose</u> among your generated alternatives?

APPENDIX B

PARAGRAPH COMPLETION TEST (PCT) SCORING

PARAGRAPH COMPLETION TEST (PCT) SCORING

For a discussion of the general background and theoretical assumptions underlying the PCT and its scoring, the reader is referred to Schroder, Driver, and Streufert (1967, pp. 185-204) and Schroder (1971, pp. 240-273) in Personality Theory and Information Processing, ed. by Schroder and Suedfeld.

The scoring manual includes a set of general operations for inferring the level of conceptual structure that generated the response. Responses are scored along a seven-point scale, which represents a continuum from low (score of 1) to high (score of 7) levels of integrative complexity.

Representative samples of the scoring of actual subjects' responses are reproduced, with an analysis of the response in terms of its structural properties, to indicate how the scoring procedures operate. These examples were taken from the Structural Scoring Manual (Phares and Schroder, 1969), developed to help train scorers.

Scoring of Responses to Stem: Rules...

a) Score of 1, indicating low complexity:

"'. . . are very boring but completely necessary. Many rules and laws I don't enjoy, but I always obey them. Rules are not made to be broken.'

Scorer 1 - This is a 1. He only sees rules in one way.
Scorer 2 - I scored it 1. There is only one perspective.
Scorer 3 - I think this is a 2 because he qualified the fact that he never breaks rules by saying that they are a pain in the neck.
Scorer 4 - I scored it a 1. He closes down completely.

Discussion:

This is a score 1 response. The S gives no indication of viewing rules in any way other than that of obedience. The mere fact that he does not always enjoy the imposition of rules is not a sufficient qualification to raise the response to a 2."

b) Score of 6, indicating high complexity:

"'. . . are formed and amended through trial and error. They weren't made to be broken but to change with changing times and societies. Should revolve around one main theme--moderation--and should be flexibly applied to situations.'

Scorer 1 - It's a higher response all right, and I would have scored it higher than a 4 except that the S doesn't talk about the purposiveness of rules. So, I gave it a 4.

Scorer 2 - This is really a sophisticated one-dimensional judgment--they're right if they're moderate; if they aren't, they must be changed which is just another way of saying 'break them.' Because the S uses the word, 'flexibly,' he has opened up a bit and so I scored it 2.

Scorer 3 - I disagree. It's definitely above a 2 except that I'm just not sure how much above. A 4 or a 5 maybe?

Discussion:

Although it might be argued that 'moderation' in this response gives indication of the purpose of rules (see Scorer 1), there are enough other referents to establish a higher score: a very high degree of conditionality; a sense of dynamism, change; a view that, rather than being externally imposed standards, rules are formed and modified (and re-formulated) by an interaction between need and circumstance. Since these processes are articulated a bit more clearly in this response than in the earlier response (see p. 4, Score 5), a score of 6, rather than 5, is given."

Scoring of Responses to Stem: When I Am in Doubt...

a) Score of 3, indicating medium-low complexity:

"'. . . I think carefully about the situation. I search for various alternatives to resolve the doubt. If the latter persists, I am somewhat disconcerted but I press on.'

Scorer 1 - This is a 2 score because the S sees the possibility of more than one alternative.

Scorer 2 - Scored it 3--there is more than one alternative stated.

Scorer 3 - I scored it 3 because there is evidence of toleration of the uncertainty as well as alternatives expressed.

Scorer 4 - I was going to score it 3 because the S expresses different perspectives but then he admitted that he was 'disconcerted' and I felt that would bring it back down to a 2.

<u>Discussion</u>:

There is a clear expression of different alternatives in this response which is sufficient to score it 3. The expression of concern over an uncertain situation, per se, is not a referent for lowering a score (see Scorer 4). Only if such an expression were accompanied by verbal evidence that the S was also "closing down" or warding off the conflict would the scorer consider giving a lower score."

b) <u>Score of 4</u>, indicating mid-point on complexity continuum:

"'. . . I try to analyze the situation to the best of my ability. I study the solutions to the problem and pick a few of the best solutions after comparing all of them. Then I act on them in the best way I know how.'

Scorer 1 - I scored it 3 because the S is seeing different solutions.
Scorer 2 - I scored it 3 for the same reasons I stated earlier; the S sees various alternatives and chooses among them.
Scorer 3 - I think it is a 4. The S sees different perspectives and is doing some uniting of them when he starts talking about 'comparing.'

<u>Discussion</u>:

As each of the scorers has already pointed out, there is good evidence in this response of the S's ability to see more than one alternative. He also indicates that he may be engaging in a process of combining these alternatives ('comparing all of them'). This, then, permits a score of 4."

APPENDIX C

CODING MANUAL: DECISION TIME ORIENTATION

CODING MANUAL: DECISION TIME ORIENTATION

Decision time orientation is based on how ideas are perceived in a time relationship. Time reference is identified by context of statement as it relates to a time base. Grammatical connotations, e.g., the relationship of nouns to verbs, and adjectives to nouns, help to determine the context of the statement.

Unit of analysis is the smallest component in a sentence that has a time reference, whether it be a word, phrase, clause, or sentence.

Numerical rating scale from zero to eight is designated, with lower numbers representing greater orientation toward the past and higher numbers representing greater orientation toward the future.

Rating Scale

$Time_0$--Unclassified. No distinguishable reference to time.

$Time_1$--Distant Past. References to experiences or events which occurred years in the past; overall life experiences. Age of respondent provides insight as to how long ago experience might have occurred.

Examples: I experienced....as a child.
My mother, etc. used to....
Based upon my childhood, my past, etc.....
Previously....
Already, I have learned....

$Time_2$--Immediate Past. References to experiences or events which occurred within the immediate past, i.e., the last year or two. Include those references to past which only indicate past time, without referring to events which took place a specified long time ago.

Examples: From experience....
It was my....(job, duty, etc.)
I have found....
I did....previously

$Time_3$--Past/Present. Combination of past and present references and/or experiences. Present references based on past experiences. References to life style, attitudes, preferences which are presently held, but were developed through past experiences.

Examples: From past experience I can now....
Considering tastes and preferences, I recommend....
I value, I prefer....

$Time_4$--Present. Indication of present behavior based on that which is on-going but not habitual; statements which denote on-going or present conditions. Feelings at the present time. (Consider when recommendations are carried out, not when they are made, since any recommendation is made at present time.)

Examples: ....should be or do.
....are considered.
....are or is.
I think she should....
I like....
Right now the demands are....
Under these circumstances....
My friends presently....
They need....

$Time_5$--Present/Future. Combination of present and future references and/or experiences.

Examples: They wish, desire....
She, he, does want....
They plan....
....can do, can be.

$Time_6$--Near Future. Predictive statements or explicit expectation of fulfillment of a "near" future state of affairs, i.e., next month, next year references. Statement as to what might happen in the immediate future.

Examples: If she waits awhile....
The next time she....
Tomorrow, or next month....
By next year....
The job will probably be....
....would choose, would want, would like, would need, etc.
....could do.
Perhaps, might, maybe, probably, etc....

$Time_7$--<u>Distant Future</u>. Predictive statements about <u>long-range</u> consequences: references to years in advance, where one expects to be in distant future. References to over a lifetime. When no near future time constraint is referred to, and implication is distant, consider reference into distant future.

Examples: I expect....to happen someday.
....may result eventually.
I aspire to....
....would anticipate.
....expect to last.
Over a long period....
In the long run....
I would select....for long-range durability.

$Time_8$--<u>Future/Past</u>. Referents to future decision based on past experiences. Indication of profiting from past--evaluating. Being critical of past and making future projections.

Examples: From continued experience....
I would plan....based on....(some past referent).

Each codable unit receives one of the above numbers, which are averaged by adding up the values and dividing by the total "n" for a given situation. The following score sheet is suggested.

DECISION TIME ORIENTATION

Coding Sheet

Subject # __________

	Probe Question Number	Time Scores by Word, Clause, or Phrase													Question Totals
Textile Situation A-	1)														
	2)														
	3)														
	4)														

____
Average Textile Time

Nontextile Situation B-	1)														
	2)														
	3)														
	4)														

____
Average Total Time Orientation

____
Average Nontextile Time

APPENDIX D

CODING MANUAL: DECISION RULE

CODING MANUAL: DECISION RULE

Decision rule represents the methods by which alternative courses of action are evaluated, and how one alternative is decided upon.

Unit of analysis is a sentence or group of sentences indicating the method used in comparing alternatives. Evidence of rule may appear throughout protocol.

Numerical rating scale from zero to five is designated, with lower numbers representing less complex rules than higher numbers.

Rating Scale

$Rule_0$--Unclassified. No evidence of selection among alternatives, nor indication that one acceptable alternative is chosen. No closure evident.

$Rule_1$--Immediate Closure. One alternative or set of alternatives is focused upon and immediately grasped. The process of decision is quick, and any analysis of choices comes after the decision is made. The limits allowable in making the decision are perceived as fixed; no evidence of weighting or evaluating.

Examples: From the beginning, I thought or believed....
I can't think of any other choice....
All the time I knew....would be best.
Clearly, the recommendation would be....

$Rule_2$--Satisficing. The advantages and disadvantages of one alternative at a time are perceived and evaluated, according to a minimum set of goals and expectations; the alternative is either accepted or rejected. The first alternative which meets or exceeds the minimum criteria is accepted. Often there is inferred rationalization--the decision maker indicates that the chosen alternative is not necessarily the best or an optimum, but it is "good enough." There is an indication of two categories--acceptable and not acceptable--and the first acceptable alternative is selected.

Examples: I chose....because....
....alternative must be chosen because....
There would be some satisfaction with....
Due to these factors....I have decided....
Since....is not acceptable, I have eliminated it and chosen....
I know it's not the best, but....
....is good enough.
I would compromise and choose....
....is just as good.

$Rule_3$--Lexicographic Ordering of Few Alternatives. Two or three alternatives are ranked, on the basis of perceived values or attributes or characteristics under consideration. All perceived factors are weighed. Closure is reached when the best alternative is chosen from other alternatives. If two or more alternatives are equivalent with respect to the most important attribute, then they are ranked on the basis of the second most important attribute. The key is some indication of ordering of alternatives--weighing and comparison must be evident.

Examples: My first recommendation would be....
My last recommendation would be....
....would be a far better choice than....
After considering....alternatives, I would evaluate....
....is preferable (better, more desirable) than....

$Rule_4$--Lexicographic Ordering of Many Alternatives. Same factors considered as with $Rule_3$, except four or more alternatives are indicated and then ranked.

Examples: This (fourth) undesirable alternative would be last because....
....has more advantages than....

$Rule_5$--SATISLEX. Alternatives are ranked on the basis of values or attributes which are most important; then next most important, etc., as with lexicographic ordering. Then unacceptable alternatives are eliminated, first on the basis of the most important characteristics or attributes. After unsatisfactory alternatives are eliminated, the first acceptable one is selected (as with satisficing). Or, a satisficing rule may be applied first, in which unsatisfactory alternatives are eliminated immediately, with a weighing and evaluating of the remaining acceptable alternatives.

Examples: After considering....alternatives, I would reject....and accept....
Since....would be unacceptable, I would rank....as follows.

Each decision situation receives a single rule rank, with justification cited from the protocol for the value decided upon. See rule coding sheet, which follows.

DECISION RULE

Coding Sheet

Subject # ___________

	Evidence of Rule in Protocol
Textile Situation A- Rule ____	
Nontextile Situation B- Rule ____	