AN EMPIRICAL INVESTIGATION OF THE STRUCTURAL FORM AND MEASUREMENT VALIDITY OF THE HILL INVENTORY

DISSERTATION

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By

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This research began with the Hill Inventory. Cognitive style preference variables were classified as one of following four types: Theoretical Codes, Qualitative Codes, Social-Cultural Codes or Reasoning Modalities. A consumer behavior perspective was then used to form an alternative structure for the Hill Inventory variables. The following three constructs were proposed: Evaluation Codes, Perceptual Codes, and Reasoning Modalities.

The purpose of this research was to assess the structural form and measurement validity of the Hill Inventory. Specific steps taken to accomplish this objective included: developing confirmatory factor and structural equation models; using the LISREL software package to analyze the model specifications; and assessing the validity of the questions used to measure the variables.

A descriptive research design was used to compare the model specifications. The research instrument consisted of

eight statements for each of twenty-eight variables for a total of 224 questions. Five-point response choices were described by the words: often, sometimes, unsure, rarely, or never. The sample consisted of 285 student subjects in marketing classes at a large university.

Data analysis began by comparing the distributions of the data to a normal case. Parameter estimates, root mean square residuals and squared multiple correlations then were obtained using the LISREL VI software package. The chi-square statistic was used to test the hypotheses. This statistic was supplemented by the Tucker-Lewis index which used a null model for comparisons. The final step in data analysis was to assess the reliability of the measurements.

This study affected the potential usage of the Hill Inventory for consumer behavior research. The major conclusion was that the measurement of the variables must be improved before model parameters can be tested. Specific question sets on the inventory were identified that were most in need of revision.

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CHAPTER I

INTRODUCTION AND OVERVIEW

Ideas and meanings are exchanged through the process of communication. Indeed, the information presented by firms is affected by a management's understanding of such individual customer characteristics as information search behavior (Moore and Lehmann 1980), presentation format preference (Bettman and Kakkar 1977), and cognitive ability (Capon and Davis 1984).

As researchers study reasons for different responses to presented information, an understanding of a consumer's decoding preferences becomes increasingly important. An individual's preferred cognitive and affective style of communication mediates initial responses to advertising (Wright 1974), recall of messages (Olson, Toy and Dover 1978, 1982), as well as subsequent behavioral intentions to buy (Lutz 1977).

An inventory of questions was designed to measure cognitive style preferences. Hill (1972, p. 3) stated:

> An individual's cognitive style is determined by the way he takes note of his total surroundings--how he seeks meaning, how he becomes informed. Is he a listener or a reader? Is he concerned only with his own viewpoint or is he influenced in decision-making by his family or associates? Does he reason as a mathematician, or as a social scientist, or as an automotive mechanic?

Far from being an isolated opinion, cognitive style has also been defined by others based on Hill's work as a consistent preference for acquiring and organizing information that involves personal methods for identifying and understanding various symbols used to communicate meaning (Ehrhardt and Corvey 1981; Furse and Greenberg 1975; Keefe 1982; Warner 1982). The Hill Inventory consists of four groups of variables that explain preferences for types of coding symbols used in messages. The groups, or implied constructs, and their corresponding variables are identified in Table 1.1.

Table 1.1
Cognitive Style Preference Constructs and Variables for the Hill Inventory

Construct	Variables	Construct	Variables
Theoretical Codes:	Auditory	Qualitative Codes:	Auditory
	-Linguistic		Olfactory
	-Quantitative		Savory
			Tactile
	Visual		Visual
	-Linguistic		
	-Quantitative		Proprioceptive
			Empathetic
Social-Cultural Codes:	Associative		Aesthetic
	Family		Ethic
	Independent		Histrionic
			Kinesic
Reasoning Modalities:	Magnitude		Kinesthetic
	Difference		Proxemic
	Relationship		Synnoetic
	Appraisal		Transactional
	Deduction		Temporal

Research within consumer behavior supported the variables selected by Hill but offered an alternative view of the constructs represented by this set. Holbrook and Huber (1979) stressed the theoretical difference between evaluation abilities and perceptual codes. Other studies also suggested that preferences for using various perceptual codes should be distinguished from abilities involved in acquiring information (Richardson 1977; Goldstein and Blackman 1978; Ehrhardt 1983; Clark and Halford 1983). The interaction between abilities and preferences seemed to affect other cognitive processes, such as the Reasoning Modality employed (Carini 1983).

This perspective is developed into a structural equation that represents the Hill Inventory variables based on three constructs: Evaluation Codes, Perceptual Codes, and Reasoning Modalities. The variables from the inventory are then classified into one of these three categories.

Purpose of the Research

The purpose of this research is to examine the construct validity of two alternative models for the Hill Inventory using a confirmatory factor analysis approach. The problem involves a comparison of the linkages between the observed variables and the proposed model structures. In addition, measurement issues related to the survey questions are also investigated. To accomplish this purpose, specific research objectives include the following:

1. To model the Hill Inventory variables based on a confirmatory factor analysis perspective of four orthogonal constructs: Theoretical Codes, Qualitative Codes, Social-Cultural Codes and Reasoning Modalities.

2. To model the Hill Inventory variables based on a structural equation perspective of three constructs: Evaluation Codes, Perceptual Codes and Reasoning Modalities.

3. To compare the explanation provided by the confirmatory factor and structural equation models of the observed data in relation to each other and to the null model of the inventory.

4. To examine the reliability of the questions used to represent the variables on the inventory.

5. To propose modifications for the operationalization of the inventory variables.

This research begins with the Hill Inventory variables for cognitive style preferences. An alternative view of the structure for these variables is then specified. The construct validity of each of these specifications is examined in isolation and in comparison to a null model. Finally the internal validity of the questions will be analyzed.

Justification of the Study

The first step of any scientific research effort is to define the domain of interest (Nunnally 1978; Churchill 1979). Although cognitive style decoding preferences have been used within educational literature, the concept is relatively new to consumer behavior applications. A measurement development process improves definitions of a conceptual area (Jacoby 1978; Churchill 1979) and the procedures used to measure defined concepts (Campbell and Fiske 1959; Zaltman 1965; Hunt 1983). Until confidence in the validity of the measurement approach is provided, causal examinations are irrelevant in any other than an exploratory sense (Sternthal, Tybout and Calder 1987).

To adapt the concept of cognitive style decoding preferences to more general applications, an empirical investigation of the measurement and modeling approach was needed. As Cote and Buckley (1987) contended, estimating sources of variation for observed data is essential to evaluate subsequent effects. As Cohen (1977, p. 2) has stated:

> We cannot hope to assess the value of the evidence, nor the truth of the conclusions unless we scrutinize the methods, probing their weaknesses, and trying to evaluate the advantages and disadvantages of different approaches.

Marketing communication studies describe how preferences vary for messages or media that people use to acquire information. Effective communication determines, in part, the success of promotional efforts (Markin 1969). Messages must command attention and be understood to be used in the purchase process (Jacoby, Hoyer and Sheluga 1980; Swinyard and Patti 1979; Burley-Allen 1982).

General factors that have been shown to affect information acquisition and usage include: demographic factors (McGuire 1976; Jackson-Beeck and Robinson 1981); lifestyles (Moschis 1980); and inner-other directedness (McDonald 1983; Hornik 1980).

The extent to which a consumer will pay attention to media messages has also been shown to be affected by similar characteristics. Individual differences in exposure to media or message formats (Bruno, Hustad and Pessemier 1973; Edell and Staelin 1983); demographic factors (Newman and Staelin 1972), psychographic factors (Myers and Alpert 1968; Bass, Pessemier and Tigert 1969; Teel, Bearden and Durand 1979), other-directedness or social influences (Woodside 1969; Hirschman and Wallendorf 1982), and cognitive sets or representations (Zaltman 1965; Markin 1969, 1974; Reynolds and Gutman 1984) provided linkages between general information acquisition and media usage patterns.

Communication efforts may be enhanced by accomodating general style preferences (Hofman 1979). Yet, scales that are based on a small number of general variables may lack explanatory power (Sood and Valentine 1983). To address this concern, Peterson and Scott (1975) called for a more precise definition and measurement of aspects of style dimensions to increase the sensitivity of applied studies.

Applications of a well-defined scale for marketing could then be varied. For example, television costs may not be justified to reach people who rely predominantly on their hearing or the personal advice of others to acquire information (Jacques and O'Brien 1986). In the industrial area, sales representatives are trained to recognize differences in how buyers prefer to acquire information (Merrill and Reid 1981; Snader 1984; McGuire 1976). A better understanding of decoding preferences may provide helpful communication sensitivity for marketing researchers.

Research Design

The data collection instrument and the sampling design are described in the following sections. The discussion concludes with an overview of the basis for developing the two models and data analysis procedures.

The Data Collection Instrument

The Hill Inventory consists of eight statements for each of the twenty-eight cognitive style variables. The questionnaire contains a total of 224 questions.

The instrument that was developed by Hill (1972, 1976a) and applied by others (Ehrhardt 1981; Ehrhardt and Corvey 1981) asked respondents to indicate whether they engaged in a described action: often, sometimes, or never.

The responses to the set of eight questions for each variable were then summed to designate a strong, moderate or weak preference for a variable such as kinesics.

Churchill and Peter (1984) found that the number of items and scale points impacted reliability more than other measurement chacteristics. Cox (1980) suggested that five to nine categories be used to provide sensitivity in measurement while retaining understanding by respondents. Reliability coefficients should also be higher for a 5-point response scale than for a smaller set of options (Nunnally 1978; Churchill 1987; Cox 1980).

This study expanded the response points from three to five. The modified instrument used the words: often, sometimes, unsure, rarely, and never to describe the numbered choices. This unbalanced set of options enabled the subjects to indicate uncertainty for a variable or particular question (Dillon, Madden and Firtle 1987).

The same defined conceptual traits as the parent personality measurement instrument should have been retained based on this type of modification (Villani and Wind 1975). According to Churchill and Peter (1984) the absence of reverse score items on Likert scales was not shown to lower reliability. Thus, this aspect was not changed for the revised instrument format.

The Sampling Design

Bearden, Sharma and Teel (1982) suggested that samples larger than two hundred be used to reduce the risk of erroneous conclusions from small sample research. Boomsma (1985) recommended that more than one hundred respondents be used for confirmatory factor analysis studies. In a prior study that used the instrument to differentiate media preferences (Furse and Greenberg 1975), a sample of three hundred respondents was used.

Based on these considerations, responses from 285 student subjects were used to provide ten observations per variable included on the instrument. Students enrolled in marketing courses during the Spring semester of 1988, at a university provided the sample population. Surveys were administered during class with the prior consent of the instructors.

Students were not allowed to leave the classroom until the end of the period to help make sure that they did not rush to complete the inventory of questions. The student subjects were asked to voluntarily participate in the study and signed a statement of mutual understanding of the purpose before beginning to answer the questionnaire.

Model Development and Analysis

This section provides a brief synopsis of the next three chapters of this report. The theoretical development of the models occurs in Chapter Two and Chapter Three, while the data analysis is reported in Chapter Four.

Bentler (1986, p. 36) explained that the procedure used to develop and evaluate models is:

> to write out a model containing random vectors and parameters, explicitly state the assumptions underlying the model, identify the fixed and free parameters of the model as well as any constraints, use a statistical function such as maximum likelihood to estimate parameters..., and test the empirical adequacy of the model using appropriate sample data.

Since there was theoretical guidance that specified the constructs and their relationships, a confirmatory factor analysis approach was appropriate (Aaker and Bagozzi 1979; Fassinger 1987). Assuming a correct model and sufficient sample size, chi-square provided a likelihood ratio test statistic to empirically assess overall model adequacy (Jöreskog and Sörbom 1983).

The chi-square statistic has been shown to be sensitive to sample size and violations of normality (Bagozzi 1981; Boomsma 1985). The Tucker-Lewis index offered a different measurement of the explanation provided by each model (Tucker and Lewis 1973; Bentler and Bonnett 1980; Bollen 1986). Improvement in the fit provided by each set of restrictions was measured by using a null model as a baseline comparison.

The parameter estimates and their corresponding standard errors were examined before either model's adequacy was assessed. A root mean square residual (RMSR) analysis compared the error to the size of observed variances and covariances (Jöreskog and Sörbom 1982). Squared multiple correlations (SMC) were used to assess the level of stability of the observed variables for each latent factor (Brooker 1979). As such, the linkages between observed indicators and the defined constructs could be examined.

Specific sets of questions for the inventory variables should have satisfied standard criteria related to validity and reliability to provide evidence of a model's appropriateness (Peter 1979, 1981; Churchill 1979). The eight questions for each of the twenty-eight variables were summed to obtain a preference score. Cronbach's Alpha (1951) and item-total correlations provided evidence of the internal consistency of these eight-item question sets.

Summary of the Design

The research instrument consisted of eight statements designed to measure each of the 28 decoding preference variables, for a total of 224 statements. This research expanded the response choices from three to five. Responses for a question were described with the words: often, sometimes, unsure, rarely, or never. The sample consisted of 285 student subjects.

Two models specified relationships between the set of twenty-eight cognitive style variables and their theoretical constructs. The maximum likelihood method was used to estimate model parameters and to test the empirical adequacy of the alternative specifications. In addition, the Tucker-Lewis index compared the improvement in fit provided by each over a null model.

Limitations of the Research

In general, structural equation modeling allows a separation between measurement and modeling errors. Its limitations lie in the complexity of using the technique and the subjectivity of the assessment of fit for the proposed models (Jöreskog and Sörbom 1982; Sharma and Shimp 1984). The chi-square test statistic simply indicates how well the model reproduces an observed covariance matrix as opposed to providing a formal test of hypothesis for the models (Bentler and Weeks 1980).

The flexibility in the level of confirmation supplied by a study enables the procedure to be used in an exploratory manner which has generated some controversy (Fassinger 1987). Whenever correspondence rules between variables and their constructs are assessed, a basis exists for different philosophical perspectives in interpreting the results (Bagozzi 1981).

Many problems may be encountered when a technique such as this is employed. Sample size sensitivities, distribution constraints, the possibilities of improper solutions such as "Heywood cases" where negative estimates of variances are derived, and the problem of nonconvergence may also present calculation or interpretation difficulties with the technique (Boomsma 1985). While supplementary approaches, such as unrestricted least squares would allow some insight to accrue (Heeler, Whipple and Hustad 1977), the contribution may be questioned if these incidents occur.

An acknowledged limitation of the research design involved the use of student subjects. This practice seemed justified based on the internal validity emphasis of the research and similarity of this group to prior applications of the instrument. All of these potential problems and constraints increased the caution in expecting the results from this one study to confirm construct validity. While the scope was limited to a preliminary investigation, an important link in the development of the concept was attained.

Significance of the Study

Differences in two models for the Hill Inventory variables suggested the need for a comparison of the construct validity of each specification. While construct validity cannot be accomplished in a single study (Cowles and Crosby 1986) guidance for continued development has been provided. The significance of this research was in improving the understanding of the constructs and measurements for the Hill Inventory.

The usefulness of developing a concept with this type of analysis was summarized by Fassinger (1987, p. 426):

> The structural component of the model may be examined separately from the measurement component; this allows inspection of measurement problems (often rooted in psychometric inadequacy) separately from the inspection of structural problems (rooted in the theory under investigation).

A benefit of this method is the ability to minimize unexamined measurement error before theory-testing procedures begin (Fornell and Larcker 1981, p. 386), which implies that:

> There are no strong arguments for limiting structural equations to causal modeling. In many situations it is useful to examine relationships at the empirical level in relation to those at the corresponding abstract level.

A confirmatory factor analysis technique allows the testing of proposed relationships even during the early stages of construct development (Aneshensel, Clark and Frerichs 1983). This type of analysis compares factor structures and the degree of error between the fit of the models and the data (Sharma and Shimp 1984).

Computer programs, such as LISREL, have been used to examine hypothesized structures (Bagozzi 1981, 1983; Strain et al. 1986). The theoretical links between variables suggest how measurements can be improved (Maruyama and McGarvey 1980).

The results of this study establish a clear direction for applications of the Hill Inventory in consumer behavior research. Before applied studies can be proposed, the questions would need to be revised. In addition, the estimates for the models provide a basis for comparison that may be used to guage improvement in the explanation of a modified set of questions for the variables.

Organization of the Dissertation

An overview of the study has been provided in this chapter. The objectives that have been established will be implemented in the chapters which follow. The cognitive style preference constructs and variables for the alternative models are defined in Chapter Two. The Hill Inventory is described before discussing the consumer behavior perspective.

The empirical models for the LISREL procedure are specified in Chapter Three. A confirmatory factor model describes the orthogonal constructs of the Hill Inventory, while a structural equation specifies the alternative model. Once the models are specified and shown to be identified, the estimation method and statistical hypotheses are defined. Then, planned comparisons of the fit provided by the alternative models to the observed data will be introduced.

The descriptive statistics and parameter estimates obtained from the data are provided in Chapter Four. This discussion begins with measures that compare the distributions of the summed scores for each variable to a normal case. Parameter estimates for each of the models based on the LISREL VI software package are then provided. The descriptive measures conclude with reliability estimates for the inventory variables.

The model results are compared in Chapter Five as the information is interpreted. These comparisons must be viewed as exploratory in nature based upon the reliability estimates. The item-total correlations for the eight-question sets that measure each of the variables indicate that revisions are needed. A discussion of the limitations of the research precedes the concluding comments.

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CHAPTER II

COGNITIVE STYLE PREFERENCES

Individual preferences for acquiring information are formed, molded and changed based on abilities, habits and interactions with others. The term "communication" implies a sharing of meaning (Bauer 1964; Zaltman 1965). During the communication process, various codes are used to form messages (Williams and Spiro 1985). These codes, or message symbols, represent objects and ideas that must be understood for an individual to acquire information.

As defined by Hill (1972, 1976a,b) an individual's cognitive style preferences represent consistent methods of acquiring information that involve personal methods for understanding various symbols used to communicate meaning. Defining the symbols, or codes of interest for this research begins with an identification of the variables. Then, the rationale for modifying the implied structure of the variables be reviewed.

The Hill Inventory

For a person to understand a message, symbolic systems within the communication process must be learned and understood. The Hill Inventory uses four constructs to explain types of message symbols that differentiate individual preferences: Theoretical Codes, Qualitative Codes, Social-Cultural Codes, and Reasoning Modalities. Specific preferences differentiate personal approaches for identifying symbols used during communication.

Within the context of a situation, cognitive style preferences are thought to be relatively consistent or stable (Greenberg 1974; Ehrhardt 1981). Learned patterns for understanding codes are described as enduring and capable of affecting lifelong communication habits (Ehrhardt 1983), as well as differentiating message understanding (Greenberg, Massey and Blake 1987). Habits or routines are also used by consumers in their decision making processes to reduce tension (Bilkey 1953). For example, people select familiar promotional messages because they involve less risk or effort and provide more comfort in the learning process (Moriarty 1986).

In the sections that follow, the four constructs used to describe the Hill Inventory will be defined. Beginning with the Theoretical Codes, specific variables are identified for each construct that differentiate individual preferences.

Theoretical Codes

Derived from academic aptitude or achievement tests, the Theoretical Codes assess an individual's understanding of verbal and numeric information in written and oral form

(Hill 1976a). The variables used to assess this construct are defined in Table 2.1. The inventory of questions provides eight measures for each of the four variables to form thirty-two questions to assess this construct.

Table 2.1
Theoretical Code Variables of the Hill Inventory

Theoretical Code Preference Variables	Definition
Auditory-Linguistics	Preferences for acquiring information through hearing words. Learning through symbolic verbal information that is spoken.
Auditory-Quantitative	Preferences for acquiring information through hearing non-word symbols. Learning through symbolic numerical or technical information that is spoken.
Visual-Linguistics	Preferences for acquiring information through reading words. Learning through verbal symbolic information that is seen.
Visual-Quantitative	Preferences for acquiring information through seeing non-word symbols. Learning through symbolic numerical or technical information that is seen.

For further information, see for example: Allport 1955; Broadbent 1957; Guilford 1959; Hill 1972, 1976a; Greenberg 1972, 1974; Cohen 1977; Strother 1982; Ehrhardt 1981, 1983; Keefe 1982; or Carini 1983.

Verbal codes refer to a preference for hearing information. Hearing is a selective process due to the information handling ability within an individual (Broadbent 1957). Further, verbal and visual aptitudes are seen to be highly correlated with general intelligence measures (Berelson and Steiner 1964).

Within marketing, consumers choose the medium and the message that will reach awareness (McDonald 1983) based upon characteristics similar to the code preference variables defined by the inventory. For example, empirical assessments diferentiate verbal and visual cognitive styles of individuals (Richardson 1977). Other studies contrast preferences for print versus audio messages (Wright 1974) and verbal versus visual information formats (Childers, Houston and Heckler 1985).

Mitchell (1986) suggested that consumers exhibit different attitudes toward the visual and verbal components of advertisements. Cole and Houston (1987) profiled the difficulties of some elderly consumer segments in processing print information or in learning from codes used in television. Thus, the Theoretical Code variables correspond to interests of marketers. The second construct of the Hill Inventory identifies Qualitative Code preferences.

Qualitative Codes

The five senses--auditory (hearing), visual (seeing), savory (tasting), tactile (touching), and olfactory (smelling)--are the channels that allow individuals to perceive stimuli. The sensory receptors, their interaction and affiliated influences mediate meanings assigned to encountered symbols (Burk 1968). Each of the sixteen preference variables is defined in Table 2.2 on the following three pages. The inventory includes eight questions for each of the sixteen preference variables to form a total of 128 questions for this construct.

During communication, sensations are converted into perceptions of the world with appropriate meanings incorporated into existing belief structures (Vernon 1966; Olson, Toy and Dover 1978, 1982). People understand codes other than those involved when reading or hearing verbal and numeric information. For example, Duncan (1969) emphasized the work of Birdwhistell who transcribed body motions into symbols of movement that conveyed meaning to others. Hall (1959, 1963, 1966) described the different meanings for social distances used when talking with others. While, Purdy (1935) directed his interest toward sensori-motor coordinations.

The variables on the inventory, such as empathy, proxemic, and kinesic, reflect an individual's preference for acquiring information in ways that go beyond hearing or seeing. In essence, the sixteen variables included on the inventory represent a variety of socially-determined meanings for message symbols.

Table 2.2
Qualitative Code Variables of the Hill Inventory

Qualitative Code Preference Variables	Definition
Auditory (hearing)	Learning is enhanced/inhibited by hearing. Ability to distinguish between sounds or tones of music. Noise or sounds may help or inhibit concentration.
Olfactory (smelling)	Learning is enhanced/inhibited by smells. Whether it is taken for granted, or overly sensitive, the sense of smell has the capacity to arouse fear, sadness, disgust, longing, or love.
Savory (taste)	Learning is enhanced by taste. Such activities as: smoking, chewing gum, eating mints, or chewing pencils, aid concentration.
Tactile (touch)	Learning through the sense of touch, temperature, or pain. May be experienced effectively through emotions as well as through physical sensations.
Visual (sight)	Perceiving with the eyes. May resent off-color videos or have trouble screening what is seen.
Proprioceptive (synthesizing)	Perceiving through a combination of sensory receptors in completing a task, such as typewriting or playing a musical instrument. May enjoy holding a number of ideas simultaneously or combining simple parts into complex acts.

(Table continues)

Table 2.2 (continued)

Qualitative Code Preference Variables	Definition
Empathetic	Sensitivy to the emotions or feelings of others allows the person to see things from another's point of view. May desire to relate to another when learning.
Aesthetic	Enjoyment of the beauty of an object, idea, or surroundings, in and of itself. Beautiful scenery, a well-written verse or constructed building may all appeal.
Ethic	Not necessarily morality, ethics refers to a commitment to a personal set of values, obligations, principles, or duties. Using ideographically defined values, for example, a priest and a criminal may both have a strong sense of ethics to their respective causes.
Histrionic	From theatre, this code refers to a preference for playing roles or the ability to understand and comply with role expectations. May prefer to exhibit a deliberate behavior, or to play a role.
Kinesic	Nonverbal behaviors include body motions, posture, gestures or other movements such as facial expressions. May be important to some and unnoticed by others. May be indicated by the use of hands when speaking.

(Table continues)

Table 2.2 (continued)

Qualitative Code Preference Variables	Definition
Kinesthetic	Involvement of the musculature in learning does not necessarily refer to mechanical aptitude. May be acquired through socialization, or social molding processes involving training. May enjoy performing motor skills that require learning an acceptable form, i.e. golf.
Proxemic	The use of social and personal space and the perception of it. Four distances for interpersonal communication include: intimate, personal, social, and public. May affect comfort in entering a conversation or dressing correctly for an occasion.
Synnoetics	Self-knowledge and awareness of one's goals and limitations. A basic awareness of capabilities and limitations may enhance/inhibit desire to acquire information or trust another's opinion.
Transactional	Influencing others, or selling an idea or product effectively involves persuasive skills. May like to convince others or be convinced by discussing differing viewpoints.
Temporal	Awareness of time and the tendency to be late or timely for appointments. Could also involve preferences for learning in the morning or the afternoon.

(For further discussion, see, for example: Purdy 1935; Hall 1959, 1963, 1966; Duncan 1969; McGregor 1974; Hill 1972, 1976a; Greenberg 1972, 1974; Dawson and Bettinger 1977; Ehrhardt and Corvey 1981; Fazio, Effrein and Falender 1981; and, Leckenby and Stout 1985)

Within marketing, Qualitative Code variables have been used to differentiate such issues as: individual message preferences (Hulbert and Capon 1972); perceptions based on sensory discrimination ability (Riordan and Morgan 1980); the content of advertising based on sensory or non-sensory judgments (Shimp 1982); and, individual attitudes toward products based on tactile or aesthetic experiences (Dawson and Bettinger 1977; Holbrook and Moore 1980). Studies of the relationships between depictive feelings and emotions displayed in advertisements (Leckenby and Stout 1985) have included aesthetic issues as well as an understanding of various roles emphasized in the messages (McGregor 1974; Holbrook and Moore 1980).

As Tolman (1932) indicated, individuals respond to presented symbols, many of which are social in nature. The Social-Cultural Codes consist of variables that reflect a preference for styles of communicating with others.

Social-Cultural Codes

Social-Cultural Code preferences reflect an individual's reliance upon the self or others to decide which symbols will be accepted or used. Three Social-Cultural Code variables on the Hill Inventory refer to authoritative, associative and independent preferences, and are defined in Table 2.3. The inventory includes eight questions for each of these variables to form a total of thirty-two questions for the construct.

Table 2.3
Social-Cultural Code Variables of the Hill Inventory

Social-Cultural Code Preference Variables	Definition
Associates	Preferences for working with friends or in small groups. May identify with peer groups or socially-oriented symbols.
Family	Preferences for authoritative symbols. May identify with the family, teachers, or other authority figures. Enjoys working under the direction of someone who supplies highly structured directions.
Independent	Preferences for learning new information on an individual basis. May enjoy working under as few constraints as possible. Enjoys symbols of self-sufficiency, self-reliance and autonomy.

For further information, see for example: Tolman 1932; Newcomb 1953; Katz 1960; Klapper 1960; Cohen 1967; Berger and Luckman 1967; Cohen and Golden 1972; Greenberg 1972, 1974; Hill 1976a; Moschis and Churchill 1978; Moschis 1980.

Individuals learn to respond to symbols based on interactions with others (Berger and Luckman 1967). A socialization process influences the information that people will accept as evidence about reality (Cohen and Golden 1972; Moschis and Churchill 1978). Respect for authority and susceptibility to persuasion relate to authoritative or familial code preferences (Ehrhardt and Corvey 1981). Autonomy relates to acquiring information independently of others (Gensch and Ranganathan 1974).

Newcomb (1953) discussed an individual's role as it is moderated by the perceptions held by others. Studies have also examined such issues as: opinion leadership and attitude formation (Katz 1960); inner-versus other-direction and susceptibility to social influences (Centers and Horowitz 1963); the role of the mass media in forming impressions of products based on lifestyles (Ward and Wackman 1971); and, social utilities, or predispositions to share information (Cohen 1967; Cohen and Golden 1972; Moschis 1980).

Within marketing, people moderate symbolic consumption in relation to products (Hirschman 1980, 1981) and media usage as well (Kassarjian 1965, 1971; Woodside 1969; Haley 1971; Hirschman and Wallendorf 1980, 1982). Acccording to Burk (1968), symbols may be used as a major means of communicating product meanings and values. Consumer predispositions are learned through social phenomena that stem from reference groups and culture (Markin 1974). For marketing communications, word-of-mouth advertising is stimulated through symbols conveyed by the mass media (Klapper 1960).

Once information is received and accepted, individuals use processing strategies to form a response or to make a decision (Capon and Burke 1980; Capon and Davis 1984). Alternative types of reasoning patterns are used by individuals to interpret perceived information.

Reasoning Modalities

Methods of reasoning establish the rules for interpreting symbols and for incorporating information into memory. Individuals prefer to interpret perceived stimuli by with different decoding process modalities. The five variables that assess the Reasoning Modality construct are defined in Table 2.5 on the following page. The inventory includes eight questions for each of the five variables to provide a total of forty questions for this construct.

For scales developed prior to the Hill Inventory, English (1954), for example, contrasted four individual styles of processing symbols based on such factors as: similarity, contrast, coexistence in space and succession in time. Individuals were seen to reason based on whether two symbols were similar, different, or related to each other. Guilford (1959) used two processing indicators: convergent and divergent. The former was defined as a search for similarities between concepts or symbols, while the latter focused on the differences.

Within marketing, research studies have associated message formats with information acquisition strategies, responses to messages and ultimate recall of information (Bettman and Kakkar 1977; Olson, Toy and Dover 1978, 1982; Capon and Davis 1984). Other Reasoning Modality variables, similar to the ones chosen for the Hill Inventory have also been used.

Table 2.4
Reasoning Modality Variables of the Hill Inventory

Reasoning Modality Preference Variables	Definition
Magnitude	Categorical reasoning, a preference for a clear set of rules, classifications or definitions for accepting or rejecting an idea. May want to know the policy or to have clear definitions in order to understand new symbols or information.
Difference	Differential reasoning, a preference for contrasting new information with old. May want to see how symbols or products differ from alternative options.
Relationship	Inductive reasoning, a pattern of looking for similarities between new information and what was learned before. May want to look at a number of specific cases and explain them with one general rule.
Appraisal	Analytical reasoning, a preference for using magnitudes, differences and relationships. May see a problem from all sides, thus may absorb new material slowly and in some detail.
Deduction	Logical reasoning, a preference for using a deductive reasoning mode to solve problems sequentially. May want to understand a general principle before a specific case.

For further information, see for example: English 1954; Guilford 1959; Vernon 1966; Greenberg 1972, 1974; Peterson and Scott 1975; Hill 1976a; Scott, Osgood and Peterson 1979; Capon and Burke 1980; Hirschman 1980, 1981, 1985; Ehrhardt and Corvey 1981; Capon and Davis 1984; Childers, Houston and Heckler 1985.

For example, the number of attributes assessed or characteristics assigned to an object has been used to describe the cognitive complexity of individuals (Peterson and Scott 1975; Scott, Osgood and Peterson 1979; Hirschman 1980). Similar to the Reasoning Modality variable for appraisal of the Hill Inventory, an individual who prefers this reasoning style desires multiple explanations for any perceived phenomena (Hirschman 1985).

Inductive reasoning patterns are used by researchers who describe relationships among perceived stimuli (Young 1966), or who use a simplifier/clarifier scale to assess cognitive styles (Schaninger and Sciglimpaglia 1981). Social comparison, and symbolic socialization seem similar to the Reasoning Modality of magnitude (Moschis 1980; Hirschman 1981). While, scientific research strives for deductive Reasoning Modalities (Hunt 1983).

Summary of the Hill Inventory

An individual's cognitive style represents a personal method for identifying and understanding various symbols that are used to communicate meaning. The Hill Inventory uses four constructs to represent cognitive style preferences: Theoretical Codes, Qualitative Codes, Social-Cultural Codes and Reasoning Modalities. Specific variables differentiate aspects of preferences for each construct.

The set of variables are discussed in the next section based on a different view of the constructs used to explain cognitive style decoding preferences. A model of the communication process is provided that describes concepts similar to those included in the Hill Inventory. This serves as the basis for deriving a structural equation model of the inventory based on the alternative definition of the constructs.

Modified Construct Definitions

A distinction is sometimes difficult to make between such aspects of the communication process as perceiving, understanding or remembering. As Young (1966, p. 153) described it:

> Perceiving is related to action as, for example, when a man sees a red light and steps on the brake pedal of his car. Perceiving is related to memory as, for example, when one recognizes the face of a friend in a crowd...Perceiving is related to thinking: If one reads a problem and starts to work out a solution, the reasoning was initiated by the perception of printed words.

Little specific guidance has yet been provided as to the nature of the relationships between the constructs of cognitive style decoding preferences. The following sections develop a theoretical basis for modifying the constructs used for the Hill Inventory. First, a model of the communication process is provided to establish the direction of inquiry. Then, the alternative construct specification is provided to conclude the chapter.

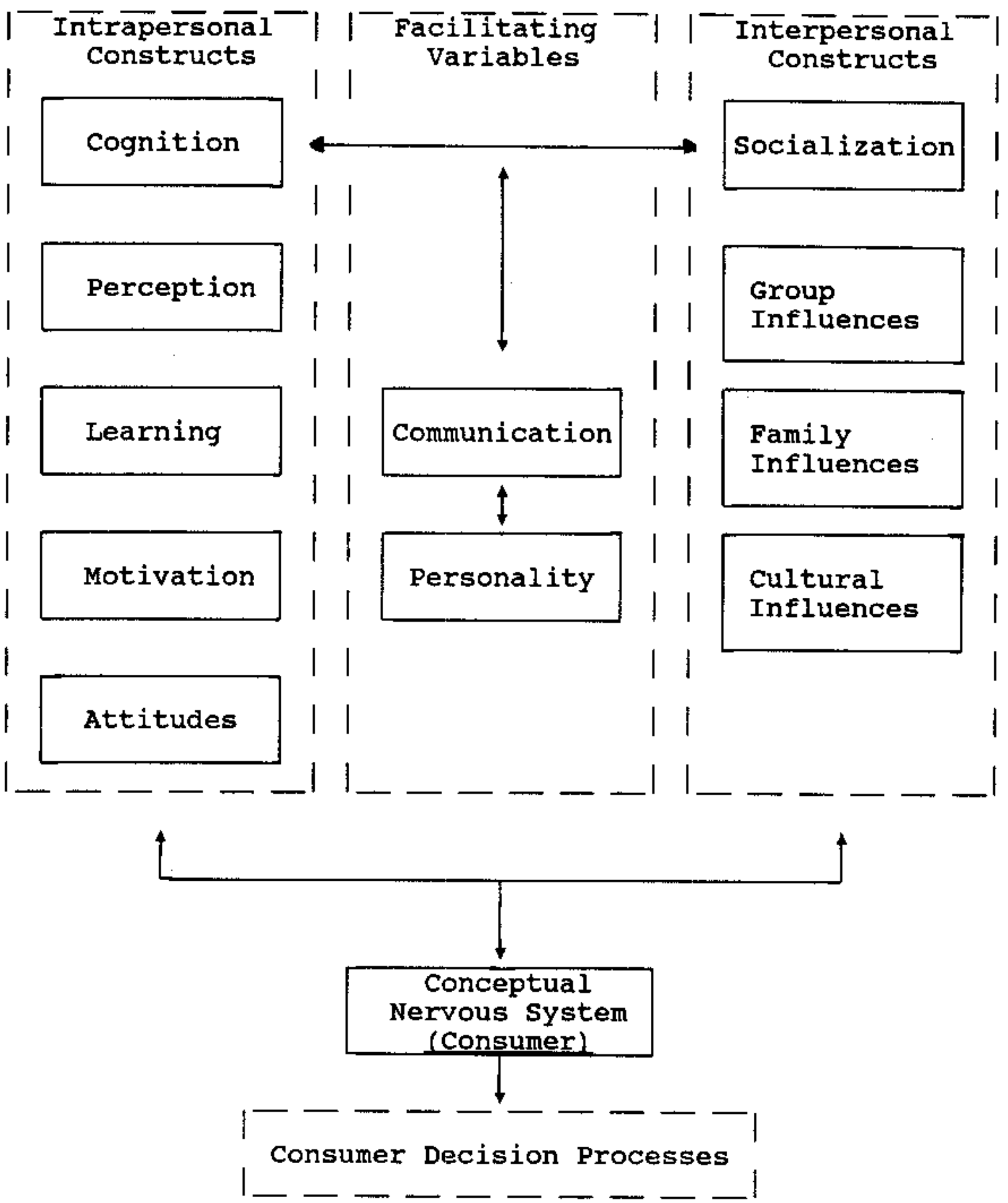
The Communication Process

A message consists of a set of encoded symbols. Individual differences affect how individuals perceive and assign meaning to the symbols they encounter. Any distinguishable combination of parts of a communication may be expected to vary according to beliefs, interests, expectations, and cultural backgrounds (Zaltman 1965).

An individual's ability to communicate with other people is not a single, unitary concept. Rather, a series of specific abilities interact to form a general capability (Berelson and Steiner 1964). A consumer behavior perspective of the communication process is shown in Figure 2.1 on the following page. It distinguishes between intrapersonal and interpersonal constructs that affect how messages are incorporated into the decision making processes.

When the inventory variables are viewed from the perspective of Figure 2.1, an alternative set of constructs may be suggested. Three constructs--Evaluation Codes, Perceptual Codes and Reasoning Modalities--might explain decoding preferences. Further, this model suggests that the first two constructs moderate the reasoning processes selected. Thus, this model provides relationships between the constructs and a proposed direction for decoding situations.

Figure 2.1
A Consumer Behavior Model of the Decision Process



Adapted from: Rom J. Markin, Jr. (1974), Consumer Behavior: A Cognitive Orientation, New York: Macmillan Publishing Co. Inc., p. 489.

Holbrook and Huber (1979) suggested that culturally-defined codes affected an internal evaluation construct related to an individual's ability. Other researchers have also emphasized that preferences for using various socially-defined codes should be distinguished from abilities involved in acquiring information (Goldstein and Blackman 1978; Ehrhardt 1983; Clark and Halford 1983).

Richardson (1977) argued that coding ability and learned preferences were literally independent dimensions along which individuals may vary. Childers, Houston and Heckler (1985) showed that one dimension of information processing, in general, related to abilities while a second dimension referred more to a style of processing. Further, their study also suggested that the use of verbal or visual symbols altered processing preferences.

Freyd (1987) also implied that perceptual processes provide the basis for higher cognitive mechanisms, such as reasoning. Kenny and Albright (1987) showed that it was possible to measure cognitive perceptions separately from differences in social skills. Marks (1987, p. 393) stated that:

> Processing begins with sensory/perceptual encoding, is followed by comparison of internal representations to some reference, and ends with a response selection.

Marlow (1986) emphasized that social intelligence was a separate concept from an academic intelligence construct. While both constructs may interact to form a general capability (Berelson and Steiner 1964), they have been viewed as separate considerations. Johnson and Russo (1978) found that a consumer's use of a particular type of decision rule depended on the structure of the available product information. In effect, consumers processed information differently based upon the message format (Bettman and Kakkar 1977). Thus, sets of learned responses to communicated symbols affected subsequent decision processes (Allport 1955; Burk 1968).

Basic components of an individual's cognitive decoding style include: (1) an ability to use symbols; (2) a preference for using symbols; (3) cultural factors that influence their interpretation; and (4) decision-making methods (Goodman 1978). Consistent with the studies described above, these components relate to abilities, preferences learned through cultural norms, and processing styles.

This insight offers an alternative view of the variables of the Hill Inventory. Based on this perspective, the sensory code preference variables would be more closely related to theoretical variables than to the other Qualitative Code preferences (Kirby and Jarman 1975).

In specific terms, the modified constructs group the theoretical variables with the qualitative-sensory code variables. This evaluation code construct interacts with a Perceptual Code construct that includes qualitative-social code variables and Social-Cultural Code variables. These two constructs, in turn affect the Reasoning Modality construct.

Thus, interactions between evaluations based on ability and Perceptual Code preferences learned from others have been cited as affecting subsequent cognitive processes. Support for this view has been provided from a general perspective as well as within the consumer behavior literature. Preferences for various codes have been thought to impact how an individual interprets incoming stimuli (Carini 1983).

Definition of the Constructs

A revised definition of the constructs that explain cognitive style preferences is shown in Table 2.5 on the following page. This perspective shows variables that comprise three constructs: Evaluation Codes, Perceptual Codes and Reasoning Modalities. There are ten, thirteen, and five variables used to assess each of these constructs, respectively.

Evaluation code preferences refer to individual abilities to communicate through the sensory receptors. The Perceptual Code construct relates to socially-determined variations of message symbol meanings. While, the Reasoning Modality construct indicates alternative methods of processing perceived information. Theoretical and Qualitative Code sensory variables of the Hill

Inventory are used to form a new construct, Evaluation Codes. Qualitative Code social and Social-Cultural Code variables become the Perceptual Code construct.

Table 2.5
Hill Inventory Constructs Based on a Consumer Behavior View

Construct and Definition	Preference Variables
Evaluation Codes: refer to ability-related variables and sensory receptors	Auditory Linguistic Auditory Quantitative Visual Linguistic Visual Quantitative Auditory Olfactory Savory Tactile Visual Proprioceptive
Perceptual Codes: refer to socially-determined meanings for codes	Empathetic Aesthetic Ethics Histrionic Kinesic Kinesthetic Proxemic Synnoetic Transactional Temporal Associates Family Independent
Reasoning Modalities: refer to individual preferences for styles of processing perceived information	Magnitude Difference Relationship Appraisal Deduction

This perspective depicts evaluation variables as part of a separate construct from Perceptual Codes learned during a socialization process. Individual abilities interact with the social rules learned or used in communication. These two constructs provide the symbols selected as inputs for an individual's reasoning processes.

Summary of the Modified Constructs

A consumer behavior model of decision processes during communication provides a basis for modifying the constructs used in the Hill Inventory to explain cognitive style decoding preferences. This view suggests that three constructs are appropriate: Evaluation Codes, Perceptual Codes and Reasoning Modalities. Evaluation and Perceptual Code preferences are defined as affecting the type of Reasoning Modality employed.

This perspective uses these three defined constructs to explain the set of variables of the Hill Inventory. Evaluation Codes are related to aspects of ability and the sensory receptors. Perceptual Codes refer to socially-defined symbols.

The next chapter develops the two model concepts of the Hill Inventory. In this manner, the adequacy of these alternative construct specifications for cognitive style decoding preferences can be empirically examined. The subsesquent analysis should suggest which view more adequately describes observed data.

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CHAPTER III

THE EMPIRICAL MODELS

The empirical model specifications that will be compared to the observed structure of the data are defined in this chapter. Once the models are specified through their implied equations and shown to be identified, the estimation method is described. A measurement model defines the relationships between observed and latent variables which provides a means for describing the validity and reliability of the data (Stewart 1981; Jöreskog and Sörbom 1983). A structural equation model specifies the proposed causal structure among the latent variables (Pedhazur 1982; Fassinger 1987).

These two perspectives are applied to the variables of the Hill Inventory. This inventory consists of four defined constructs: Theoretical Codes, Qualitative Codes, Social-Cultural Codes, and Reasoning Modalities. A confirmatory factor analysis is used to assess the degree to which the data conform to this proposed structure. Then, a structural equation model for the Hill Inventory is developed that contains three constructs: Evaluation Codes, Perceptual Codes and Reasoning Modalities. This view is based on a consumer behavior perspective.

Model Specifications

Model specifications are formal statements about the relationships between theoretical constructs, observed variables and corresponding errors (Fassinger 1987). A classical explanation of measurement error assumes that an individual has a true score from which measured observations differ on a random basis, i.e. $y = \eta + \epsilon$ (Nunnally 1978). When several measures are used for a construct, the true-score model is expressed as:

$$Y = \Lambda_y \eta + \epsilon$$

$$X = \Lambda_x \xi + \delta$$

In this format, y and x become vectors of measures, η (eta) is a vector of true scores for endogenous variables, ξ (xi) is a vector of true scores for exogenous variables, Λ (lambda) is a matrix of parameters that relate the observations to true scores, and ϵ (epsilon) and δ (delta) are vectors of errors (Bagozzi 1983).

According to Bentler and Bonett (1980, p. 589):

> Sample data are summarized in S, the sample covariance matrix. It is hypothesized that the corresponding population covariance matrix Σ with elements σ (sigma) is generated by q true though unknown parameters that can be assembled in the q x 1 vector Θ (theta), so that each element of the covariance matrix is a function of the q elements of Θ (theta) under a given model.

The relationship between S and Σ is estimated based on the theoretical models. These proposed structures are then compared to the patterns observed in the data.

For example, the matrix of observations for exogenous variables is summarized as:

$$\Sigma = \Lambda_x \Phi \Lambda_x' + \Theta$$

In this formula, Λ (lambda) is a matrix of parameters relating observations to true scores; Φ (phi) is the covariance of true scores, and Θ (theta) is a matrix of error variances and covariances (Bagozzi 1980). If the sample data matrix conforms to the hypothesized structure, S will converge to Σ (Bentler and Bonett 1980). The extent to which S approaches the proposed Σ forms a basis for testing the two models of interest.

The proposed factor structures for the confirmatory factor and the structural equation models will be defined graphically and in matrix form. Once each model is specified, the issues of identification and estimation are addressed.

Confirmatory Factor Model Specifications

The Hill Inventory consists of four constructs, or exogenous variables, that are measured by twenty-eight observed variables. The graphic representation of the implied factor structure is shown in Figure 3.1 where the Theoretical Codes, Qualitative Codes, Social-Cultural Codes and Reasoning Modalities are assumed to be uncorrelated. The fixed and free parameters to be estimated are then identified in Table 3.1 for this model.

Figure 3.1
The Confirmatory Factor Model of the Hill Inventory

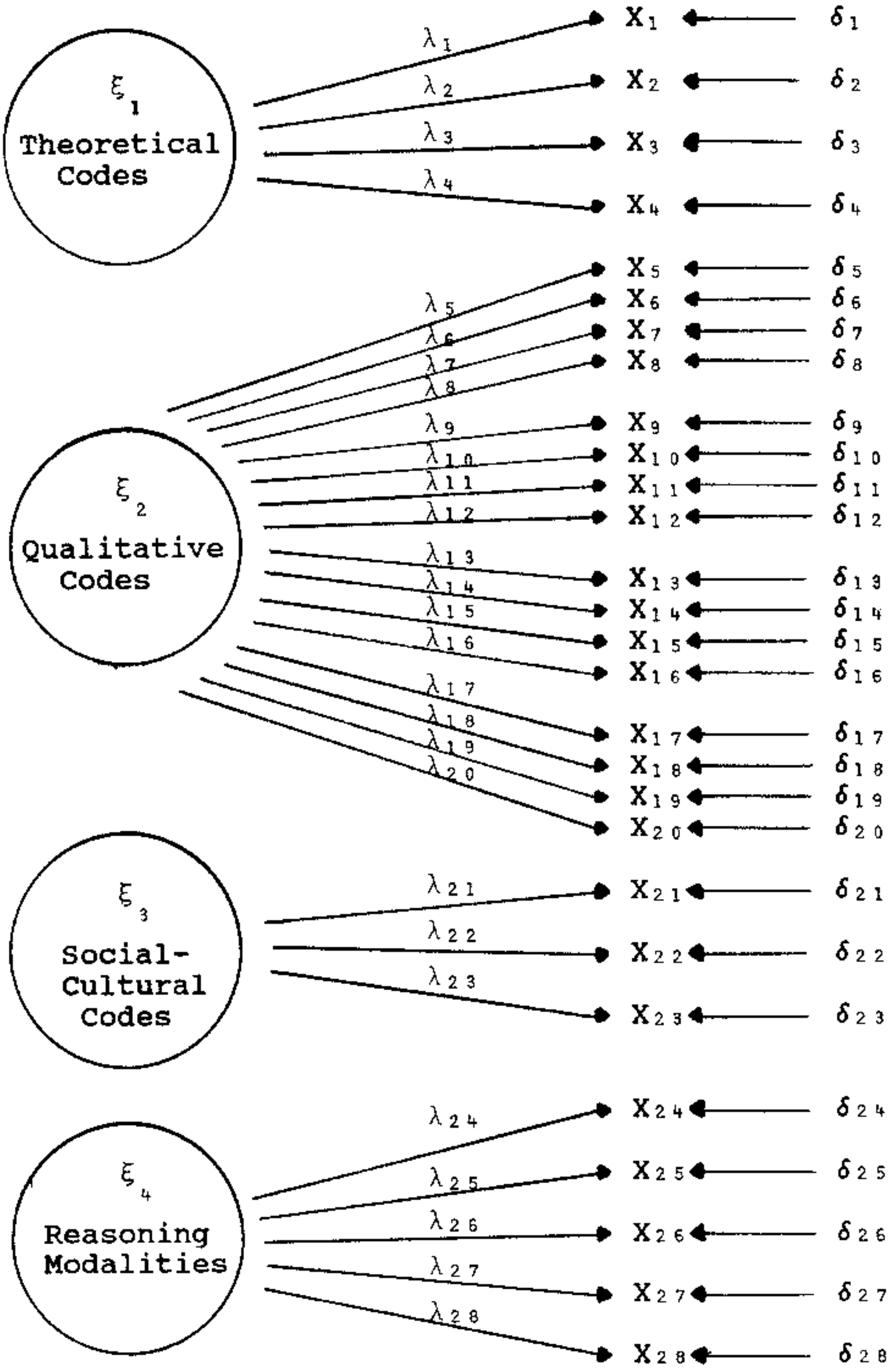


Table 3.1
Fixed and Free Parameters of the Confirmatory Factor Model for the Hill Inventory

Observed Variables	Proposed Exogenous Variables: Theoretical Codes	Qualitative Codes	Social-Cultural Codes	Reasoning Modalities
Auditory-Linguistic	1	0	0	0
Auditory-Quantitative	1	0	0	0
Visual-Linguistic	1	0	0	0
Visual-Quantitative	1	0	0	0
Auditory	0	1	0	0
Olfactory	0	1	0	0
Savory	0	1	0	0
Tactile	0	1	0	0
Visual	0	1	0	0
Proprioceptive	0	1	0	0
Empathetic	0	1	0	0
Aesthetic	0	1	0	0
Ethic	0	1	0	0
Histrionic	0	1	0	0
Kinesic	0	1	0	0
Kinesthetic	0	1	0	0
Proxemic	0	1	0	0
Synnoetic	0	1	0	0
Transactional	0	1	0	0
Temporal	0	1	0	0
Associative	0	0	1	0
Familial	0	0	1	0
Independent	0	0	1	0
Magnitudes	0	0	0	1
Differences	0	0	0	1
Relationships	0	0	0	1
Appraisal	0	0	0	1
Deduction	0	0	0	1

Zeros equal fixed parameters, and ones represent parameters to be estimated.

In mathematical terms, the measurement model consists of the equations shown in Table 3.2 below.

Table 3.2
The Confirmatory Factor Measurement Model Equations

$X = \Lambda_1 \xi_1 + \delta_1$	$X = \Lambda_{15} \xi_2 + \delta_{15}$
$X = \Lambda_2 \xi_1 + \delta_2$	$X = \Lambda_{16} \xi_2 + \delta_{16}$
$X = \Lambda_3 \xi_1 + \delta_3$	$X = \Lambda_{17} \xi_2 + \delta_{17}$
$X = \Lambda_4 \xi_1 + \delta_4$	$X = \Lambda_{18} \xi_2 + \delta_{18}$
	$X = \Lambda_{19} \xi_2 + \delta_{19}$
$X = \Lambda_5 \xi_2 + \delta_5$	$X = \Lambda_{20} \xi_2 + \delta_{20}$
$X = \Lambda_6 \xi_2 + \delta_6$	
$X = \Lambda_7 \xi_2 + \delta_7$	$X = \Lambda_{21} \xi_3 + \delta_{21}$
$X = \Lambda_8 \xi_2 + \delta_8$	$X = \Lambda_{22} \xi_3 + \delta_{22}$
$X = \Lambda_9 \xi_2 + \delta_9$	$X = \Lambda_{23} \xi_3 + \delta_{23}$
$X = \Lambda_{10} \xi_2 + \delta_{10}$	
$X = \Lambda_{11} \xi_2 + \delta_{11}$	$X = \Lambda_{24} \xi_4 + \delta_{24}$
$X = \Lambda_{12} \xi_2 + \delta_{12}$	$X = \Lambda_{25} \xi_4 + \delta_{25}$
$X = \Lambda_{13} \xi_2 + \delta_{13}$	$X = \Lambda_{26} \xi_4 + \delta_{26}$
$X = \Lambda_{14} \xi_2 + \delta_{14}$	$X = \Lambda_{27} \xi_4 + \delta_{27}$
	$X = \Lambda_{28} \xi_4 + \delta_{28}$

These measurement model equations are summarized as:

$$X = \Lambda_x \xi + \delta$$

For this research, X is a (28 x 1) vector of observed variables; Λ (lambda) is a (28 x 4) matrix of the coefficients relating X and the exogenous variables; ξ (xi) is a (4 x 1) vector of unobserved exogenous variables; and δ (delta) is a (28 x 1) vector of residuals, or errors. Further, the model assumes that the variables and errors are measured as deviation scores and that the errors are uncorrelated with the exogenous variables (Bagozzi 1980). These specifications provide the hypothesized structure for the variables of the Hill Inventory.

The proposed covariance matrix ($\Sigma = \Lambda_x \Phi \Lambda_x' + \Theta$) results from multiplying the (28 x 4) Λ_x matrix by Φ (phi), an identity matrix, and by the (4 x 28) Λ_x' matrix. The Θ_δ (theta-delta) matrix, which is added to the product, is a diagonal matrix of unique variances for each variable.

Structural Equation Model Specifications

In addition to defining the measurement model, the structural equations relate exogenous to endogenous variables. Designating endogenous variables as η (eta) and exogenous variables as ξ (xi), the structural equation and corresponding matrices are shown in Table 3.3. For this model, β (beta) is based on the one endogenous variable; η (eta) is a (1 x 1) vector of the latent endogenous variable; Γ (gamma) is a (1 x 2) matrix of coefficients of the effects of exogenous variables; ξ (xi) is a (2 x 1) vector of latent exogenous variables; and ζ (zeta) is a (1 x 1) vector of residuals, or errors in the equation. The resulting measurement matrices are shown in Table 3.4.

Table 3.3
The Structural Equation Model for the Hill Inventory

$$\begin{bmatrix} 1 \end{bmatrix} \eta_1 = \begin{bmatrix} \gamma_1 & \gamma_2 \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \zeta \end{bmatrix}$$

$$\beta \quad \eta \quad = \quad \Gamma \quad \xi \quad + \quad \zeta$$

Table 3.4
Measurement Matrices for the Structural Equation Model

Endogenous Variable Measurement Matrices

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \end{bmatrix} = \begin{bmatrix} \lambda_{24} \\ \lambda_{25} \\ \lambda_{26} \\ \lambda_{27} \\ \lambda_{28} \end{bmatrix} \begin{bmatrix} \eta_1 \end{bmatrix} + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \epsilon_4 \\ \epsilon_5 \end{bmatrix}$$

$$Y = \Lambda_y \quad \eta + \epsilon$$

Exogenous Variable Measurement Matrices

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \\ X_7 \\ X_8 \\ X_9 \\ X_{10} \\ X_{11} \\ X_{12} \\ X_{13} \\ X_{14} \\ X_{15} \\ X_{16} \\ X_{17} \\ X_{18} \\ X_{19} \\ X_{20} \\ X_{21} \\ X_{22} \\ X_{23} \end{bmatrix} = \begin{bmatrix} \lambda_1 & 0 \\ \lambda_2 & 0 \\ \lambda_3 & 0 \\ \lambda_4 & 0 \\ \lambda_5 & 0 \\ \lambda_6 & 0 \\ \lambda_7 & 0 \\ \lambda_8 & 0 \\ \lambda_9 & 0 \\ \lambda_{10} & 0 \\ 0 & \lambda_{11} \\ 0 & \lambda_{12} \\ 0 & \lambda_{13} \\ 0 & \lambda_{14} \\ 0 & \lambda_{15} \\ 0 & \lambda_{16} \\ 0 & \lambda_{17} \\ 0 & \lambda_{18} \\ 0 & \lambda_{19} \\ 0 & \lambda_{20} \\ 0 & \lambda_{21} \\ 0 & \lambda_{22} \\ 0 & \lambda_{23} \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \\ \delta_7 \\ \delta_8 \\ \delta_9 \\ \delta_{10} \\ \delta_{11} \\ \delta_{12} \\ \delta_{13} \\ \delta_{14} \\ \delta_{15} \\ \delta_{16} \\ \delta_{17} \\ \delta_{18} \\ \delta_{19} \\ \delta_{20} \\ \delta_{21} \\ \delta_{22} \\ \delta_{23} \end{bmatrix}$$

$$X = \Lambda_x \quad \xi + \delta$$

The assumptions of the model include that the variables are measured as deviation scores with means equal to zero, that ζ (zeta) and ξ (xi) are uncorrelated, and that β (beta) is nonsingular (Pedhazur 1982; Bagozzi 1980). In addition to these matrices, Φ (phi) is an identity matrix, the Θ (theta) matrices are diagonal containing the unique variances for each of the variables, and Ψ (psi) is a (1 x 1) matrix of residuals for η (eta).

The measurements of this model are summarized as:

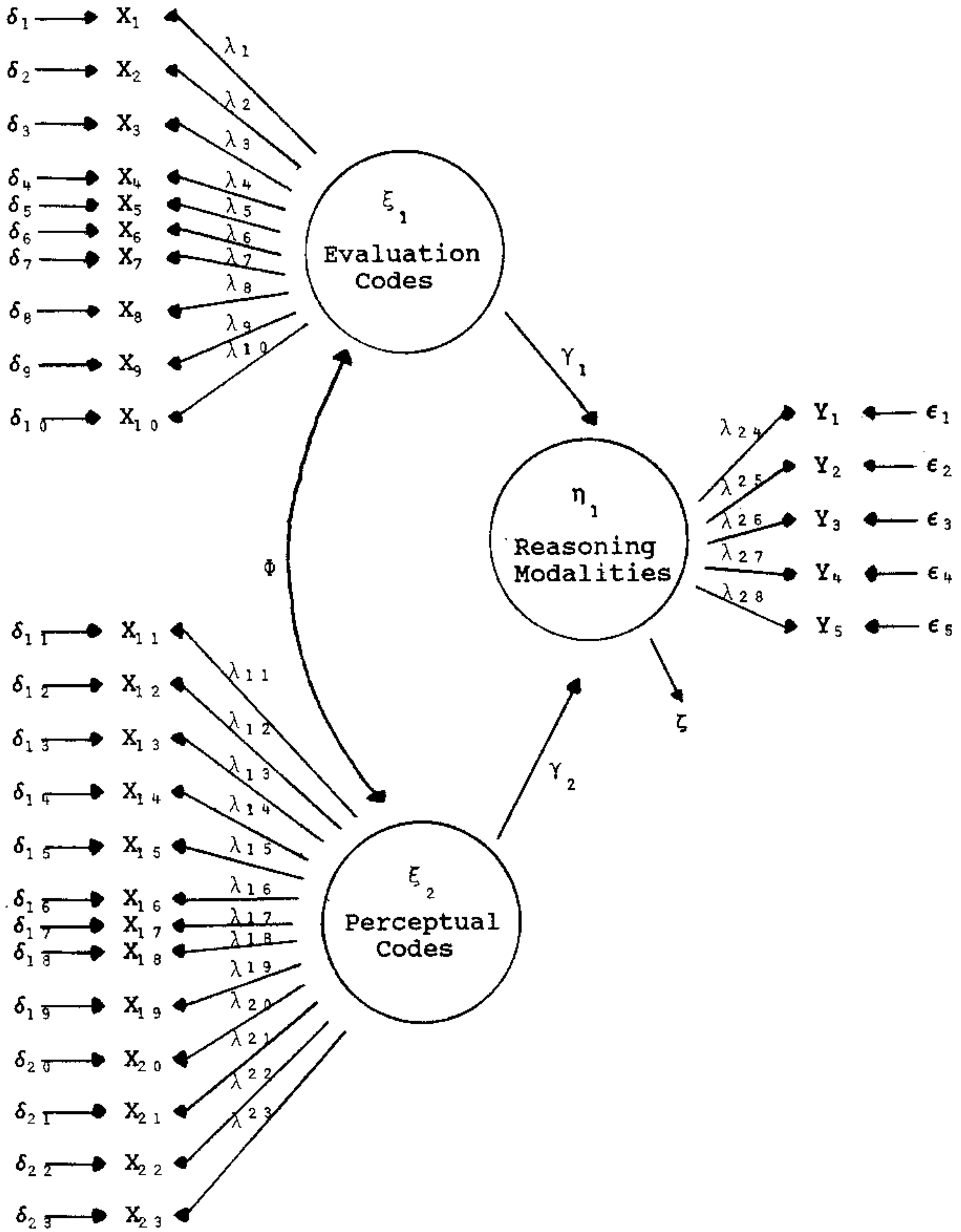
$$Y = \Lambda_y \eta + \epsilon$$

$$X = \Lambda_x \xi + \delta$$

In this case, y is a (5 x 1) vector of endogenous variable measures; Λ_y is a (5 x 1) matrix of coefficients relating y to the endogenous variable; ϵ is a (5 x 1) vector of errors of measurement of y; x is a (23 x 1) vector of exogenous variable measures; Λ_x is a (23 x 2) coefficient matrix relating x and the exogenous variables; and δ is a (23 x 1) vector of errors.

These relationships are shown graphically in Figure 3.2 and depict the two exogenous variables, Evaluation Codes (ξ_1) and Perceptual Codes (ξ_2), and the one endogenous variable, Reasoning Modality (η_1). The exogenous variables are considered to be correlated, and each is shown to affect the endogenous variable in a recursive relationship.

Figure 3.2
The Structural Equation Model for the Hill Inventory



Identification of the Models

Prior to assessing the fit of a proposed model to data, the model must be identified (Boomsma 1985). While identification can represent the greatest practical problem for implementing confirmatory factor analysis (Long 1983a), theoretical logic assists in the resolution of that problem (Fassinger 1987). The task of identification is to specify the model based on substantive considerations in terms of fixed, constrained and free parameters such that the solution is unique. If many specifications would produce the same estimates, the model is not identified.

If a model cannot be shown to uniquely identify the parameters, then estimations cannot be interpreted. Several necessary conditions can be met for identification, while there is more controversy concerning sufficiency of tests.

Both proposed models can be algebraically identified based on the structural specifications provided. Further, the scale of the latent variables is set by use of deviation scores with variances equal to one.

As shown in Figure 3.2, the structural portion of the model is recursive and is just identified given no covariance among the structural error terms (Howell 1987). Since there is one such term for the structural equation model this condition is met. Further, the β (beta) matrix is assumed to be zero.

Estimation of the Models

Once a model is identified, sample data from a matrix of covariances, S, may be used to estimate the population parameters (Long 1983b). According to Parson and Schultz (1978, p. 66):

> The maximum likelihood method involves finding the value of a parameter that makes the probability of obtaining the observed sample outcome as high as possible.

The maximum likelihood fitting function is:

$$F = \log|\Sigma| + tr(S\Sigma^{-1}) - \log|S| - (p + q)$$

This equation is a function of the independent parameters related to the constrained or free elements in the specified matrices, which are minimized (Jöreskog and Sörbom 1982, 1983). This function approaches zero when the sample covariance and population matrices are identical (Bentler and Bonnett 1980).

The fitting function minimizes the difference between the observed matrices and the population specifications given the constraints proposed by the models. According to Jöreskog (1969, p. 191):

> When the minimum of F has been found, the minimizing values of $\underset{\wedge}{\Lambda}$, $\underset{\wedge}{\theta}$ and Ψ are the maximum likelihood estimates $\hat{\Lambda}$, $\hat{\theta}$ and $\hat{\Psi}$, and the hypothesis implied by the fixed parameters can be statistically tested.

The matrices and the vectors have been specified, where appropriate, for each of the models proposed in this research. If the observed variables have a multinormal distribution represented by linear additive relationships, the maximum likelihood estimates are precise with large samples. If the distributions deviate moderately from normality the reported standard errors in parameter estimates must be interpreted cautiously (Jöreskog and Sörbom 1983).

A potential concern in parameter estimation involves the issue of nonconvergence. Nonconvergence may be caused by poorly specified models, poor starting values, or sampling fluctuations in the variances and covariances. According to Boomsma (1985) the probability of experiencing the problem is greatest with small samples (N < 100) or for models with two indicators per factor. Neither condition applies to this study.

Statistical Hypotheses

The specifications for the models provide constrasting structures for the Hill Inventory of variables. While it is inappropriate to think in terms of conducting a formal statistical test of a given structure, the conceptual task is to compare one model to another and to decide which fit with the data is most acceptable (Jöreskog and Sörbom 1982).

The null hypothesis for the first model is stated as:

1. Null Hypothesis (H0) for the confirmatory factor model:

There is no difference between the structure specified by the confirmatory factor model for the Hill Inventory and the observed structure of the correlation matrix.

In a similar manner, the null hypothesis for the structural equation model is stated as:

2. Null Hypothesis (H0) for the structural equation model:

There is no difference between the structure specified by the structural equation model for the Hill Inventory and the observed structure of the correlation matrix.

The alternative hypotheses for each null is that the population covariance matrix (Σ) complies with other specifications. The chi-square statistic then indicates the goodness-of-fit between each of the models and the observed data (Heeler, Whipple and Hustad 1977). Observing a probability level greater than .05 would imply that S does not differ significantly from the Σ specified by the hypothesis. If lower probabilities are obtained, the researcher would reject the null hypothesis.

The chi-square test is supplemented by a nonnormed incremental fit index developed by Tucker and Lewis (1973). The literature implies that this index would be higher for the structural equation model than for the confirmatory factor model. This suggests that the second model provides a greater improvement in explanation over a null model. The null hypothesis for this index is stated as:

3. Null Hypothesis (Ho) for the Tucker-Lewis Index:

The index for the structural equation model will not differ from the index provided by the confirmatory factor model.

These three hypotheses refer to the theoretical structure between the latent variables. In addition, the rules of correspondence between the latent variables and their measurements are part of each model and propose that observed indicators will load on given constructs. The factor structure specification shown in Table 3.1 is a set of twenty-eight factor loading expectations for the confirmatory factor model. The measurement equations shown in Table 3.4 consist of the expected relationships for the structural equation model. Since variables are generally imperfect measures of constructs, the error terms (ϵ and δ) capture variation unrelated to the latent variables (Aaker and Bagozzi 1979).

Summary of Model Specifications

The confirmatory factor model relates four exogenous variables to twenty-eight observed variables based upon orthogonal specifications. The structural equation model has two exogenous variables that affect one endogenous variable. Identification addresses the issue of unique determination of the parameter estimates in each case. The maximum likelihood method of parameter estimation allows theoretical structures to be tested. The two proposed models provide the hypotheses. In addition, the Tucker-Lewis index assesses the improvement in explanation of each model over a null model. Expected loadings of variables and constructs complete model specifications.

Data Analysis

The final issue of the research design involves the planned data analysis. Two types of relations have been conceptualized for the study. First, measurement models for each theoretical structure related measures to latent variables. Second, the form of the relationships between the latent variables has been based on proposed structural specifications.

A basic assumption for analysis in this research was that the data conformed to a multivariate normal distribution. Descriptive statistics based on the Kolmogorov-Smirnov test (Conover 1980) and analysis of the kurtosis and skewness of each distribution were planned to assess the extent to which this condition was met. If the values for skewness and kurtosis were close to zero the distribution was considered to be normal (Norusis 1986). Moderate violations of this assumption in the data allowed parameter estimates to be obtained.

Parameter Estimates

Parameter estimates provide the first test of whether the structures implied by the models are correct. In a general sense, the standard errors and squared multiple correlations show how well, or poorly, the observations act as indicators of the latent variables. A root mean square residual (RMSR) measures the average of the residuals

(Jöreskog and Sörbom 1982). As residual variance, the RMSR should be very low, such as .019, or close to zero (Fassinger 1987).

Squared multiple correlations (SMC) measure the strength of the relationship between observed and latent variables. With possible SMC values ranging from zero to one, larger values would imply better explanation (Jöreskog and Sörbom 1982, 1983). Parameter estimates are obtained by using the LISREL VI computer program (Jöreskog and Sörbom 1983).

Once problems were overcome, chi-square values and other measures of fit enabled initial assessments to be made. Two measures were used to assess the credibility of the model specifications: the chi-square value and the Tucker-Lewis nonnormed fit index. Each of these tests were viewed as exploratory in nature due to the normality violations and measurement reliabilities.

Model Assessments

For the first two hypotheses, a chi-square statistic tests the overall fit of each model. For example, a chi-square statistic with $p > .05$, and an RMSR < .05 would indicate a good fit of the data to the proposed model. Due to this statistic's dependency on sample size and normal distributions, it may be supplemented by the Tucker-Lewis index (Tucker and Lewis 1973; Bentler and Bonnett 1980) which compares the chi-square values of the models.

The formula for this index (Bollen 1986, p. 376) is:

$$\rho_{k-o} = \frac{\dfrac{X^2_k}{df_k}}{\dfrac{X^2_0}{df_0}}$$

In this formula, X^2_0 = the chi-square value obtained from a null model; and X^2_k = chi-square value obtained from a specific estimation. The null model specified that the variables were mutually independent with no common factors. It was obtained by setting the covariance matrix (Σ) equal to Φ (phi), a diagonal matrix.

Instrument Analysis

The measurement instrument consists of eight questions for each of the twenty-eight variables. If all questions for a single variable are related, it would provide support for the conclusion that they had been sampled from the domain of a single construct (Nunnally 1978; Churchill 1979).

Cronbach's (1951) coefficient alpha (α) indicates each variable's level of internal consistency. When scale items for an indicator are intercorrelated, alpha's range from .6 to .8 for variables. A number of variables with lower alphas indicate a need for question revisions.

To improve the operationalization of the variables, the item-total correlations for each set of questions was also included in the analysis. These figures directly affected the conclusions that could be drawn based on the present measurement approach.

Summary of Data Analysis

Data analysis started by insuring that the multivariate normal assumption could be met. Parameter estimates, standard errors and squared multiple correlations then provided the initial steps of data analysis to assess whether plausible values had been obtained. The chi-square statistic and Tucker-Lewis index were used to test the hypotheses.

The final step in the data analysis was to assess the instrument questions with Cronbach's alphas and item-total correlations. These measures described the reliability of the eight-item question sets for each of the variables included on the Hill Inventory.

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CHAPTER IV

DESCRIPTION OF THE DATA

The results of the research are presented in this chapter. The descriptive measures for the Hill Inventory variables are shown in the first section of the chapter. Using the SPSS-X (SPSS-X 1988) software package, summary measures such as the range and coefficient of variation provide a starting point. The distributions of the observed variables are then compared to the normal case. The section concludes with the correlation matrix.

The model estimates for the confirmatory factor and structural equation specifications are reported in the second section of this chapter. The discussion emphasizes key indices that will affect interpretation of the results. The chapter concludes with two measures of the reliability of the instrument, Cronbach's alpha (α) and the item-total correlations for the question sets.

Descriptive Measures

Data analysis begins by considering the values of the descriptive statistics for the sample. The Hill Inventory consists of eight questions for each of the twenty-eight variables for a total of 224 items. Selected values for the twenty-eight variables are provided in Table A.1 in the Appendix. To obtain a preference score, responses to the eight questions for each variable are first summed. Given the five response choices on the instrument, the possible range of values for each of the summed scores is from a minimum of eight to a maximum of forty.

For this administration of the Hill Inventory the lower numbers were assigned to the positive or frequent usage response choices. Values of one or two on the instrument reflected "often" or "sometimes" and values of three or four included the "rarely" or "never" choices. Initial editing involved the omission of missing values and an examination of the frequency distributions for each of the summed preference scores on the instrument.

Normal Distribution Assessments

A preliminary concern of data analysis is the degree to which the observed distributions exhibit a normal pattern. The Kolmogorov-Smirnov procedure defines a test statistic as the maximum distance between the observed and normal distribution functions (Conover 1980). The null hypothesis for this test is that a variable does not differ from the normal case.

The Kolmogorov-Smirnov test results for each of the variables are shown in Table A.2. The null hypothesis was not rejected ($p > .05$) for three variables which included the Theoretical Code variables for auditory-linguistic and auditory-quantitative preferences, and the Qualitative Code variable for kinesic preferences. The null hypothesis was rejected for each of the other twenty-five variables which suggested they did exhibit deviations from normality. This indicated a need to investigate the issue further for information concerning the degree of departure from the normal specification.

Kurtosis reflects the amount of peakedness of a distribution in comparsion to what would be expected in a normal distribution (Norusis 1986). In skewed distributions, the mode and the median differ which shows an asymmetric dispersion of the observations (Bohrnstedt and Knoke 1982).

Jöreskog and Sörbom (1982) suggested that moderate deviations of the distributions for the observed variables from normality would still allow examination of the parameter estimates. Boomsma (1985) stated that the LISREL estimation was robust for symmetric distributions with normal kurtosis. However, she also implied that the procedure was not as robust for skewed distributions.

The measures of skewness, kurtosis, the median and the mode are provided in Table A.3 and show the deviations that are present in the observed distributions. These values imply that the departures from normality are rather moderate. For example, the largest difference between the median and mode values for these variables is two points.

For seven of the variables of the Hill Inventory, a negative kurtosis indicated that fewer responses fell into the tail of the distributions than would be expected in the normal case. The measures ranged in value from -.002 to -.524, which showed a small departure (Norusis 1986). The other twenty-one variables exhibited a positive kurtosis which showed that a larger number of responses occurred in the tails than what would be expected for a normal distribution. The measures ranged in value from .001 to 2.137 which showed a larger deviation from the normal curve than for the former cases.

The median and mode for each variable described the skewed distributions. For example, thirteen variables had an equal median and mode. This occurred for the following variables: the Theoretical Code variables for auditory-linguistic and auditory-quantitative preferences; the Qualitative Code variables for olfactory, savory, tactile, visual, aesthetics, ethics, kinesthetic, proxemic, and transactional preferences; and the Reasoning Modality variables for magnitude and deduction.

Ten variables exhibited a negative skew which meant that respondents indicate more frequent usage of the style variables. These included the following: the Theoretical Code for visual-linguistic preference; The Qualitative Code variables for auditory, empathetic, histrionic, and temporal preferences; The Social-Cultural Code variables for associative, family, and independent preferences; and, the Reasoning Modality variables for relationship and appraisal.

The distributions for the remaining five variables were skewed in a positive direction which meant that respondents indicated relatively less frequent usage of the variable. These included the following: the Theoretical Code visual-quantitative variable; the Qualitative Code variables for proprioceptive, kinesic, and synnoetic preferences; and the Reasoning Modality variable for difference.

The assessment of the distributions for the preference variables instilled a cautious tone for testing the adequacy of the specified models. Yet, insight into the relative degree of fit with the observed variables remained a viable goal of the study given the nature of the skewness measures.

The Correlation Matrix

A correlation matrix describes the relative degree of association among the variables and diffuses the effect of varying units of measurement (Rummel 1970). Measures of one factor should be related among themselves and distinct from other variables (Bagozzi 1981). The observed correlations are shown in Table A.7. The coefficients which are considered to be significantly different from zero ($p < .025$) are shown in bold print.

A visual examination of the correlations showed that variables did not exhibit expected relationships. For example, the Reasoning Modality variables correlated with the Social-Cultural Code variables and with such Qualitative Code variables as empathy or proxemics. Theoretical Code variables and those that assess Sensory Code preferences did not appear to have as many significant loadings with Reasoning Modality variables.

Summary of Descriptive Measures

Descriptive statistics for the Hill Inventory variables provided a basis for data analysis. The range of answers and coefficients of variation for each variable led to an assessment of whether or not a normal distribution matched that of the observed variables.

The Kolmogorov-Smirnov test statistic and values for skewness and kurtosis showed that deviations from normality were present in the observed distributions. An inspection of the values suggested that these deviations were moderate in nature. For example, the maximum difference between the median and mode for a variable was two points.

The correlation matrix then provided insight into the degree of association between the questions of the inventory. This suggested that variables did not always correlate with their specified factors and did associate with variables defined for other factors.

Model Estimates

The LISREL estimates for the alternative model specifications are discussed in the next three sections. Parameter estimates could not be obtained without slight modifications and these changes will be described for each section as the results are shown. The null model provides the baseline comparison for both substantive models and will be presented first. Then, the results of the confirmatory factor analysis will be shown before the structural equation model is described.

The Null Model

The null model presumes that each variable is an independent construct (Bentler and Bonnett 1980). The LISREL commands for the null model are shown in Table A.4. This model is used as a comparison for the results of the substantive models as it should represent the worst case (Tucker and Lewis 1973).

In effect, the null model for the Hill Inventory specified that latent variables were not needed to explain the observed correlations. According to this assumption, Φ (phi) was diagonal to represent the twenty-eight independent variables which were equal to the number of ξ (xi) latent variables. The Θ_δ (theta-delta) matrix was set to zero, and the Λ_x(lamba-x) matrix was assumed to equal identity.

The goodness-of-fit measures for the null model are provided in Table 4.1. These results show an RMSR value of .225, which does deviate from the ideal level of zero. Each of the measures indicate that these specifications do not fit the observed data.

Table 4.1
Goodness-of-Fit Measures for the Null Model of the Hill Inventory

Summary Measure	Value
Chi-square with 378 degrees of freedom:	2,454.52
Calculated probability level:	(0.000)
Goodness-of-Fit Index:	0.405
Adjusted Goodness-of-Fit Index:	0.361
Root Mean Square Residual:	0.225

The estimates for the substantive models of this research are presented in the next two sections. The goodness-of-fit indices are described as well as the parameter estimates for the matrices.

The Confirmatory Factor Model

The confirmatory factor model specifications were first shown in Table 3.1. Based on this view, Φ (phi), an identity matrix, represented the four independent latent variables. The Θ_δ (theta-delta) matrix was diagonal with no correlations among the error terms. The Λ_x (lambda-x) matrix consisted of twenty-eight rows of variables that corresponded to one of the four factors.

The LISREL commands for the confirmatory factor model are shown in Table A.4. This technique is based on the assumption that the models have been identified (Fassinger 1987). Although this is done mathematically and conceptually, the program also checks this condition and reports singular matrices by stating when a matrix is not positive definite (Jöreskog and Sörbom 1983).

The confirmatory factor analysis was performed using the correlation matrix. There were 275 valid observations available for the maximum-likelihood estimation process. A positive-definite theta-delta matrix could not be obtained in the first computer trial.

Heeler, Whipple and Hustad (1977) recommended the unweighted least squares procedure to solve problems with the maximum-likelihood process. Subsequently, the estimate of .175 was obtained with the unweighted least squares method and used to fix the first theta-delta value. Once this value was modified, the estimates were obtained without warning messages.

The maximum-likelihood estimates for the Λ_x (lambda-x) matrix are shown in Table 4.2. The columns represent the four exogenous variables. The coefficients then estimate the magnitude of the expected change in the observed variable for a one unit change in the defined latent variable (Jöreskog and Sörbom 1982). These values are obtained only for the elements specified as free.

Table 4.2

The Λ_x (Lambda-X) Estimates for the Confirmatory Factor Model

Observed Variables	Exogenous Variables: Theoretical Codes	Qualitative Codes	Social-Cultural Codes	Reasoning Modalities
Theoretical Auditory-Linguistics	0.909			
Theoretical Auditory-Quantitative	0.389			
Theoretical Visual-Linguistics	-0.394			
Theoretical Visual-Quantitative	-0.113			
Auditory		0.515		
Olfactory		0.639		
Savory		0.448		
Tactile		0.446		
Visual		0.449		
Proprioceptive		0.547		
Empathetic		0.556		
Aesthetics		0.566		
Ethics		0.382		
Histrionics		0.548		
Kinesic		0.550		
Kinesthetic		0.526		
Proxemic		0.686		
Synnoetic		0.521		
Transactional		0.611		
Temporal		0.282		
Associative			0.599	
Family			0.461	
Independent			-0.517	
Magnitude				0.317
Differences				0.652
Relationships				0.763
Appraisal				0.590
Deduction				0.433

While the correlation coefficients for the observed and latent variables of the confirmatory factor model did not exhibit an extremely high degree of association, they indicated relative relationships. For example, the Theoretical Code variables consisted of auditory and visual preferences for acquiring linguistic and quantitative information. As shown in Table 4.2, the loadings of the Theoretical Code variables for visual preferences were negative. For the Social-Cultural Code variables also, the independence preference exhibited an inverse relationship with the associative and family preference variables.

A few variables exhibited an association with the defined factors. The variables that had the highest loadings included: olfactory; proxemic; and transactional Qualitative Codes; and relationship and difference Reasoning Modalities.

The theta-delta matrix represents the variances of the error terms for the observed variables while the squared multiple correlation (SMC) reflects the strength of association between the observed and latent variables (Jöreskog and Sörbom 1982, 1983).

As shown in Table 4.3, two variables contained a higher SMC than their theta-delta variances: the first variable for which .175 was fixed, and the Reasoning Modality variable for relationship preferences. This did not reinforce the model's tenets.

Table 4.3
Squared Multiple Correlations and Theta-Delta Values for the Confirmatory Factor Model of the Hill Inventory

Preference Variable	Theta-Delta Values	Squared Multiple Correlations
Theoretical Auditory-Linguistic	.175*	.825
Theoretical Auditory-Quantitative	.849	.151
Theoretical Visual-Linguistic	.845	.155
Theoretical Visual-Quantitative	.987	.013
Auditory	.735	.265
Olfactory	.592	.408
Savory	.799	.201
Tactile	.801	.199
Visual	.799	.201
Proprioceptive	.701	.299
Empathetic	.691	.309
Aesthetics	.679	.321
Ethics	.854	.146
Histrionics	.700	.300
Kinesic	.698	.302
Kinesthetic	.724	.276
Proxemic	.529	.471
Synnoetic	.729	.271
Transactional	.626	.374
Temporal	.921	.079
Associative	.642	.358
Family	.788	.212
Independent	.732	.268
Magnitude	.900	.100
Difference	.575	.425
Relationship	.418	.582
Appraisal	.652	.348
Deduction	.812	.188

* δ was set to .175 based on the Unweighted Least Squares estimate of its value.

The variables with the highest SMC values included: olfactory, proxemic, difference and relationship preferences. The range of values for these four variables was from .408 to .582, which suggested that each variable retained a large proportion of unique or unexplained variance.

This impression is reinforced when the summary information for the model is considered. The goodness-of-fit measures are shown in Table 4.4 for the confirmatory factor model. These values summarize the degree of fit between the specifications and observed responses. These statistics by themselves must be viewed with caution. It is their comparison to the other models that yields insight.

The observed variables measured their associated latent variables with a coefficient of determination equal to .799. The other summary values reinforced the initial impression that much of the variation in the data remained unexplained. For example, the RMSR of .157 was higher than the zero value which was optimum, which suggested that improvement in explanation is needed. Yet, this did show an improvement over the RMSR of the null model which was reported as .225 in Table 4.1. At first glance, the goodness-of-fit indices may appear to be relatively high. This is not the case as this value should be above .9 to indicate a good fit of a model.

Table 4.4
Goodness-of-Fit Measures for the Confirmatory Factor Model of the Hill Inventory

Summary Measure	Value
Coefficient of Determination for the Exogenous Variables:	0.799
Chi-square with 351 degrees of freedom:	1200.68
Calculated probability level:	(0.000)
Goodness-of-fit Index:	0.744
Adjusted Goodness-of-fit Index:	0.704
Root Mean Square Residual:	0.157

The large chi-square value was not unexpected. This statistic may have been affected by several factors that were present in this sample of data. For example, deviations from normality, the large sample size, or the use of the correlation matrix as input for the data analysis process may all have contributed to the obtained value of 1,200.68, which is large.

The Structural Equation Model

When a consumer behavior model was applied to the Hill Inventory a structural equation was derived. Based on this perspective, two exogenous variables affected one endogenous variable. The model included a Φ (phi) matrix with ones on the diagonals and correlations among the two latent exogenous variables on the off-diagonals. The proposed Lambda matrices were first shown and discussed in Table 3.1.

Parameter estimates could not be obtained with the original model specifications without warnings for the positive definiteness of the lambda matrices. When a lambda coefficient in each of the three columns was given a starting value of one, the maximum likelihood estimates were derived without error or warning statements.

The coefficients for the Λ_y (lambda-y) matrix are shown in Table 4.5. These values relate the observed y variables to η (eta), the Reasoning Modality factor. The Reasoning Modality variables, relationship and difference, exhibit the strongest explained variance based on the defined factor. This matches the implications of the confirmatory factor model results in Table 4.2 for this set of variables. In each case, the difference and relationship preferences show the highest loadings with the Reasoning Modality factor.

Table 4.5
The Λ_y (Lambda-Y) Matrix of the Structural Equation Model

	Reasoning Modality
Magnitude	1.000*
Difference	1.791
Relationship	1.715
Appraisal	1.428
Deduction	0.975

* This value was initialized to equal 1.00

The coefficients for the Λ_x (lambda-x) matrix are shown in Table 4.6. These values relate the observed x variables to the Evaluation and Perceptual Codes. As shown, when Sensory Code variables are separated from the Perceptual Code variables for the structural equation model a greater number exhibit higher loadings than were found for the confirmatory factor model.

In this case, the following variables were of interest: auditory, olfactory, savory, visual and proprioceptive Evaluation Codes; and empathy, aesthetic, histrionic, kinesic, kinesthetic, proxemic, synnoetic, transactional and independent Perceptual Codes.

In addition to the loadings of the variables on the factors, the structural equation provides estimates of the relationships between the factors. The resulting values for the Γ (gamma), Φ (phi), and Ψ (psi) matrices are shown in Table 4.7, and they generate several questions. The Γ (gamma) estimate for the Evaluation Codes is shown as .008 while that for the Perceptual Codes is .422. The Φ (phi) estimate of the association between these two factors is reported to be .955, an extraordinarily high value. The Ψ (psi) estimate is shown as .056 to represent errors in the equation. The associations expected between the exogenous and endogenous variables are not supported. Rather than cause for support of the theory, these values actually decreased credibility in the model specifications.

Table 4.6
The Λ_x (Lambda-X) Matrix of the Structural Equation Model

	Evaluation Codes	Perceptual Codes
Theoretical Auditory-Linguistics	0.904*	
Theoretical Auditory-Quantitative	0.485	
Theoretical Visual-Linguistics	0.130	
Theoretical Visual-Quantitative	0.087	
Auditory	0.691	
Olfactory	0.884	
Savory	0.626	
Tactile	0.594	
Visual	0.658	
Proprioceptive	0.681	
Empathetic		0.785
Aesthetics		0.773
Ethics		0.555
Histrionics		0.717
Kinesic		0.773
Kinesthetic		0.675
Proxemic		0.879
Synnoetic		0.708
Transactional		0.796
Temporal		0.375
Associative		0.524
Family		0.395
Independent		0.824*

* These values were initialized to equal 1.00

Table 4.7
The Γ (Gamma), Φ (Phi) and Ψ (Psi) Matrices of the Structural Equation Model

Γ Gamma

	Evaluation Codes	Perceptual Codes
Reasoning Modality	0.008	0.422

Φ Phi

	Evaluation Codes	Perceptual Codes
Evaluation Codes	1.000	
Perceptual Codes	0.955	1.000

Ψ Psi

	Reasoning Modality
Reasoning Modality	0.056

The θ_{ε} (theta epsilon) and SMC values for the Reasoning Modality are shown in Table 4.8. This information provides estimates for the random errors of measurement and the strength of the relationship between the observed and latent variables.

Table 4.8
Squared Multiple Correlations and Theta-Epsilon Values for the Endogenous Variable of the Structural Equation Model

Preference Variable	Theta-Epsilon Values	Squared Multiple Correlations
Magnitude	.839	.161
Differences	.485	.515
Relationships	.528	.472
Appraisal	.673	.327
Deduction	.847	.153

The information in Table 4.8 suggested that the difference modality was the only variable that had more shared variance with the latent variable than unique variance left unexplained by the model. None of the SMC values implied a strong link between a variable and the Reasoning Modality.

The θ_δ (theta-delta) and SMC values for the Evaluation and Perceptual Code variables are shown in Table 4.9. The olfactory and proxemic Perceptual Code variables have the highest SMC values. All of these variables also retain a large proportion of unique variance.

The SMC value for the Perceptual Code variable for independent preferences was -.226. The formula used to calculate the SMC for a variable is given as: $1 - \theta/S$, where θ contains the error variance and s is the oberved variance for a variable (Jöreskog and Sörbom 1983). Since the lambda value was initialized at one, the SMC had to assume a negative value in this case.

Table 4.9
Squared Multiple Correlations and Theta-Delta Values for the Exogenous Variables of the Structural Equation Model

Preference Variable	Theta-Delta Values	Squared Multiple Correlations
Theoretical Auditory-Linguistics	.904	.096
Theoretical Auditory-Quantitative	.866	.134
Theoretical Visual-Linguistics	.990	.010
Theoretical Visual-Quantitative	.996	.004
Auditory	.729	.271
Olfactory	.555	.445
Savory	.777	.223
Tactile	.799	.201
Visual	.753	.247
Proprioceptive	.736	.264
Empathetic	.651	.349
Aesthetics	.662	.338
Ethics	.826	.174
Histrionics	.709	.291
Kinesic	.662	.338
Kinesthetic	.742	.258
Proxemic	.563	.437
Synnoetic	.717	.283
Transactional	.642	.358
Temporal	.920	.080
Associative	.845	.155
Family	.912	.088
Independent	1.226	-.226

The summary statistics for the model are shown in Table 4.10. The coefficient of determination for the exogenous variables is given as -1.348. The formula for this estimate is as follows: $1 - |\Theta|/|S|$ (Jöreskog and Sörbom 1983).

The determinant of the correlation matrix, S, for all the observed variables is shown in Table A.7 to be .00123, nearly zero. This explains the negative value. While the coefficients of determination for the endogenous variables and for the structural equation as a whole are above .70, the RMSR value of .251 and the high chi-square value indicate problems in the model specifications.

Table 4.10
Goodness-of-fit Measures for the Structural Equation Model of the Hill Inventory

Summary Measure	Value
Total Coefficient of Determination for the Exogenous Variables:	-1.348
Total Coefficient of Determination for the Endogenous Variables:	0.719
Total Coefficient of Determination for the Structural Equation:	0.767
chi-square with 349 degrees of freedom:	1,195.54
probability level:	(0.000)
Goodness-of-fit Index:	0.761
Adjusted Goodness-of-fit Index:	0.722
Root Mean Square Residual:	0.251

Summary of Model Estimates

The maximum-likelihood method was used to produce estimates for the null, confirmatory factor and structural equation models related to the Hill Inventory. The parameter estimates and goodness-of-fit indices suggested that neither substantive model explained a sufficient amount of the variance observed in the variables. However, before these results can be interpreted to mean that neither model fits, other psychometric issues of measurement must be addressed.

Measurement Reliability

Before conclusions can be drawn as to a model's adequacy, the measurements themselves must be examined from a psychometric perspective. Two values are used to assess the items of the instrument: Cronbach's alphas (Cronbach 1951) and item-total correlations (Nunnally 1978). These summary statistics provide the basis for improving the operationalization of the concepts and for recognizing the difference between model misspecifications and measurement error.

The alphas (α) for each variable are shown in Table 4.11. These values indicate lower levels of reliability in the measurement of the variables than what one would expect for applied research studies. The lowest reliability coefficients were for two visually related variables.

Table 4.11
Reliability Measures For the Hill Inventory Questions

Variable Name	Cronbach's Alpha
Theoretical Auditory:	
Linguistic	.4462
Quantitative	.5565
Theoretical Visual:	
Linguistic	.5731
Quantitative	.2023
Qualitative Codes:	
Auditory	.5876
Olfactory	.6523
Savory	.4119
Tactile	.4524
Visual	.2690
Proprioceptive	.5849
Empathetic	.6838
Aesthetics	.6639
Ethics	.4537
Histrionics	.5594
Kinesic	.6016
Kinesthetic	.4431
Proxemic	.7233
Synnoetic	.5723
Transactional	.7574
Temporal	.7383
Social-Cultural Codes:	
Associative	.6791
Family	.6547
Independent	.5024
Reasoning Modalities:	
Magnitude	.4532
Differences	.5345
Relationships	.5334
Appraisal	.5449
Deduction	.6649

The alphas of .20 and .26 reported for the Theoretical visual-quantitative and Qualitative Code visual preferences are very low. The highest values range from .72 to .76 for the proxemic, transactional and temporal codes. Ten of the variables exhibit alphas above .6, which represents a fairly good value for exploratory research of scale items (Nunnally 1978).

The information provided in Table A.8 for the item-total correlations offers insights into problems with specific variables of the inventory. For example, the first question for the Theoretical Code auditory-linguistic variable asks how often the respondent prefers a lecture class. This question has a negative correlation with the summed preference score for the variable. A negative value suggests that the subjects responded to this one question in a different manner than to the other seven items in the set. The item-total correlations are discussed in more depth in Chapter Five.

Summary of Data Description

Descriptive measures suggested that the models could be tested based on their specifications with some qualifications. Varying units of measurement for the preference score variables indicated the correlation matrix would be needed for analysis. The distributions also exhibited moderate deviations from normality.

The goodness-of-fit measures for the null model were shown prior to presenting the confirmatory factor and the structural equation model estimates. Each of the relevant matrices for the substantive models were described within the chapter. The chi-square values and RMSR levels reinforced the impression that the models did not fit the data. These results suggested that an examination of the measures was needed.

The reliability analysis assessed the measures. Cronbach's alphas ranged in value from .20 to .76 which showed a need for improvement in the inventory's questions. This chapter presented the results for the proposed steps of the data analysis process. The next chapter incorporates these findings into the interpretations and suggestions for improvements in the model design and operationalization of the variables in the inventory.

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CHAPTER V

ANALYSIS AND RECOMMENDATIONS

This study examined two aspects of the measurement of cognitive style preferences based on the Hill Inventory. The first issue concerned models of the latent structure for the inventory variables while the second addressed the operationalization of the constructs by specific sets of questions. Logical and empirical evidence for linkages between defined constructs and their measures have been described.

In this chapter the results will be interpreted to provide recommendations for improvements in the modeling and operationalization of the variables. First the model estimates will be compared so that one model can be tentatively recommended. Then, the instrument and its questions will be discussed in terms of suggested modifications. Finally, limitations and extraneous factors that may have affected the results are also recognized and incorporated into the findings of the research. The model comparisons are exploratory in nature due to the previously identified problems with the operationalization of the variables. Until the validity is improved, model evaluation remains tentative.

Model Comparisons

The results of the null, confirmatory factor and structural equation model specifications will be compared in this section. The three hypotheses will first be assessed in terms of the sample evidence. Then, the comparative results will be used to discuss implications for the specified models. The section summary provides a synopsis of the conclusions for the models and an introduction for the measurement analysis section that follows.

Tests of Hypotheses

The first step in interpretation was to assess the hypotheses that were established in Chapter Three as part of the research design. The first two hypotheses concerned the fit of the model specifications to the observed data. For the confirmatory factor and structural equation models, the null hypothesis was that no difference existed between the specified structure and that of the observed variables. In each case, the alternative hypothesis was that the observed correlation matrix could fit any of a number of other structural patterns.

The results and goodness-of-fit measures for each of the models are shown in Table 5.1 to facilitate comparisons. In each case, the null hypothesis would be rejected ($p < .05$). This implies that the models do not fit the observed patterns in the variables. Further, the Tucker-Lewis indices show no difference in the explanation provided by either substantive model.

Table 5.1
Goodness-of-fit Measures for the Null, Confirmatory Factor and Structural Equation Models

Summary Measure	Null Model	Confirmatory Factor Model	Structural Equation Model
Chi-Square	2,454.52	1,200.68	1,195.54
degrees of freedom	378	351	349
probability level	(0.000)	(0.000)	(0.000)
Goodness-of-fit Index	.405	.744	.761
Adjusted Goodness-of-Fit Index	.361	.704	.722
Root Mean Square Residual	.225	.157	.251
Coefficient of Determination for the:			
Exogenous Variables	*	.799	-1.348
Endogenous Variables	*	*	.719
Structural Equation	*	*	.767
Tucker-Lewis Index (null=base)	*	.527	.528

* Omitted values were not applicable for the specified model.

The information in Table 5.1 indicated that the null hypothesis would be rejected for both models. In effect, neither specification fit the pattern of observed data. The goodness-of-fit measures also reinforced this general conclusion. The adjusted goodness-of-fit index for the structural equation was .722 while that for the confirmatory factor model was .704, slightly lower. Neither index supported the specified structure.

The third hypothesis compared the fit of the confirmatory factor and structural equation models by proposing there would be no difference in the Tucker-Lewis Index values (Tucker and Lewis 1973). The alternative hypothesis favored the explanatory power of the structural equation model. As shown in Table 5.1, this null hypothesis was not rejected since the Tucker-Lewis indices of .527 and .528 were almost identical for the two models.

Model Implications

The confirmatory factor model resulted in a coefficient of determination of .799. In contrast, the structural equation model included a coefficient of determination for its exogenous variables of -1.348, which suggested problems with the model specifications. The Φ (phi) coefficient related the two exogenous variables of the structural equation model and had a value of .955 for this sample. This "near perfect" correspondence also raised suspicions about the model specifications.

Unreasonable values such as .955 and the negative coefficient of determination indicated that the structural equation model did not fit the data. Further, the RMSR value of .251 reinforced the conclusion that the specifications poorly represented the observed data from the Hill Inventory for this sample of subjects. The RMSR values contrasted the level of improvement in the explanation provided by the models.

The closer the RMSR is to zero, the stronger the evidence that the implied structure matches the observed data (Fassinger 1987). As shown in Table 5.1, the confirmatory factor model has an RMSR of .157 compared to the null model value of .225. This suggests the former model improves the explanation. However, the RMSR value of .251 for the structural equation model is actually higher than that of the null.

The null model contained twenty-eight independent latent variables. The confirmatory factor model proposed that four exogenous variables improved the explanation of the latent structure of the inventory. The specifications for the structural equation model changed the number of latent factors from four to three and altered the implied relationships between these constructs. In effect, this reduced the number of exogenous variables from four to two. Based on the RMSR values for the models, fewer factors did not match the pattern of the observed data well.

Evidence of this conclusion could also be seen in the negative coefficient of determination for the exogenous variables of the structural equation model. The Tucker-

Lewis Indices simply reinforced the initial impressions. These results suggested that neither of the tested models adequately matched the observed patterns in the data.

Based on the evidence provided by this sample, the confirmatory factor model remains the "best" explanation of the observed latent structure for the Hill Inventory variables. The measures indicate that significant improvement can be achieved in the model specifications.

Summary of Model Comparisons

The null hypotheses for the models were both rejected. This indicated that each failed to explain the observed patterns in the data. Comparisons of model results offered insights for the structure of the variables in the Hill Inventory. When compared to the null model, both substantive models improved the explanation to some extent.

A negative coefficient of determination for the structural equation model and a higher RMSR value than that for the null model suggested it was not a viable consideration for this sample of data. The confirmatory factor model more adequately described the observations.

Based on the model comparisons, the focus of analysis for the next section is the confirmatory factor model. The tables provided in Chapter Four are used to assess specific aspects of the maximum likelihood estimates. This analysis provides the basis for tentative suggestions to improve the model of the structure for the Hill Inventory variables.

Revising The Model Specifications

This section examines a basis for revising the confirmatory factor specifications of the Hill Inventory. Psychometric issues related to the reliability of the measures constrain the degree to which the model can be evaluated. With these considerations in mind, however, descriptions of the results based on this sample offer a path for model development work.

The Theoretical Codes

The exogenous variables for the confirmatory factor model were shown in Table 4.2. If the measurement of the variables was correct, then the model might be modified based on the following observations. The value for the first variable was affected by fixing the Θ_δ (theta-delta) element. With no other loadings above .4 for this factor, these variables might be omitted from applied studies.

The literature reviewed in the second chapter of this report defined the first construct of the Hill Inventory, Theoretical Codes, as an academic aptitude or achievement measure. Berelson and Steiner (1964) suggested that verbal and visual aptitudes were highly correlated with general intelligence.

The low loadings for the Theoretical Code variables emphasized the complexity of assessing a "general intelligence" construct for applied research. As stated in

Chapter Two, research has focused on a visual or verbal orientation (Richardson 1977; Childers, Houston and Heckler 1985). When the values of these variables were compared to the Qualitative-Codes, this impression was reinforced.

The Qualitative and Social-Cultural Codes

The Qualitative and Social-Cultural Codes would each consist of fewer variables. The Qualitative Code factor was correlated best with the following variables: auditory, olfactory, proprioceptive, empathetic, aesthetic, histrionic, kinesic, kinesthetic, proxemic, synnoetic and transactional preferences.

These eleven variables provide a link between the Qualitative Codes and the socialization process. These preferences must be learned and interpreted for communication to occur (Berger and Luckman 1967). Relative support for the socialized aspect is also provided by the third factor of the confirmatory factor model and by the structural equation estimates.

The third exogenous variable contrasted associative and independent Social-Cultural Code preferences. The studies cited in Chapter Two stressed an inner-other directedness concept (Centers and Horowitz 1963). Predispositions to share information have provided the means for describing types of information acquisition behavior for consumer behavior (Cohen 1967; Cohen and Golden 1972; Moschis 1980).

When viewed as a preference for information presentation formats, this information may be captured by Qualitative Code preferences. Although the structural model as a whole was not supported, evidence for the composition of the Qualitative Codes can be seen in the factor loading matrix shown in Table 4.6. The Perceptual Code variables that have the highest loadings include:

empathetic	aesthetic
histrionic	transactional
proxemic	synnoetic
kinesic	independence

Since the three Sensory Code variables mentioned for the confirmatory factor analysis, auditory, olfactory and proprioceptive, were not part of the structural equation they were not duplicated on this list. Other than these variables and the inclusion of the independence code, the list was the same as that described on the prior page.

The Reasoning Modalities

The Reasoning Modality construct would also consist of a smaller list of variables based on the loadings shown in Table 4.2. Three variables would be selected to represent this concept: difference, relationship and appraisal. As stated in the Chapter Two, Guilford (1959) contrasted convergent and divergent thinking styles. Within marketing, work has focused on analytical complexity similar to the appraisal modality variable (Hirschman 1980).

When the Qualitative Codes with significant loadings are considered, the concepts of perceiving similarities, differences, or viewing a problem from many perspectives reinforces the thrust of measuring style preferences. Consumer behavior research is concerned with descriptions that differentiate cognitive style preferences for information. Given a set of Qualitative Code variables as input, consumers assimilate, compare and analyze the meaning of the presented symbols.

The Hill Inventory captures these ideas within a set of other variables that do not seem to be explained by the defined factors as well. Strengthened measurements and corresponding model estimates would improve the concept for consumer behavior applications. This may be achieved by focusing on the variables that provide the most efficient differentiation of preferences. Before this step can be taken, the measurement of the variables must be sound.

The rationale for the caution in viewing model modifications as anything other than exploratory work is developed in the next section as the variable questions are discussed. While the conclusions stated above seem to make sense in light of the empirical data and prior theoretical suggestions, the validity of the measurements cannot be assured in this case. Thus, the results must be viewed as tentative in nature.

Summary of the Revised Model Specifications

The confirmatory factor model shown in Table 4.2 provided the basis for the discussion of changes in the model specifications. Variables that seemed to measure the defined constructs the best were identified. In each case, a smaller number of variables was recommended.

The Hill Inventory might be modeled based on the following specifications. Two exogenous variables would be measured by eleven variables. The Qualitative Codes would consist of the following eight variables: empathetic, aesthetics, histrionics, kinesics, proxemics, synnoetics, transactional, and independence codes. The Reasoning Modality factor would consist of the following three variables: difference, relationship, and appraisal.

These model results are exploratory. Final implications for modeling the variables of the Hill Inventory may still include a variety of options, such as: (1) increasing the exogenous constructs; (2) improving the focus of the variables that assess a defined construct; or (3) improving the operationalization of the variables.

Measurement Analysis

The questions that form the summed scores for each of the variables are the focus of this section. Correlations among groups of variables are discussed in terms of the four constructs defined for the confirmatory factor model of the Hill Inventory: Theoretical, Qualitative, Social-Cultural and Reasoning Modalities.

Once the observed patterns are described, the item-total correlations will be examined for the question sets of the Hill Inventory. This analysis provides suggestions for specific questions in need of revision.

The Correlation Matrix

The correlation matrix shown in Table A.7 provides a basic source for exploring relationships among variables. As an example of the information that can be used to explain difficulties in the confirmatory factor analysis, the first exogenous variable will be thoroughly discussed. Then examples from each of the other three constructs will be described.

Within the Theoretical Code construct, three sets of variables exhibited significant correlation levels. These included the following pairs: auditory-linguistic and auditory-quantitative preferences; the auditory-linguistic and visual-linguistic variables; and the auditory-quantitative and visual-quantitative preferences. In basic terms, preferences for hearing words and symbols, hearing and seeing words, and hearing and seeing symbols were associated.

The following pairs of variables did not exhibit a significant correlation: auditory-quantitative versus visual-linguistic preferences; and auditory-linguistic versus visual-quantitative variables. These variables represented preferences for hearing numbers as opposed to seeing words and for hearing words as opposed to seeing numbers. Thus, the preferences that may describe this latent construct in terms of its uncorrelated factors were as follows:

1) Hearing symbols . . . . . Seeing words

2) Hearing words . . . . . . Seeing symbols

This information coincided with the contrast between verbal and visual preferences that was discussed earlier in this chapter. When the correlations of Theoretical Code variables were viewed in relation to the other twenty-four variables on the inventory, other patterns also emerged.

The visual-linguistic and visual-quantitative variables did not correlate to any extent with the Qualitative Code sensory variables. This may help explain why the structural equation model was relatively unsuccessful in combining these variables as one factor.

The first two variables, auditory-linguistic and auditory-quantitative, did correlate with all of the Qualitative Code sensory variables. The auditory-linguistic and auditory-quantitative preferences exhibited positive correlations with such variables as: empathy, histrionic, kinesic, kinesthetic, proxemic, synnoetic and transactional codes. While, the visual-linguistic and visual-quantitative codes did not exhibit a relationship.

The Theoretical Codes and Reasoning Modalities showed that the majority of variables in these two areas were associated to some degree. The exceptions included Theoretical Code variables for visual preferences which did not correlate well with the Reasoning Modality for difference. The Theoretical Code auditory-linguistic variable also did not correlate well with appraisal or deduction preferences.

When Qualitative Code variables were examined, individual variables also correlated with those from the other three exogenous variables. For example, the Qualitative Code transactional variable was not related to the Social-Cultural Code preferences for family or independence. The variables correlated with others in the inventory and did not follow the dictates of orthogonal constructs.

For the Social-Cultural Code variables, preferences for independence in acquiring information reacted differently to other variables of the inventory than the associative or family variables. Independent preferences did correlate to some degree with visual-linguistic, visual-quantitative, auditory, tactile, and histrionic preferences. The independence variable also showed an inverse correlation with the other two variables of the Social-Cultural Codes.

The associative and family preferences also interacted with other variables on the inventory. The proprioceptive, empathetic, aesthetic, histrionic, kinesic, kinesthetic, proxemic, and transactional variables correlated to some degree with associative preferences. The visual-quantitative, olfactory, savory, empathetic, aesthetic, ethic, kinesic, and kinesthetic variables correlated with family preferences. Both of these variables showed a relationship with all of the Reasoning Modality variables with the exception of deduction.

As a group, the Reasoning Modality variables correlated with the majority of the other variables in the inventory with a few exceptions. For example, the deduction variable did not correlate with associative or family preferences. The appraisal variable was not correlated with the temporal variable. The magnitude preference was not associated with the transactional variable.

The correlations were not a strong indication of underlying latent structure but did provide an interesting depth of information to the results of the model tests. Rather than orthogonal dimensions, various facets of the observed variables in the inventory correlated with variables defined for other latent constructs. This pattern was observed throughout the correlation matrix and indicated a need to examine the questions themselves.

Cronbach's Alpha Levels

In Chapter Four, the results of the Conbach's Alpha (Cronbach 1951) measures of reliability for the question sets were presented in Table 4.1. The alpha (α) values suggested that the questions did not measure the defined variables very well.

The lowest alpha values of .20 and .27 were for the visual-quantitative Theoretical Code variable and for the visual Qualitative Code variable, respectively. The best alphas, as high as .757, were for the proxemic, transactional and temporal Qualitative Code variables. Most of the reliability coefficients were in the .4 to .6 range of values. These levels caused a need to examine the question sets a bit more carefully. Specifically, the question was asked as to the item-total correlations for each of the eight questions used to measure a variable of the inventory.

The next section provides a summary of the findings for this analysis. These measures imply the questions and question sets that are in need of revision on the Hill Inventory.

The Item-Total Correlations

Based on the problems with the fit of the models and the moderate levels for Cronbach's alpha, a more in-depth look at the questions of the inventory was needed. Item-total correlations separate questions for a variable.

The information shown in Table 5.2 compares the item-total correlations for the auditory-linguistic variable and provides the actual questions. The largest values, ranging from .33 to .36, relate to questions that contrast speaking from writing.

Table 5.2
Questions for the Theoretical Auditory-Linguistic Variable

Question and Identification Number		Item-Total Correlation
A1	I prefer the traditional lecture-type of classes.	-.1029
B1	After I write something, I read it aloud so that I know how it sounds	.0853
C1	I prefer to follow spoken directions rather than written ones	.2689
D1	I do better on tests that cover information I have heard rather than read.	.1767
E1	I would rather say something than write it	.3684
F1	People would say I speak more understandably than I write.	.3645
G1	I can make more sense out of what a person means when he speaks to me rather than if he writes to me.	.3371
H1	I understand the news better when I hear it rather than when I read it.	.1713

These questions did not use the terms: hearing words or seeing symbols. Further, an extraneous cue was also introduced into each question. For example, the first question, labeled A1, refered to lecture classes but not to a preference for hearing information. The next question asked respondents first to write something then to express a preference for reading it aloud. This is termed a double-barreled question (Dillon, Madden and Firtle 1987). The questions continued to ask about directions, tests, speaking, writing, and acquiring information about news but did not ever ask specifically about auditory-linguistic (hearing words) preferences.

In contrast, Table 5.3 shows the questions for proxemic preferences which exhibit higher item-total correlations than the auditory-linguistic set. The three questions with the highest correlations, which range from .44 to .52, ask respondents to indicate how often they can tell when it is appropriate to put their hand on another person, to tell a joke to another person, or to make introductions.

Table 5.3
Questions for the Qualitative Code Proxemic Variable

Question and Identification Number		Item-Total Correlation
A17	I know how close I can stand to other people without making them uncomfortable .	.3775
B17	I know when it is alright to introduce myself and when I should wait to be introduced	.4412
C17	I can tell which boss or teacher to call by their first names	.3367
D17	I can tell how friendly I can be with a stranger	.4678
E17	I know how much I need to apologize when I bump into someone in a store	.3655
F17	I can tell when it is O.K. to tell a joke.	.4858
G17	I know when it is O.K. for me to put my hand on another person's shoulder.	.5248
H17	I know who I can ask a favor of without imposing	.3391

While these questions sampled widely from the proxemics concept, they all denoted an awareness of social distance from others. In this regard they focused better on a key aspect of the variable's meaning than did the first set of variables. Although they offered some consistency, the item-total correlations could be improved still further by re-examining the questions for each variable.

The item-total correlations are shown in Tables A.8 through A.35 for each of the variables on the Hill Inventory. The conclusions drawn from the two tables shown in this chapter are repeated again and again. For example, questions to assess Qualitative Code ethic preferences focused on subjects that ranged from moral values and promises to completing a task or pausing at a stop sign. Questions that assessed the temporal variable included completing tasks, being late for appointments, and turning in assignments on time.

While the variable may be sound if measured correctly, the questions did not appear to assess the concepts as well as they could. Thus, the cautious tone of the model comparisons seems to have been justified based on this information. Rather than conclude a link between the model structures and the data could be assessed, the study's conclusions relate more strongly to the operationalization of the inventory elements.

Summary of the Measurement Analysis

Analysis of the correlation matrix for the twenty-eight variables of the Hill Inventory identified discrepancies in the relationships between variables of defined orthogonal factors. Variables within each group exhibited significant correlations with those from each of the other defined constructs of the inventory.

The reliability measures provided by the Cronbach's Alphas led to a need for an assessment of the question sets. Analysis of the item-total correlations uncovered problems with the wording of sets of questions designed to assess variables of the inventory. Double-barreled subjects and extraneous cues were identified as problems within the phrasing of many of the questions. The conclusion reached was that the questions did not measure the defined constructs in a sufficiently precise manner to be effective for applied research.

Limitations of the Research

The constraints on the possible conclusions that can be drawn from this research are addressed in this section. The limitations of the study are described by three problems. The first relates to chi-square and the distribution of the data. The second concerns the use of the correlation matrix for analysis, while the final limitation relates to the variable measurement.

The Chi-Square Statistic

Chi-square tends to increase as the distributions differ from normal and as the sample size increases. Large sample sizes and departures from normality tend to increase chi-square beyond the value expected from specification error in the model (Jöreskog and Sörbom 1982).

The observed distributions did deviate from normal and the hypotheses were assessed with a chi-square statistic. This limitation was addressed early in the research and appropriate supplementary measures were incorporated. However, the conclusions of the research were limited by the observed distributions, large chi-square values, and high root mean square residual levels.

The Correlation Matrix

If theoretical variables of one factor correlate with indicators of the other factors, the overall fit of the model will no longer be perfect. The degree of deviation from a perfect fit is a function of the magnitude of correlations between indicators of different constructs. Chi-square depends, in part, on the magnitude of error, or the extent of deviation of the sample correlation matrix from the theoretical matrix (Sharma and Shimp 1984).

Analysis of the correlation matrix showed that variables of one construct were associated with those from other defined factors of the inventory. Thus, the models, as specified, could not be clearly rejected or commended.

Further, the correlation matrix is not the preferred input for the LISREL package. When this matrix is used instead of the covariance matrix, it may have serious effects on the parameter estimates (Boomsma 1985). Yet, the covariance matrix could not be used for this investigation based on the differences in the units of measurement. This condition also limits the conclusions of the model testing portion of the research.

The Question Sets

To construct homogenous sets of questions for a variable, those with the highest correlations with the total score should be selected. When the preference scores are based on one variable rather than a diverse set of items on a test, Nunnally's (1978) suggested level of .25 seems low.

The item-total correlations of the Hill Inventory questions ranged from negative values to a high of .606. The analysis of individual questions revealed that many did not measure the defined variable. This limitation provided that major constraint on the ability to draw conclusions about the model specifications of this research.

Summary of the Limitations

The measurement issues described above and the indeterminacy of the meaning of the chi-square value instilled a cautious tone for the interpretation of the results. Unexpected correlations, low alpha values, and low item-total correlations within the question sets limited the ability to reject or commend a model specification. These difficulties constrained the generalizability of the conclusions and thus limited the force of the findings.

Yet, in scale development work, limitations are encountered at each phase. Those that have been described here are less disastrous than many which could have been seen. The concluding comments summarize the positive aspects of the study results.

Concluding Statements

A set of defined variables to explain preferences for communicated symbols was provided by the Hill Inventory. This research examined the linkages between the latent constructs of the inventory and their measurements. As such, the results offered guidance for developing the scale for consumer behavior applications.

While the model structure for the inventory could not be determined, an exploratory path was described for later scale development work. The major contribution of the study was the exposure of the low reliability of the inventory questions. The operationalization of the variable concepts would have to be improved before being applied to consumer research situations.

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APPENDIX

DESCRIPTIVE STATISTICS FOR THE HILL INVENTORY

Table A.1
Descriptive Values for Cognitive Style Preference Score Variables on the Hill Inventory

Preference Score	Mean	Standard Deviation	Minimum	Maximum	Valid n	Coefficient of Variation
Theoretical Auditory-Linguistic	17.39	3.76	8	31	285	.216
Theoretical Auditory-Quantitative	21.92	4.41	12	33	284	.201
Theoretical Visual-Linguistic	16.94	4.24	8	37	285	.250
Theoretical Visual-Quantitative	14.64	3.22	8	26	285	.220
Auditory	13.72	3.61	8	27	285	.263
Olfactory	17.41	4.29	8	29	285	.246
Savory	16.08	3.71	8	28	282	.231
Tactile	12.04	2.98	8	23	285	.248
Visual	15.34	2.99	10	25	285	.195
Proprio-ceptive	14.99	4.09	8	35	284	.273
Empathetic	15.64	3.97	8	33	285	.254
Aesthetics	16.06	4.21	8	31	285	.262
Ethics	14.47	3.14	8	26	285	.217
Histrionics	16.52	3.96	8	30	285	.240
Kinesic	17.73	4.60	8	33	285	.259
Kinesthetic	15.90	3.79	9	28	285	.238
Proxemic	13.26	3.61	8	29	285	.272
Synnoetic	14.21	3.15	9	25	285	.222
Transactional	16.06	4.06	8	29	284	.253
Temporal	13.44	3.95	8	30	285	.294
Associative	19.32	4.71	9	37	283	.244
Family	17.46	4.68	8	32	284	.268
Independent	16.28	3.52	9	32	284	.216
Magnitude	15.51	3.37	8	30	285	.217
Difference	17.57	3.99	8	29	285	.227
Relationships	17.29	3.78	8	32	285	.219
Appraisal	17.90	3.67	9	32	285	.205
Deduction	17.60	4.58	8	34	284	.260

Table A.2
Kolmogorov-Smirnov Goodness-of-Fit Test for each Variable

Variable Name	Kolmogorov-Smirnov Z-Value	2-tailed probability
Theoretical:		
Auditory-Linguistic	1.266	.081*
Auditory-Quantitative	1.123	.161*
Visual-Linguistic	1.647	.009
Visual-Quantitative	1.720	.005
Qualitative Codes:		
Auditory	2.402	.000
Olfactory	1.733	.005
Savory	1.454	.029
Tactile	2.392	.000
Visual	1.692	.007
Proprioceptive	1.554	.016
Empathetic	2.077	.001
Aesthetic	2.010	.001
Ethic	1.679	.007
Histrionic	1.562	.015
Kinesic	1.291	.071*
Kinesthetic	1.692	.007
Proxemic	2.022	.001
Synnoetic	1.787	.003
Transactional	1.399	.040
Temporal	2.208	.000
Social-Cultural Codes:		
Associative	1.526	.019
Family	1.410	.037
Independent	1.473	.026
Reasoning Modalities:		
Magnitude	1.531	.018
Difference	1.365	.048
Relationship	1.525	.019
Appraisal	1.484	.024
Deduction	1.610	.011

*At the .05 level of significance, the distribution does not deviate from a normal distribution.

Table A.3
Skewness, Kurtosis, the Median and the Mode

Variable Name	Skewness	Kurtosis	Median	Mode
Theoretical:				
Auditory-Linguistics	.573	.846	17	17
Auditory-Quantitative	.205	-.524	22	22
Visual-Linguistics	.674	1.442	17	16
Visual-Quantitative	.492	.256	14	15
Auditory	.956	.947	13	11
Olfactory	.332	-.088	17	17
Savory	.242	-.131	16	16
Tactile	1.083	1.493	11	11
Visual	.388	-.258	15	15
Proprioceptive	.833	1.512	15	16
Empathetic	1.092	2.137	15	13
Aesthetic	.500	.001	15	14-15
Ethic	.453	.145	14	14
Histrionic	.532	.274	16	15
Kinesic	.339	-.195	18	20
Kinesthetic	.601	.217	16	16
Proxemic	.758	.551	13	13
Synnoetic	.776	.633	14	15
Transactional	.433	.132	16	16
Temporal	1.248	2.069	13	11
Associative	.479	.375	19	18
Family	.485	-.002	17	16
Independent	.372	.798	16	15
Magnitude	.642	1.008	15	15
Differences	.307	-.405	17	18
Relationships	.380	.390	17	16
Appraisal	.466	.337	18	16
Deduction	.616	.823	17	17

Table A.4
LISREL Commands For the Null Model of the Hill Inventory

```
USERPROC NAME=LISREL
NULL MODEL SPECIFICATIONS
DA NI=28 NO=285 MA=KM
NA
ZS1 TO ZS28
RA
MO NX=28 NK=28 PH=DI LX=ID TD=ZE
OU SS TO RS TM=120
END USER
```

Table A.5
LISREL Commands For the Confirmatory Factor Model

```
USERPROC NAME=LISREL
CONFIRMATORY FACTOR SPECIFICATIONS
DA NI=28 NO=285 MA=KM
NA
S1 TO S28
RA
MO NX=28 NK=4 PH=ID LX=FU,FI TD=DI,FR
FIX TD 1 1
VALUE .175 TD 1 1
FREE LX 1 1 LX 2 1 LX 3 1 LX 4 1 LX 5 2 LX 6 2 LX 7 2
FREE LX 8 2 LX 9 2 LX 10 2 LX 11 2 LX 12 2 LX 13 2
FREE LX 14 2 LX 15 2 LX 16 2 LX 17 2 LX 18 2 LX 19 2
FREE LX 20 2 LX 21 3 LX 22 3 LX 23 3 LX 24 4 LX 25 4
FREE LX 26 4 LX 27 4 LX 28 4
OU SS TO RS TM=120
END USER
```

Table A.6
LISREL Commands For the Structural Equation Model

```
USERPROC NAME=LISREL
STRUCTURAL EQUATION SPECIFICATIONS
DA NI=28 NO=285 MA=KM
NA
S24 TO S28, S1 TO S23
RA
MO NX=23 NK=2 NY=5 NE=1 PH=ST LX=FU,FI LY=FU,FI TD=DI TE=DI
     BE=ZE GA=FU,FR
FIX LY 1 1
VALUE 1.00 LY 1 1
FREE LX 2 1 LX 3 1 LX 4 1 LX 5 1 LX 6 1 LX 7 1 LX 8 1 LX 9 1
FREE LX 10 1 LX 11 2 LX 12 2 LX 13 2 LX 14 2 LX 15 2 LX 16 2
FREE LX 17 2 LX 18 2 LX 19 2 LX 20 2 LX 21 2 LX 22 2
FREE LY 2 1 LY 3 1 LY 4 1 LY 5 1
FIX LX 23 2
VALUE 1.00 LX 23 2
FIX LX 1 1
VALUE 1.00 LX 1 1
OU SS RS TO TM=120
END USER
```

Table A.7
Correlation Matrix for the Hill Inventory Variables

	S1	S2	S3	S4	S5	S6	S7	S8	S9
S1	1.0000								
S2	**0.3777**	1.0000							
S3	**-0.3716**	0.0105	1.0000						
S4	-0.0680	**-0.1833**	**0.2343**	1.0000					
S5	**0.1329**	**0.1796**	**0.1356**	0.0539	1.0000				
S6	**0.2245**	**0.1671**	0.0140	0.0027	**0.4112**	1.0000			
S7	**0.1650**	**0.1519**	0.0523	0.0350	**0.2930**	**0.3890**	1.0000		
S8	**0.1636**	0.0488	0.0194	0.1009	**0.2570**	**0.3178**	**0.3297**	1.0000	
S9	**0.2408**	**0.1332**	0.0501	0.0795	**0.1218**	**0.3576**	**0.2451**	**0.2081**	1.0000
S10	**0.1354**	**0.1756**	0.0586	-0.0807	**0.3173**	**0.3355**	**0.2463**	**0.2023**	**0.1983**
S11	**0.2382**	**0.1744**	0.0350	0.1073	**0.2224**	**0.3572**	**0.1411**	**0.1311**	**0.3758**
S12	**0.1232**	0.1012	**0.1310**	**0.1817**	**0.2833**	**0.3848**	**0.2360**	**0.2954**	**0.4376**
S13	0.0387	0.0750	**0.1685**	**0.2192**	0.0717	**0.2171**	0.0340	0.1009	**0.1180**
S14	**0.2594**	**0.2254**	-0.0280	-0.0447	**0.3264**	**0.3528**	**0.2508**	**0.2445**	**0.2139**
S15	**0.3064**	**0.1686**	0.0361	0.1004	**0.2595**	**0.3977**	**0.3135**	**0.2674**	**0.2609**
S16	**0.1397**	**0.1669**	**0.1306**	-0.0199	**0.2859**	**0.2969**	**0.2417**	0.1079	**0.1875**
S17	**0.1961**	**0.1920**	0.0996	0.0381	**0.3720**	**0.4084**	**0.2913**	**0.3425**	**0.2666**
S18	**0.2258**	**0.2154**	**0.1377**	0.1153	**0.1710**	**0.2339**	**0.1794**	**0.2316**	**0.1830**
S19	**0.2210**	**0.2515**	0.0287	-0.0141	**0.3325**	**0.3167**	**0.2263**	**0.1733**	**0.1938**
S20	-0.0235	**0.2358**	**0.2027**	-0.0248	0.0975	0.1150	0.1129	**0.1389**	0.0832
S21	**0.2756**	**0.2230**	0.0121	-0.0754	**0.1444**	**0.2561**	**0.2162**	0.0379	**0.3721**
S22	0.0918	0.0474	0.0233	**0.1279**	0.0292	**0.2305**	**0.0912**	0.1065	**0.1962**
S23	0.0471	0.0002	**0.1836**	**0.1730**	**0.1536**	0.0700	0.0452	**0.1571**	-0.0451
S24	**0.1955**	**0.1855**	**0.1510**	**0.1386**	**0.1776**	**0.2297**	**0.1248**	**0.1477**	**0.2384**
S25	**0.2348**	**0.2449**	0.0614	0.0591	**0.2300**	**0.3998**	**0.2020**	**0.1478**	**0.4012**
S26	**0.1978**	**0.2937**	**0.1333**	**0.1581**	**0.2543**	**0.2878**	**0.2716**	**0.1823**	**0.2815**
S27	0.1020	**0.2215**	**0.2261**	**0.1673**	**0.2398**	**0.2643**	**0.1415**	0.0903	**0.2911**
S28	0.0953	**0.3337**	**0.2059**	**0.2120**	**0.1683**	0.0425	0.0230	0.0217	0.0403

(Bold numbers are significantly different from zero, $p < .025$)

Table A.7 (continued)

	S10	S11	S12	S13	S14	S15	S16	S17	S18
S10	1.000								
S11	**0.212**	1.000							
S12	**0.249**	**0.426**	1.000						
S13	**0.144**	**0.411**	**0.308**	1.000					
S14	**0.352**	**0.276**	**0.264**	0.106	1.000				
S15	**0.210**	**0.337**	**0.377**	**0.242**	**0.356**	1.000			
S16	**0.646**	**0.271**	**0.245**	**0.222**	**0.261**	**0.221**	1.000		
S17	**0.277**	**0.369**	**0.368**	**0.271**	**0.385**	**0.341**	**0.326**	1.000	
S18	**0.248**	**0.305**	**0.207**	**0.352**	**0.224**	**0.227**	**0.245**	**0.512**	1.000
S19	**0.412**	**0.376**	**0.274**	**0.204**	**0.384**	**0.311**	**0.312**	**0.458**	**0.459**
S20	**0.209**	0.075	0.051	**0.161**	0.107	**0.125**	**0.209**	**0.248**	**0.331**
S21	**0.149**	**0.353**	**0.192**	0.034	**0.283**	**0.291**	**0.200**	**0.185**	0.062
S22	0.080	**0.201**	**0.211**	**0.246**	0.101	**0.220**	**0.167**	0.098	0.193
S23	-0.011	-0.045	0.082	0.016	**0.131**	0.077	-0.032	0.114	0.116
S24	**0.134**	**0.254**	**0.212**	**0.286**	**0.190**	**0.263**	**0.314**	**0.237**	0.222
S25	**0.316**	**0.368**	**0.393**	**0.274**	**0.326**	**0.337**	**0.296**	**0.335**	0.310
S26	**0.240**	**0.314**	**0.381**	**0.292**	**0.221**	**0.292**	**0.307**	**0.320**	0.228
S27	**0.132**	**0.349**	**0.329**	**0.260**	**0.156**	**0.312**	**0.234**	**0.204**	0.188
S28	**0.207**	**0.149**	**0.157**	**0.289**	0.076	**0.161**	**0.255**	**0.154**	0.232

	S19	S20	S21	S22	S23	S24	S25	S26	S27
S19	1.000								
S20	**0.209**	1.000							
S21	**0.252**	0.041	1.000						
S22	0.069	0.104	**0.276**	1.000					
S23	0.075	**0.159**	**-0.310**	**-0.239**	1.000				
S24	0.068	**0.247**	**0.215**	**0.352**	0.003	1.000			
S25	**0.350**	0.100	**0.315**	**0.248**	0.049	**0.296**	1.000		
S26	**0.266**	**0.116**	**0.222**	**0.206**	0.010	**0.174**	**0.499**	1.000	
S27	**0.167**	0.059	**0.277**	**0.265**	0.026	**0.222**	**0.391**	**0.442**	1.000
S28	**0.192**	**0.169**	0.023	0.056	0.090	0.120	**0.208**	**0.385**	**0.246**

(Bold numbers are significantly different from zero, $p < .025$)

Determinant: .000128690

Table A.8
Questions For the Auditory-Linguistic Variable

Identification Number and Question		Item-Total Correlation
A1	I prefer the traditional lecture-type of classes.	-.1029
B1	After I write something, I read it aloud so that I know how it sounds	.0853
C1	I prefer to follow spoken directions rather than written ones.	.2689
D1	I do better on tests that cover information I have heard rather than read.	.1767
E1	I would rather say something than write it .	.3684
F1	People would say I speak more understandably than I write.	.3645
G1	I can make more sense out of what a person means when he speaks to me rather than if he writes to me.	.3371
H1	I understand the news better when I hear it rather than when I read it	.1713

Table A.9
Questions for the Auditory-Quantitative Variable

Identification Number and Question		Item-Total Correlation
A2.	I find it easy to add numbers in my head that have been spoken to me.	.3613
B2.	I can remember a telephone number once I hear it.	.2503
C2.	I talk about "sale" prices with others before I go shopping	.0492
D2.	Oral math tests are easier for me than written ones	.1747
E2.	I find it easy to solve arithmetic problems that are read to me	.3654
F2.	If I were buying a car, I could learn more about the engine if someone told me about it than if I had to read about it.	.1840
G2.	I find it easy to "talk in formulas" with my classmates and teachers in math class . .	.3686
H2.	It is easy for me to remember numbers and prices I have heard during a conversation. .	.4405

Table A.10
Questions For the Visual-Linguistic Variable

Identification Number and Question		Item-Total Correlation
A3.	I would rather read a map than listen to someone give me directions	.2511
B3.	I prefer to read a newspaper myself rather than listen to someone read a portion of it aloud.	.2681
C3.	I would rather take a written English test than an oral English test.	.1895
D3.	I write an explanation better than I tell it.	.2777
E3.	I would rather read directions than hear them read to me.	.3964
F3.	I understand information better when I read it rather than when I hear it.	.3593
G3.	I score well on tests which depend upon my knowing what I have read	.3330
H3.	I prefer classes where we have to read text-books rather than just listen to a lecture .	.2555

Table A.11
Questions For the Visual-Quantitative Variable

Identification Number and Question		Item-Total Correlation
A4.	I complete my own income tax form or feel confident that I could compute my taxes if I had to learn.	-.0852
B4.	I can understand most graphs or numerical charts without much trouble.	.2275
C4.	I do my best math work on written tests rather than on oral ones	.2275
D4.	In order to add seven or eight numbers I have to write them down.	.0490
E4.	I solve math problems faster if they are written down	.2903
F4.	I can better understand a math problem if I see it in writing.	.2851
G4.	I need to write down a phone number in order to remember it	.0481
H4.	It helps me if I keep a written record of how I spend money.	.0229

Table A.12
Questions For the Auditory Variable

Identification Number and Question		Item-Total Correlation
A5.	I can listen to a song and recognize the "tune" the next time I hear it	.2909
B5.	I listen to sounds, for example of a car's engine, to tell if something is running correctly.	.3794
C5.	I can tell the difference between two closely pitched sounds	.4586
D5.	Outside noises take my attention from what I am doing.	.0828
E5.	I tune a radio by the sounds I hear and not by the numbers on the dial	.1556
F5.	It bothers me when the radio is not tuned just exactly right	.2342
G5.	When I listen to music, I can tell one instrument from another.	.4848
H5.	I can tell who is on the phone just by listening to the voice for a few seconds . .	.2480

Table A.13
Questions For the Olfactory Variable

Identification Number and Question		Item-Total Correlation
A6.	An unpleasant smell bothers me more than it does others	.2596
B6.	I can tell if food is fresh or stale by its smell.	.3526
C6.	I am among the first to smell gas odors in a car	.4717
D6.	I feel that the smell of a store has a lot to do with its sales	.2923
E6.	I can identify familiar flowers or plants by their smell	.4127
F6.	I can identify familiar foods by their smell.	.4434
G6.	I think the "smell" of a new car is one of the nicest things about it	.2155
H6.	I can tell "what's cooking" by the smells of the food	.4766

Table A.14
Questions For the Savory Variable

Identification Number and Question	Item-Total Correlation
A7. I return to a restaurant only if the taste of the food served there is good	.0551
B7. The taste of a drink is important to me. . .	.1890
C7. I carry with me either cigarettes, gum, mints, a pen, etc., that I can chew on . . .	.2396
D7. I can taste the difference between Coke and Pepsi Cola with my eyes closed	.1536
E7. I can concentrate better when I have something on which to chew or to eat	.3261
F7. The taste of food is more important to me than the way it looks.	.1666
G7. I enjoy new foods because I like new tastes.	.1554
H7. I can tell by tasting if vegetables have just the right amount of seasoning	.1452

Table A.15
Questions For the Tactile Variable

Identification Number and Question	Item-Total Correlation
A8. I feel the material in an outfit before buying it	.2349
B8. I touch realistic-looking silk flower arrangements to see if they are real	.0548
C8. I prefer to write with a pen or pencil that "fits" my fingers	.1376
D8. I can button my coat in the dark	.2633
E8. I can tell a nickel from a dime in my pocket with my fingers	.2881
F8. I would pick up and feel vegetables and fruits in a store before buying them	.3192
G8. I can tell the difference between cotton and silk.	.2537
H8. I can tell my hair needs washing by the way it feels when I touch it	.3101

Table A.16
Questions For the Visual Variable

Identification Number and Question	Item-Total Correlation
A9. I understand a story better in a movie than in a book	.1557
B9. I notice when a movie or television picture is slightly out of focus	.0310
C9. I can understand a speaker better if I can see him talking.	.2134
D9. I like looking at art work	.0031
E9. Pictures in textbooks help me to understand what the book is saying.	.3150
F9. I learn more from a picture than I do from a written description	.1487
G9. I choose clothes mostly because of the way they look on me.	.0032
H9. I use the numbers on the dial when I tune a radio	-.0051

Table A.17
Questions For the Proprioceptive Variable

Identification Number and Question	Item-Total Correlation
A10. I consider myself to be a good amateur athlete.	.4124
B10. I look at one thing with my eyes while doing some other task with my fingers at the same time	.3477
C10. I have been told I am a good dancer.	.2936
D10. I can write without looking at my hands. . .	.2233
E10. I do well in activities that require hand-eye coordination.	.3829
F10. I can write while another person dictates to me	.1668
G10. There is a sport I can play well enough to enjoy.	.3566
H10. I can catch a ball that has been struck or thrown	.2153

Table A.18
Questions For the Empathetic Variable

Identification Number and Question	Item-Total Correlation
A11. I understand how people feel when they are being punished	.2701
B11. I am patient with those who cannot seem to keep their mind on a subject	.2840
C11. My friends tell me I am understanding. . . .	.4838
D11. I "feel" the emotions of others as they feel them.	.5150
E11. When I am around someone who is hurt, I feel hurt, too	.4447
F11. I can understand and be patient with someone who is frightened.	.4995
G11. I try not to say something which might hurt someone's feelings.	.2419
H11. I can offer criticism to someone without hurting them	.2897

Table A.19
Questions For the Aesthetic Variable

Identification Number and Question	Item-Total Correlation
A12. I enjoy listening to music when the quality of the sound is good	.1168
B12. I read a poem or the words to a song over and over because the words seem so beautiful.	.4343
C12. I want useful things to be as pretty as possible	.2423
D12. I think poetry is beautiful because of its ideas and words.	.5354
E12. I enjoy the way an author writes as much as the story he tells	.3428
F12. I would go out of my way to see beautiful scenery.	.4853
G12. I enjoy the beauty of a well-designed building	.4477
H12. I prefer a tidy room or desk	.2057

Table A.20
Questions For the Ethic Variable

Identification Number and Question	Item-Total Correlation
A13. I live my life according to my own moral values	.0186
B13. I do not let things interfere with completing an assignment or task	.2116
C13. I believe a promise should be kept	.1813
D13. I would stop at a stop sign at three in the morning even if there were no one else around	.2268
E13. I would give up something right now rather than do anything I think is wrong.	.3660
F13. When I decide to do something, I usually carry through and do it.	.1593
G13. I would give up money before I would give up what I believe in	.2462
H13. I keep working hard even when no one is watching	.1995

Table A.21
Questions For the Histrionic Variable

Identification Number and Question	Item-Total Correlation
A14. I act friendly and helpful when the situation requires me to behave in a certain manner	.0512
B14. I can pretend to feel a certain way when I do not really feel that way at all if I must	.3527
C14. I can act interested even though I am bored when listening to a teacher.	.3438
D14. I laugh at jokes that I don't think are funny.	.1901
E14. I can pretend to be happy and comfortable even when I am not	.5401
F14. I can act tough in order to show others that I am not scared	.2141
G14. I would probably be a good actor in a play .	.1694
H14. I can act like I know what I am doing when it seems like a good thing to do	.3743

Table A.22
Questions For the Kinesic Variable

Identification Number and Question	Item-Total Correlation
A15. Even while on the phone, I "talk with my hands"	.4993
B15. I shrug my sholders when saying, "I don't know"	.1670
C15. I blush in situations where many others do not.	.0681
D15. When I shake hands, my handshake tells the other person how sincere I am.	.2852
E15. People say that when I talk, my eyes talk, too.	.3445
F15. I can tell how a person feels by the way he sits or stands.	.2055
G15. I use my hands to help me talk	.5040
H15. I use facial expressions to show how I feel.	.4806

Table A.23
Questions For the Kinesthetic Variable

Identification Number and Question	Item-Total Correlation
A16. I think it is important to learn to play sports correctly	.3206
B16. I can wash dishes or set a clock without looking at my hands.	-.0664
C16. I am better coordinated than most people . .	.3547
D16. I walk up a staircase without falling or slipping.	.1815
E16. I do well in sports.	.3615
F16. I am willing to practice the steps to a new dance until I can do them really well. .	.1943
G16. I learned to write clearly by practicing my handwriting	.0403
H16. I can hit with a bat a ball that is thrown to me.	.3912

Table A.24
Questions For the Proxemic Variable

Identification Number and Question	Item-Total Correlation
A17. I know how close I can stand to other people without making them uncomfortable . .	.3775
B17. I know when it is alright to introduce myself and when I should wait to be introduced	.4412
C17. I can tell which boss or teacher to call by their first names.	.3367
D17. I can tell how friendly I can be with a stranger.	.4678
E17. I know how much I need to apologize when I bump into someone in a store	.3655
F17. I can tell when it is O.K. to tell a joke. .	.4858
G17. I know when it is O.K. for me to put my hand on another person's shoulder.	.5248
H17. I know who I can ask a favor of without imposing	.3391

Table A.25
Questions For the Synnoetic Variable

Identification Number and Question	Item-Total Correlation
A18. I can tell when I am under too much pressure	.3892
B18. I do what I set out to do.	.1883
C18. I know how well I have done on a test before I get my score back	.1845
D18. I know my weak points.	.4026
E18. I know when I have taken on too much responsibility	.2508
F18. I know my strong points.	.3596
G18. I can accept it when someone criticizes me .	.2298
H18. I can predict how I will react in various situations	.3038

Table A.26
Questions For the Transactional Variable

Identification Number and Question	Item-Total Correlation
A19. I can put others at ease in tense situations	.4355
B19. I can persuade people who are having an argument into discussing their problems. . .	.5475
C19. I can get a group to make a decision when I am ready for them to complete a discussion	.5012
D19. I can "take charge" of a situation	.5114
E19. I am able to verbally stop arguments between other people	.4659
F19. I can talk others into doing what I would like for them to do.	.5103
G19. My friends involve me in solving their problems	.3079
H19. I am a good salesperson.	.4032

Table A.27
Questions For the Temporal Variable

Identification Number and Question	Item-Total Correlation
A20. I can tell how long it will take to complete most tasks	.2717
B20. I know how long it takes me to drive places	.3437
C20. It bothers me for a friend to be late for an appointment with me	.4426
D20. It bothers me when events do not start on time.	.4831
E20. I am among the first to arrive at a meeting.	.5704
F20. I turn in assignments when they are due. . .	.2520
G20. I arrive at class on time.	.5214
H20. I keep my appointments on time	.6062

Table A.28
Questions For the Associative Variable

Identification Number and Question	Item-Total Correlation
A21. I learn something better when I can discuss it with friends.	.3746
B21. I enjoy an activity more if my friends are there.	.3431
C21. I like for my friends to help me make decisions	.3540
D21. I like to work in groups in class.	.4407
E21. I like to have a friend go with me when I go shopping to help me make choices .	.3439
F21. I would want to talk with my friends before I took a new job	.4963
G21. I am influenced by my friends' political opinions	.2395
H21. I like class projects where there is a lot of group work.	.4234

Table A.29
Questions For the Family Variable

Identification Number and Question	Item-Total Correlation
A22. I try to live based on what my family says is right or wrong.	.3930
B22. I talk with my close family before making major decisions.	.4261
C22. I enjoy activities more when I am with my family.	.4274
D22. My political choices are influenced by my family's views	.3478
E22. I talk with my family before doing anything that might affect them	.3926
F22. I think of my boss or instructor as if he or she is a father or mother figure: I don't want them to be "one of the gang." .	.1510
G22. My family is the biggest influence on my religious beliefs.	.3575
H22. I make it a point not to let other things interfere with family plans.	.3764

Table A.30
Questions For the Independence Variable

Identification Number and Question	Item-Total Correlation
A23. I solve my own problems without suggestions from others.	.1652
B23. I place my own goals ahead of the goals of others	.2197
C23. I like to make up my own mind about what is right and wrong.	.2305
D23. I make my own political choices.	.1824
E23. I would rather do things my way even if it disappoints my family.	.2434
F23. I prefer to work alone most of the time when given a choice	.2492
G23. I prefer classes where I can do independent work	.2695
H23. I would rather do a class project alone than do it with a group.	.2948

Table A.31
Questions For the Magnitude Variable

Identification Number and Question	Item-Total Correlation
A24. Life is simple as long as I abide by the rules.	.1969
B24. I do not sympathize with people who break the law.	.0693
C24. I must know what the rules are in order to know whether a person has done right or wrong	.1771
D24. I follow the rules of most games and do not "cheat"	.2196
E24. I think that rules and regulations should be followed	.4222
F24. I would rather work where the rules and standards are clearly stated	.2081
G24. Because there is a law that says we stop for red lights, I would always stop for a red light.	.3550
H24. If I find the article I had in mind, I buy it without shopping further.	.1350

Table A.32
Questions For the Difference Variable

Identification Number and Question	Item-Total Correlation
A25. When I meet someone new, I notice how we are different.	.2737
B25. I learn how to be successful by examining my mistakes.	.3172
C25. I think that holidays are different from other days of the year	.1547
D25. I could learn how to drive a new car by comparing how it was different from my old car.	.2395
E25. I could better learn a topic if I see how it differs from other topics	.4250
F25. I use jokes or funny remarks to change the point of view in many situations	.1454
G25. If I had to explain soccer to someone, I would tell them how it differs from other sports they know about, like football.	.3014
H25. I wear contrasting colors in my choice of clothing	.1943

Table A.33
Questions For the Relationship Variable

Identification Number and Question	Item-Total Correlation
A26. I take courses that have a lot in common	.0686
B26. I tend to see all parts of the world as being related.	.3272
C26. I solve a problem by seeing if it is like other problems I have solved	.3191
D26. When I look at something (like a painting, building, statue), I like to compare it to others I have seen	.2670
E26. I get to know someone new by finding all the ways we react alike.	.3875
F26. I can put together most jigsaw puzzles	.0741
G26. I like to figure out how parts of a whole fit together	.2371
H26. I learn what other people believe in by seeing how it is similar to what I believe	.3764

Table A.34
Questions For the Appraisal Variable

Identification Number and Question	Item-Total Correlation
A27. I take longer to solve a problem than do others because I want to know more about it than do most people.	.2847
B27. I change my mind about decisions I have made.	.1352
C27. I think decisions are better ones if I think about them for a long time	.2793
D27. I have to decide things before I can get enough information	.0906
E27. I worry about decisions because I see so many possible ways to solve the problem. . .	.3392
F27. I like to look at a problem from as many ways as possible	.3143
G27. I want to know as much about a problem as I can before I make a decision	.3580
H27. It takes me a long time to shop for clothes because I go to several places to compare. .	.3071

Table A.35
Questions For the Deduction Variable

Identification Number and Question	Item-Total Correlation
A28. I reason in a very logical fashion	.3142
B28. I avoid guessing when solving problems . . .	.2656
C28. I find reasoning like the following helps me to understand my thinking: All dogs have four legs. Rover is a dog. Therefore, Rover has four legs	.2509
D28. I like to solve a problem by starting with something I know is true.	.1567
E28. I understand theorems used in geometry . . .	.4590
F28. I enjoy riddles or puzzles that must be solved where the correct answers can be figured out from information in the rules. .	.3863
G28. I enjoy the reasoning patterns used in math courses	.5080
H28. I like games that require me to use logic. .	.5187

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