This is to certify that the

thesis entitled

COGNITIVE STRUCTURE: ITS MEASUREMENT AND DOMAIN SPECIFICITY

presented by

Jacqueline Ur Cooney

has been accepted towards fulfillment of the requirements for

M.A. degree in Communication

[signature]
Major professor

Date Nov 15, 1976

COGNITIVE STRUCTURE: ITS MEASUREMENT AND DOMAIN SPECIFICITY

By

Jacqueline Ur Cooney

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Communication

1982

ABSTRACT

COGNITIVE STRUCTURE: ITS MEASUREMENT
AND DOMAIN SPECIFICITY

By

Jacqueline Ur Cooney

A review of the social science literature on the concept "cognitive complexity" and the surrounding controversy suggests that cognitive complexity can be examined as three distinct properties in judgment:

(1) Differentiation, the number of dimensions used.

(2) Articulation, the fineness of distinctions along any one dimension.

(3) Integration, the equality of dimension use.

Hypothesized are that cognitive structures are domain specific and a function of experience in the domain.

Subjects' paired comparions of concepts within an interpersonal and a mechanical domain produced raw distance matrices which were orthogonally decomposed using GALILEO™, a metric multidimensional scaling routine. The resulting spaces were compared and analyzed on the three properties using correlations and multiple regression techniques.

Results of analyses indicate mixed support for the hypothesis of domain specificity; some properties are highly correlated across domains while others are not. Experience is not supported as a significant predictor of cognitive structure.

For my father, who always knew this was
really for my mother.

ACKNOWLEDGMENTS

The number of individuals to be thanked on any project increases in direct proportion to the amount of time required to complete the project. In other words, when you take as long as I have to complete a thesis, the list of folks who contributed and enabled keeps growing.

When I was an undergraduate, I wrote a poem:

Hansel and Gretel U.
An oven.
Stifling
hot
close.
The witch
Baking our minds
Into cookie-cuttered gingerbread.

And, in my first term or so of graduate school, a professor remarked that we had been taught too well, that all of our papers read as if they had been stamped out with the same cookie-cutter. Of course, never being one for doing much of the expected, I knew I was in trouble. And so we begin.

My first thanks go to Dr. Erwin Bettinghaus. He has served well (and long) as my advisor and chair of my committee, helping me through the hoops and boxes. He is a man, as my friend Michael pointed out, of infinite patience. But even more importantly, he allowed me the independence, the autonomy, the freedom to learn, to explore, to try something a bit off the beaten path. Dr. Bettinghaus never forced me into the mold, although taking that route might have been much easier (on both of us). Mostly, he never said, "I told you so," when there were <u>so</u> many chances to do so. For all of this, he has my thanks.

Dr. Edward Fink spent countless hours with me, trying formula upon formula, sounding out measurement methods and procedures, working through all the possibilities and factors to be considered in measurement decisions. I particularly remember one day when we were working on the measurement of articulation; Ed and I thought we finally had it. But he trucked me into at least three other offices, and we worked it all out/through again, just to see what might have been overlooked. And, when it came time for rewrites, Ed again spent hours of meticulous, detailed work with me. I'm sure that this will never be as good as Ed would like it to be. I only hope, Eddie, that it's good enough.

Dr. Michael Moore was my third "official" committee member. As an outside member, Mike was my sanity, my oasis, and my perspective in the midst of what often seemed an otherwise insane world. I thank you, Mike, for that, but mostly for teaching me that the important question is, "So what?"

Dr. Joseph Woelfel contributed to this product in a number of ways. What I know and understand about GALILEO™ is Joe's teaching. And he somehow always managed to convey the idea that what I was involved in was worth doing; I wasn't always so sure, you know. Mostly, he early on shook all of my preconceived notions of measurement and methodology. He made me look, explore, try. Like a child with a new puzzle, I learned by playing "What if...?", and re-learned to challenge, "Why?"

Dr. Katrina Winecoop Simmons was invaluable. She nursed, hand-held, listened, sympathized, empathized. Trina was one of the sounding boards Ed and I used often. I've lost count of how many Saturdays and brunches Trina shared, helping me break through overwhelming writer's block to get this done.

Michael Cody and Rick Holmes made me promise that I would do nothing more than give them a simple acknowledge. But I feel rather as Michael did in trying to thank Rick simply. Somehow these two took numbers from coded pages and magically turned them into spaces. They just "took care of" things--and me. Still, to paraphrase, "Michael and Rick helped, too."

Ken, Steve, and Claire were students of mine who spent hours deciding on rating criteria and coding data. Ken Zgraggen became team leader, making decisions, smoothing wrinkles, and "handling" difficulties for me. All of their assistance is appreciated.

Suzy Pavick is to be especially thanked for being much more than a typist. Working in Flint while living in Lansing has made this a rather difficult project to coordinate. Suzy has orchestrated picking up, delivering, photoreducing, and all those other related activities. She has reminded me of administrative and necessary details when I would easily have let them slip by. There is always a smile in her voice, even when ill and/or tired, as she assures (and reassures) me, "We'll have it in on time."

The list of friends who have read, supported, discussed, listened, and hugged is enormous. They need, most of all, to be thanked for being there, and for knowing when to be a nudge and when to leave it alone. Celebrations are to be shared with BJ, Hersh, Teri, Kathy, Forslin, Guy, Nancy, Tim, Jay, and Bruce. Most of them will never see this, but they made it possible.

My parents, of course, deserve recognition for their piece in this. My father always loved learning; he instilled in me curiosity, the need to know, to try something old in new ways. My mother has taught me perserverance (or, at least, she has tried). I'm not sure which was more valuable in getting this degree.

And, finally, my husband, Doug, deserves special recognition. I've been "thesis"-ing almost as long as we've been married. Thank you, sweetheart--for everything.

So it goes.

TABLE OF CONTENTS

Chapter		Page

LIST OF TABLES

Table		Page

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Purpose of the Study

When I began this study, I was interested in the concept "cognitive complexity" and explanatory factors for "complex" and "simple" cognitive styles. As I reviewed the literature and explored the area further, I noticed several things.

First, it seems that no one is really sure what "cognitive complexity" means; and those researchers/theorists who are adamant in their views hold differing opinions. As a result, I have come to believe that "cognitive complexity" is not one property, but, rather, a number of different properties. I have focused on three properties which seem to characterize the literature: differentiation, articulation, and integration. I do not believe that there is a combination of these three properties which is inherently more complex or simple than another.

Secondly, the cognitive complexity literature tends to be highly value-ladened and judgmental. There somewhere seems to have been generated the notion that "highly complex" cognitive styles are better or associated with high intelligence; that individuals who exhibit "simple" cognitive styles are simple in the more colloquial sense. This position lacks substantiation, and I do not support it.

Finally, individuals have been characterized as exhibiting a generalized style, whether complex or simple. Review of the literature suggests that individuals may have a range or pattern within which they tend to operate. The particular configuration, however, will vary from subject area to subject area for any individual.

Because the term "cognitive complexity" has been associated with inappropriate value judgments, and because the use of the term falsely suggests a unitary concept, I will avoid its use in this work. I will instead use the terms "cognitive style" and "cognitive structure". The term "cognitive style" will be used to mean, at a theoretical or conceptual level, an approach--a way of generally looking at, categorizing, and processing the world. "Cognitive structure" refers to a measurement or operationalization of the theoretical concept "style"--an exhibited pattern or configuration of properties.

The separation of aspects of cognitive complexity into different properties is supported by the literature. Vannoy (1965) comparatively examined twenty measures of cognitive complexity. Correlations between the measures are disappointingly low. Vannoy also notes that "a factor analysis did not yield a large first factor on which all of the tests or even a large proportion of them were substantially loaded (p. 394)." His findings suggest two propositions: (1) Cognitive complexity, as measured, is not a single trait, but rather a generalized term for a number of distinct characteristics in judgment; and, (2) cognitive style is not a generalized individual trait, but varies with the domain of concepts under consideration.

In the present study, cognitive style has been examined as a structure in a multidimensional space. In order to characterize differences in structures, three properties have been used:

differentiation, articulation, and integration. Using those measures, I will develop support for two hypotheses:

(1) Cognitive structure is domain-specific.

(2) Differences in cognitive structures are a reflection of different experience levels in the domain.

Since the study relies upon my assumptions and definitions regarding cognition, the next section outlines those concepts germane to the work.

Cognitive Style: Assumptions and Definitions

Measures of cognitive style depend on assumptions about cognition. For purposes of this study, these assumptions are: (1) Cognitive style can be examined as an exhibited structure occupying a multidimensional space; (2) A cognitive space consists of a number of elements arranged into larger sets, or domains; (3) Within these domains, attributes are used to make judgments about elements; (4) It is possible to measure cognitive space using multidimensional scaling techniques. The next section describes several important constructs and their implications for this study.

Elements

An *element*, or cognitive element, is a phenomenological projection of the world. That is, it is an internal representation of some object or concept which can be called forth in the imagery of the individual. An element, then, may have some extensional counterpart in physical reality, such as "dog" or "chair", or no physical counterpart, such as "happiness" or "truth".

The suggestion that such objects or concepts can be "called forth" refers to the necessary existence of a phenomenological label for an element--a label based on an individual's unique experience, as opposed to an agreed-upon or consensual label. Without a label, it is improbable, if not impossible, that a concept or object exists as an element for an individual. It is quite possible that one might recognize a property, trait, or quality in a group of objects, but without a label for the quality, it does not exist as an element for the individual.

For example, one might find a "sameness" among administrators, but without a label such as "bureaucrat", this sameness does not occur as a cognitive element which can be discriminated from other elements. It should be noted that it is not necessary to have a "proper" or "correct"--or even appropriate--label to represent a concept or object, only to have one. In the above example, "administrative sameness" could serve as a cognitive element if it were to label the quality noticed. A child may refer to a dog, or all house pets with four legs, as "bow-wow". "Bow-wow" has some internal representation for the child who uses it. Few can tell you exactly what "star-quality" is, but this nebulous phrase exists as an element for those who discuss it. Cognitive elements, then, are internal representations of objects or concepts which have some semantic label attached to them.

Domains

A further assumption is that elements are arranged in some order. In other words, some elements are subsets of other elements. These larger sets of elements are domains. An individual may have a domain, or category of elements, called "family". The domain "family" may be divided into "maternal relatives" and "paternal relatives", or "nuclear" and "extended". Those domains may be further subdivided into elements until a separate representation for each element (or, here, family member) is arrived at. Each domain, then, is a cognitive element which can be further subdivided into other elements.

Attributes

Within a domain, elements are evaluated along conceptual rulers or attributes. One uses attributes to differentiate and describe elements. Like cognitive elements, attributes are phenomenological, differing between individuals on the basis of their past experiences. Some attributes are independent of one another. For example, weak-strong is independent of good-bad. Others are interrelated. Pretty-ugly, kind-cruel, and pleasant-unpleasant are strongly related to one another (Osgood, Succi and Tannenbaum, 1957).

Structural Properties of Cognitive Space

Given the above assumptions about cognitive space, it is necessary to find descriptors, some way to describe similarities and differences in order to compare spaces. Identifying and measuring these descriptors have been the main thrust of the literature in cognitive complexity. A review of the literature suggests three major structural properties as useful in describing cognitive spaces and the arrangements of elements within them. These are: differentiation, articulation, and integration. Explication of each property and its value in describing cognitive space follows.

Differentiation

Differentiation is the ability to discriminate among elements. This ability is the aspect of cognitive style most often examined (Zajonc, 1960; Scott, 1963, 1969; Vannoy, 1965). Kelly (1955) used "constructs", sets of bipolar adjectives along which subjects were asked to rate how one person was different from a pair of others. Several studies have used variations of the semantic differential to measure the similarity-differentiation of elements. A comparative review of methodologies by Vannoy (1965) shows concurrence on the property of differentiation as an indicator of complexity.

It is unfortunate that the distinction between attributes and dimensions is often unclear in the literature. For example, Zajonc (1960) states:

> It is assumed that objects and events are perceived and discriminated on the basis of psychological dimensions. By a psychological dimension is understood the organism's capacity to respond to stimuli in such a way that, given a set of stimuli and a set of responses made to them, the stimuli and responses form two ordered sets, with a determinate correspondence between the elements of each set (p. 159).

Zajonc's definition does not allow one to discriminate between the two terms. Indeed, the use of "attribute" or "dimension" appears rather interchangeable.

An attribute can be considered to be a vector in space, typically conceived of as ending in bipolar adjectives (e.g., good-bad). An attribute is used by an individual to evaluate elements. Attributes may be highly correlated and interdependent. It is not necessary that an attribute pass through the center of the space, nor that it span the space. This is illustrated with the figure below (Cody, Marlier, and Woelfel, 1975, p. 14). Here, a number of attributes are arrayed in a two-dimensional space. Note that the soft-hard attribute neither spans the space nor passes through the center.

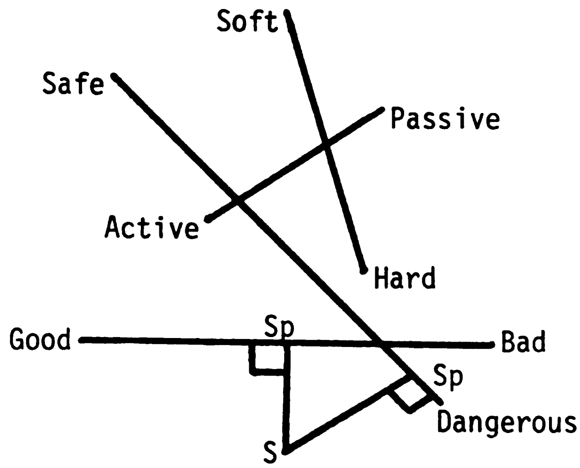

Figure 1. Four attributes arrayed in a two-dimensional space

In contrast, dimensions are imposed on the space <u>post</u> <u>hoc</u> by the investigator as a result of some orthogonal decomposition. Dimensions always span the space, always pass through the center, and have no endpoints. More importantly, dimensions are orthogonal factors, created to be uncorrelated with one another.

The research to be reported here focuses on the number and nature of dimensions rather than of attributes for two reasons. First, it is possible for an individual to evaluate elements using several attributes with little differentiation among the elements. For example, one subject may evaluate individuals on the highly correlated attributes of good-bad, beautiful-ugly, kind-cruel, pleasant-unpleasant, and friendly-unfriendly. A second individual may use only three less-correlated attributes: good-bad, weak-strong, and fast-slow. In their work with the semantic differential (an attribute scale), Osgood, Suci, and Tannenbaum (1957) have shown that the second set of attributes, although smaller in number, falls along three dimensions--evaluation, potency, and activity, respectively. In the first case, all the attributes suggested fall along only one dimension--evaluation. The person who uses a larger number of dimensions is said to discriminate more than the person who uses fewer dimensions in judging elements. The person who discriminates more has a more differentiated space. Therefore, this study focuses on the use of dimensions, rather than the use of attributes.

The second reason for a focus on dimensions involves consideration of increasing dimensionality. If all of the elements in a space were to be represented as maximally differentiated from one another, the dimensionality of the space would be N-1, where N is the number of elements.

For example, to locate point P in a one-dimensional space, the information necessary is one coordinate, the distance from point O.

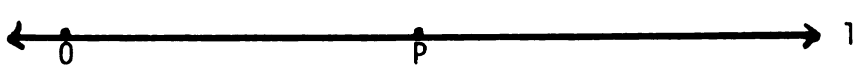

Figure 2. One-dimensional space with concepts O, P

To locate point P in Figure 3, a two-dimensional space, two pieces of information are necessary. The coordinate of the distance point P is from O is necessary along Dimension 1 and along Dimension 2.

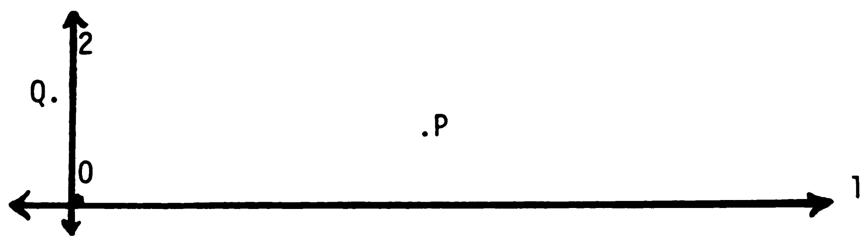

Figure 3. Two-dimensional space with concepts O, P, and Q

If the dimensions are labelled, then Figure 2 corresponds to the structure used by a person who judged a concept using only, let us say, the evaluative dimension (good-bad). That individual would only be able to tell how good or bad P is in relation to O; that is, how much better or worse.

If Dimension 2 is labelled "potency", then Figure 3 corresponds to the cognitive structure of an individual who used two dimensions in judging concept P. This second individual would be able to tell two things: how good or bad P is in relation to O, and how strong or weak P is in relation to O. In addition, the two-dimensional space in Figure 3 can tell more about other elements, e.g., Q.

These examples can be extended with more dimensions. The higher the dimensionality of the space, the more information which can be stored in the space about each element. Information, then, is a second reason for focusing on dimensionality.

Since the concept of differentiation is the degree to which "a given person is capable of identifying and discriminating objects and events" (Zajonc, 1960, p. 160), then it is logical to examine the level at which the maximum information to distinguish between objects can be stored. In our examples above, the first subject, with more attributes, has fewer dimensions, and therefore less information in the space about the elements. Subject two has fewer attributes, but more dimensions, and, therefore, more information.

In light of the above discussion, the research which follows will focus on dimensionality as a structural property which can be used as a descriptor of cognitive space in terms of differentiation.

Articulation

Articulation (Scott, 1969) is a second structural property of cognitive structure and is essentially another kind of differentiation: it is the ability to discriminate elements along any one dimension. One way of approaching articulation is the examination of category width, or the ability to make fine distinctions along a dimension. Articulation, then, is the dispersion of elements on a dimension (Pettigrew, 1958; Shrauger and Altrocchi, 1964; Vannoy, 1965).

The ability of an individual to make discriminations assumes, of course, that there are distinctions between the elements to be classified. That is, if an individual were asked to differentiate between concepts that all seem to load in a particular category, then that dimension would appear unarticulated. It might, in fact, be the case that the dimensions was unarticulated. However, it might be well-articulated, with no concepts available to be rated in other categories.

Suppose an individual were asked to rate five chairs in terms of comfort. If all of the chairs were soft, supporting, and comfortable, measurement would exhibit an unarticulated dimension. If chairs were chosen along a continuum to hard, unsupporting, and uncomfortable, more articulation might be shown, depending on the cognitive style of the individual doing the ratings.

The utility of a conceptualization such as articulation may not be obvious. Consider, however, the possible ways of categorizing elements on an evaluative dimension. One individual might habitually cluster elements into two essentially black-and-white categories at extremes: liked and disliked. A second individual might add a third category at the center of the space to accomodate those elements about which s/he is neutral. An individual who would use maximum discrimination between elements, with many "grey" areas, would use the full dimension in order to make fine distinctions. One can see that such differences in categorization, which have in the past been related to authoritarianism and dogmatism, may be characteristic of different cognitive styles. Articulation, then, is the second structural property to be examined in this study.

Integration

The integration of a cognitive structure is the third structural property to be considered in the research which follows. Lewin (1936) describes integration as a restructuring or "unification of systems" (p. 155). Scott (1974) has suggested:

> The general term, integration, is used here to indicate a basis for systematic interrelation among cognitive elements--a principle of organization that is potentially applicable to new elements as well as old (p. 564).

The following section will review studies by Scott and Wegner focusing on attributes and their use which lead to the conceptualization of the property of integration used in this study.

Unlike others who have investigated integration (Vannoy, 1965), Scott's studies (1969, 1974) examine four styles of integration using attributes: affective balance, affective-evaluative consistency, centralization, and image comparability.

(1) Affective balance is an integrative style which is an extension of Heiderian balance. In Scott's schema, affective balance is "an integrative style in which objects (images) are related by classification on the basis of similarity, or 'belonging together', and

this classification corresponds to their classification on the affective attribute ('liking')" (1974, p. 565). In this style, then, objects which are evaluated similarly along attributes (as either liked or disliked) would be located at points on the attributes with similar or "balanced" relations in the space.

(2) High affective-evaluative consistency is a "high correlation between the affective attribute (liking) and all evaluative attributes" (Scott, 1974, p. 565), such as pleasant or kind.

(3) Centralization is the use of a single attribute to account for a large percentage of the variance in the space. A central attribute is one with a large proportion of the elements projected upon it. An individual using this cognitive style might use the affective attribute (liking) to evaluate all of the elements presented. S/he might use the affective attribute to account for most of the variance in the space, a primary descriptor, only "filling out" his or her judgments with some salient elements on other attributes.

(4) The fourth integrative style Scott suggests is image comparability. This approach assigns all elements values on all attributes, uses all attributes equally, much as in scientific classification schemes.

Since this study examined dimensions rather than attributes, Scott's measures are inappropriate as he defined them. There is, for example, no affective attribute to examine for the first or second integrative style. As for the last two styles, the differences between attributes and dimensions become critical.

While it is possible that an element may be evaluated outside the range of an attribute (where either the attribute does not apply, or the element is off the scale--e.g., "gooder than good"), an element cannot be evaluated outside the range of a dimension. All elements have values on all dimensions. Therefore, no one dimension will have a higher proportion of elements projected on it (centralization), and image comparability is necessarily obtained.

What may be more appropriate here, then, is to examine how the dimensions are used. If one dimension (not attribute) accounts for a high proportion of variance in the space, a highly centralized cognitive style analogous to Scott's construct may be suggested. If the dimensions are used with equality, i.e., if they each account for roughly the same percentage of variance in the space, an image comparability analogy may be made.

Wegner (1974) has examined integration at the attribute level in a discussion of utility, again use and usefulness. "Low utility attributes were those used to describe only one of the acquaintances, while high utility attributes were those used to describe more than one of the acquaintances" (p. 1). This conception of utility is related to Scott's notion of centrality and image comparability. High utility attributes would create a highly centralized space. It should be noted that image comparability is an integrative style most characteristic of the natural sciences where classificatory systems are exclusive and exhaustive. The use of low utility attributes would parallel image comparability.

The idea of utility or use can be examined in terms of dimensionality. Given a set of dimensions for a cognitive space, the dimensions can be examined as suggesting different cognitive styles of integration. The eigenvalue of any dimension represents the percentage of the variance in the space accounted for by that dimension (Van de Geer, 1971). The dimensions could have high or low utility and account for a great deal or little of the variance in the space. Dimensions could be used equally, analogous to image comparability; or one dimension could be used much more than others--a highly centralized space. A dimension with high utility would account for a high proportion of the variance in the space, and, conversely, low utility dimensions would each account for some of the variance. It would appear that such differences are related to differences in integrative styles of cognitive structures. Differences in utility of dimensions will be examined in the research which follows.

Independence of Properties

Scott (1969, 1974) and Wegner (1974) have indicated in their studies that there may be interrelationships between the three properties discussed above. That is, the different aspects of cognitive style may not be independent properties. Analysis of the possibility of interdependence of the structural properties was examined in this study.

Restatement of Structural Properties

Vannoy (1965), in a comparative study of a number of different measures for cognitive complexity, found that there is a set of factors to be considered:

> It has generally been postulated that some persons are prone to employ a few dimensions when they perceive and evaluate stimuli, or are inclined to make only very gross discriminations along dimensions of meaning. Other persons are believed to employ many dimensions and/or to make fine discriminations along the dimensions they employ (p. 385).

A review of the literature, then, suggests three properties which can be used to describe cognitive structures:

(1) Differentiation: the ability to discriminate along many dimensions; the number of dimensions.

(2) Articulation: the ability to make fine distinctions along dimensions; the way in which elements are clustered on dimensions.

(3) Integration: the ability to employ these dimensions as useful evaluators; the equality with which they are used in the space.

These properties have been identified as descriptors of cognitive structure. One can hypothesize reasons for variations in spaces which can be measured in terms of these properties. In the next section, hypotheses in which these properties are dependent variables will be suggested.

Hypotheses

Domain Specificity

Zajonc (1960) states:

> It is assumed that a cognitive structure relevant to a particular object or event is activated primarily when the person expects to deal with information about that object or event (p. 161).

This statement indicates that the type of cognitive structure activated is in part a function of the elements to be categorized. Discriminations of different types are relevant for different areas of concentration. One can think of distinctions which are important and functional for some areas of experience and not for others. For example, color is important for stopping at traffic lights and appreciating some art, but not in solving mathematical problems. Although some writers (Schroder, Driver and Streufert, 1967) have suggested that cognitive complexity (or style) is a pervasive trait, others (Scott, 1963, 1969, 1974; Vannoy, 1965; Zajonc, 1960) have indicated that different styles and structures are used for different domains of elements under consideration. The tendency to use a particular style is in part a function of the particular domain of elements to be considered. In the research which follows, it is hypothesized that:

> H_1: Cognitive structure is domain-specific; different cognitive structures would be expected for different cognitive domains.

<u>Experience</u>

The notion of domain specificity has been carried a step further by Wicker (1969), who postulated that complexity in the cognitive structure for any one area is a function of the "frequency and intensity of interaction" an individual has had with elements in the domain. The interaction proposal has been supported by studies in subcultural lexicons (Friendly and Glucksburg, 1970). It is reasonable to expect that the more communication an individual has within a domain, the more messages received about the domain, and the more information s/he will have about that domain. The increase in information should affect the structure of that domain.

Scott (1969, 1974) has examined differences across domains of nations, acquaintances, family and self. He found that increases in information tend to increase dimensionality. Since more dimensions are needed to store more information, as discussed earlier, the finding is logical. He states:

> There should be no implications here that there exist two kinds of people, simple and complex--or even a continuous gradation of types--for this would require a unitary trait of complexity-simplicity pervading all areas of peoples' cognitive functioning. There is little evidence yet for such a general attribute. It would seem equally plausible that the degree of complexity-simplicity varies within a single individual on the amount and kind of knowledge he has about them and on the kind of functional demands with which that domain is confronted in the course of his daily life--e.g., with demands for complex adaptive responses or with demands for conformity to a stereotyped normative pattern (1963, p. 74).

Thus:

H_2: The structure of a cognitive space will vary as a function of experience in the domain being examined.

Chapter Summary

This chapter began with a discussion of assumptions about cognitive style and structure. A review of the literature suggests three structural properties which can be used to describe cognitive spaces:

(1) Differentiation: the ability to discriminate along many dimensions.

(2) Articulation: the ability to make fine distinctions along those dimensions.

(3) Integration: the ability to use the dimensions as evaluators.

These properties suggest a cluster or pattern of behavioral tendencies which could be used to characterize different cognitive styles. The properties were hypothesized to be domain specific and to vary as a function of experience in a given domain.

CHAPTER 2

METHODS

In this section, I will outline the operations performed to measure the structural properties of cognitive space presented in Chapter 1: dimensionality, articulation, and integration. In this study, the sets of data produced by subjects answering a questionnaire (Appendix A) were raw data matrices of similarity judgments between all possible pairs of concepts within each of two areas, or domains. These matrices became the input for a metric multidimensional scaling routine, GALILEO™, which factors the matrices into n-dimensional geometric spaces. The results of the GALILEO™ routine produce a conceptual map of the space represented in each raw distance matrix. Operations performed on the data produced by the GALILEO™ program were used to measure the structural properties already outlined. This chapter will also detail considerations in the choice of the methodology, construction of the instrument, the sample, and analytic procedures employed.

Choice of Methodology: GALILEO™

GALILEO™ is a metric multidimensional scaling routine based upon a general linear model wherein cognitive processes are viewed as motion in a multidimensional space. Subjects are given an exemplar unit (e.g., "If red and white are 100 units apart, how far apart are...?"). Using this subjectively standardized unit, paired comparisons are made for all possible pairs of a set of concepts. The results of comparisons based on this unit will produce a matrix of dissimiliarities, or distances. The variance-covariance matrix transformed from this matrix is orthogonally decomposed to provide a description of the cognitive space. Individual measurements are usually aggregated for analysis to increase reliability.

GALILEO™ makes two assumptions which are important in the measurement of differences or distances:

(1) The distance between a concept and itself is zero for all concepts. That is, concepts are not viewed as occupying basins in the space, but are measured as points ($d_{ii} = 0 \; \forall_i$).

(2) The distance between point A and point B is the same as the distance between point B and point A for all points ($d_{ij} = d_{ji} \; \forall_{i,j}$).

This second assumption merits some explication. If you were to drive from New York to Chicago, for example, you might take a particular route, and you would log a certain number of miles on the odometer. On your return trip from Chicago to New York, you might take an entirely different route, or one-way streets and detours might affect your mileage. In this instance, then, the distance from New York to Chicago would not be equal to the distance from Chicago to New York. GALILEO™ makes the "as the crow flies" assumption that the distance between the cities is the same, regardless of point of origin. In so doing, the distance between the concept pair needs to be measured only once, as either AB or BA. That is, GALILEO™ uses concept pair combinations, not permutations.

Instrument Construction

To examine the hypothesis of domain specificity, subjects were asked to make judgments in each of two unrelated domains. The first domain, interpersonal constructs, was chosen based on Vannoy's (1965) review of cognitive complexity measures. In his review, Vannoy indicated that researchers rely heavily on the Kelly Role Construct Repertory (RCR) test. The RCR test asks subjects to tell how one person is different from a pair of others. Perhaps because of early (1955) introduction, or because the test appears to be significantly related to other indicators of complexity, a number of RCR constructs (or concepts) have been incorporated into other measures (Allard and Carlson, 1963; Tripodi and Bieri, 1963; Vannoy, 1965; Wicker, 1969). These constructs were used to create the interpersonal domain for the instrument used in the study. In an effort to select a second domain which was as different as possible from the interpersonal concepts, mechanical concepts were used in the second domain.

Choosing the Constructs

In his discussion of the RCR test, Kelly (1955) introduces a large number of possible constructs, far too many to be used in the study. If symmetry is assumed ($d_{ij} = d_{ji}$, as in GALILEO™), then the number of possible pair combinations for any group of N concepts is $\frac{N (N-1)}{2}$. Six concepts were chosen for each of the two domains. The concept "Self" was included as an anchor in each domain. Thus, there were a total of seven concepts in each of the two domains, or 21 paired comparisons for each space; $\frac{7(6)}{2}$. The total number of paired comparisons on the questionnaire, then, was 42, a number I felt was small enough to prevent a fatigue factor from affecting resulting scores.

In the Winter term of 1976, a group of 18 students living in a dormitory at Michigan State University was given a list of 22 interpersonal constructs selected from the Kelly RCR. Subjects were asked to rank the constructs from the most important (a score of 1) to least important (a score of 21). Results are presented in Table 1. The student rankings were then used to help choose the constructs.

Because, as earlier discussed, the structural property of articulation can only be examined when there are distinctions between elements to be arrayed, it was important to choose concepts which were not clustered. That is, in order for an individual to use a great distance along a dimension to distinguish between objects, those objects presented must span some continuum and be unlike one another. At the same time, choosing elements within categories allows the researcher to examine the fineness of distinction made. For these reasons, the constructs were selected in pairs from the endpoints and the middle of the rank order. In each case, the pair selected was less than a point apart in average rank, allowing examination of the fineness of distinction in the space.

No set of mechanical constructs has been established in the literature which has the level of acceptance of the RCR. For this questionnaire, the mechanical domain was created according to the following criteria: (a) the machines suggested were those with which most students would have experience; (b) the concepts were felt to

Table 1: Rankings of the Kelly Role Construct Repertory Constructs by Students (N=18)

Rank Order of Student Rankings	Average of Student Rankings[a]	Interpersonal Construct
13	11.00	A teacher you liked
21	17.50	*A teacher you disliked
3	4.93	Your wife (husband) or present girl (boy) friend
1	2.05	*Your mother (or the person who played the part of a mother in your life)
2	2.50	*Your father (or the person who played the part of a father in your life)
8	9.00	The person to whom you would most like to be of help
12	10.66	The most intelligent person you know personally
15	12.44	The most successful person you know personally
7	8.66	The most interesting person you know personally
6	6.88	Your brother nearest your age (or the person who has been most like a brother)
4.5	5.16	Your sister nearest your age (or the person who has been most like a sister)
11	10.44	Your closest girl (boy) friend before you started going with your wife (husband) or present girl (boy) friend
10	9.55	*A person you have met in the past six months whom you would most like to know better
17	15.27	A person with whom you have been closely associated who appears to dislike you
4.5	5.16	Your closest friend of the same sex as yourself
16	14.47	A person of the same sex as yourself whom you once thought was a close friend but in whom you were badly disappointed later
19	16.77	The minister, priest, or rabbi with whom you would be most willing to talk over your personal feeling about religion
18	15.66	Your physician
20	17.16	*A person with whom you usually feel uncomfortable
9	9.33	*The happiest person you know personally
14	12.16	The person you know personally who appears to meet the highest ethical standards

[a]In cases where there was no response, those subjects were dropped from averaging the total for that concept.

*Chosen for the final questionnaire.

span the same evaluative continuum as the interpersonal constructs (i.e., an attempt was made to hold the evaluative dimension constant); (c) the concepts varied widely in "physical" characteristics--type of machine, power source, function, etc. One example of this parallelism is the replacement of the interpersonal construct "the most disliked teacher" with the mechanical construct "the University computer", a machine for which most students have developed a marked distaste and which is academically associated. See Table 2 for the mechanical constructs used.

Selecting the Standard

Within each domain, subjects would be asked to report distances, or to make similarity-dissimilarity judgments between the pairs of concepts. In order to make these judgments, subjects were presented with a relational ruler. Gordon and DeLeo (1975) suggest that choosing "the extreme or near-extreme pair (as a ruler) would produce the least variable judgments if we assume that the concepts are not forced into a restricted space and also assume a relatively homogenous set of concepts" (p. 11). In this study, each domain had a 100-unit ruler.

Gordon and DeLeo also suggest that the concept pair used as the ruler should be relevant to the domain of concepts being judged. The concepts used at endpoints of each ruler were relevant in terms of each domain. The rulers were:

IF THE TEACHER YOU'VE HAD THAT YOU LIKED THE MOST AND THE TEACHER YOU'VE HAD THAT YOU DISLIKED THE MOST ARE 100 UNITS APART, HOW FAR APART ARE:

and

Table 2: Constructs Used in the Survey Instrument

Interpersonal Domain	Mechanical Domain
Your mother (or the person who has been most like a mother to you)	Your refrigerator at home
The person you know who makes you the most uncomfortable	The vending machine you use most often
The person you've met in the last six months that you would like to get to know better	Your telephone at home
Your father (or the person who has been most like a father to you)	Your family's car or your own car (or the car you drive most often)
The teacher you disliked the most	The University administrative computer
The happiest person you know	Your stereo
Yourself	Yourself

IF THE BEST CAR YOU'VE EVER OWNED OR USED AND THE WORST CAR ("LEMON") THAT YOU'VE EVER OWNED OR USED ARE 100 UNITS APART, HOW FAR APART ARE:

Only one of the concepts on the ruler given for each domain was used in the judgments made by subjects for that domain, so that the space itself was not anchored. The "teacher" ruler was used for the interpersonal domain, with only "the teacher that you disliked the most" appearing in the group of concepts. The "car" ruler was used for the mechanical domain, with the concept "your family car or the car you drive most often" appearing in the paired comparisons.

Within the questionnaire, the order of presentation of the two domains was varied, so that some subjects received the interpersonal concepts first, some the mechanical. This alternation was done to further counter any possible biases or fatigue effect in judging the second domain presented.

Independent Variables: Operations

Experience

Seventy-three students taking courses in the Communication Department in the Spring term of 1976 were the subjects. Because the amount of experience in a domain is hypothesized to affect the cognitive structure of the domain, subjects were asked to report the number of college course credits they had in each of the domains. Subjects were also asked to report outside experiences in each domain. A group of coders rated the experiences on a scale of 1 to 99 for strength of interaction with the area. (See Appendix B for an explanation and examples of the ratings.) Interaction scores and credits were totalled to produce an experience score for each individual in each of the two domains.

Domain Specificity

Subjects were assigned to low or high mechanical experience groups and low or high interpersonal experience groups. This assignment produced a 2 x 2 design of experience within the two domains. Seventeen groups of four or five subjects were created. Subjects were randomly assigned to an appropriate experience group in one of the four cells (see Table 3).

It should be noted that there is a great variation between the experience levels, with a mean of 56.74 for the interpersonal domain, and 9.51 for the mechanical domain. Within the mechanical domain, high experience is any score over one. Only one of the subjects had a mechanical experience score over 52, the criterion for high interpersonal experience. However, if the experience hypothesis holds, any interaction with an area should alter the cognitive structure. The apparent arbitrariness is one of degree, not of basic properties.

Dependent Variables: Operations

Once the subjects completed the questionnaire, raw distance matrices were processed by the metric multidimensional scaling routine GALILEO™. The output produced spaces for each group in each of the domains. The following section details the operations performed to describe and compare those spaces in terms of the structural properties of differentiation, articulation, and integration.

Differentiation

Differentiation, or dimensionality, is the ability to distinguish between concepts on a number of different dimensions. The

Table 3: Distribution of the Sample Groups by Experience in Each Domain

	Level of Mechanical Experience	
	Low (≤1)	High (> 1)
Level of Interpersonal Experience	N (n) # [a]	N (n) #
Low (0-51)	5 (20) 1-5	4 (17) 6-9
High (52+)	5 (22) 10-14	3 (14) 15-17

[a]N = Number of groups; n = number of subjects; # = numbers assigned to groups

higher the dimensionality of the space, the more information which can be stored. In this study, two measures of dimensionality were used: (1) The number of dimensions needed to account for 85% of the variance in the space; (2) The percentage of variance in the total space accounted for by each of the variables.

Number of dimensions. In their discussion of the dimensionality of cognitive or psychological space, Barnett and Woelfel (1976) point out that underlying the dimensional question is the assumption that concepts to be judged "share attributes in varying magnitudes and are therefore linear combinations of each other" (p. 1). This commonality among concepts means that the actual number of dimensions used by subjects will in most cases be less than the maximum possible number of dimensions (i.e., less than one fewer than the number of concepts, N-1). However, either because of measurement error or because of individual difference, investigators usually find that all of the N-1 dimensions account for some (however small) portion of the variance.

In their review, Barnett and Woelfel point out the inadequacy of a number of commonly-used measures of dimensionality; the scree test, Kruskal's stress test, and interpretation of loadings on the dimensions. One problem with such measures is that they are static measures, as is the data collected in this study. If data were collected over time, correlational studies would allow the separation of functional dimensions from those created by random measurement error. A second problem with the most often-used measures is that they tend to be overly stringent in providing goodness of fit, so that even error scores are reproduced, or the measures are lax enough to leave as much or more variance unexplained as explained. Finally, the measures create problems in terms of study replicability.

It has been decided to recognize the arbitrariness of the dimensionality determination with static data, and to use the number of dimensions needed to account for 85% of the variance in the space.

Percent of variance on dimensions. It has been suggested that it is not the number of dimensions which should be emphasized, but rather how they are used--their size in terms of the space. For example, if one had to describe a tall, thin figure and a short, somewhat wider figure, one could use the dimensions of height and width to distinguish between them. Height, however, would account for the largest percentage of the variance in the space, since the greatest difference lies along that dimension. Vannoy (1965) points out that Ware (1958) used a measure of dimensionality which "took the percentage of variance extracted by the first factor" (p. 387).

In the present study, the percentage of variance in the total space explained by each dimension was recorded as an additional measure in examining the dimensionality of the cognitive structure.

Articulation

Articulation is the fineness of distinctions made along any one dimension. Some cognitive styles may use the dimensions to make fine discriminations between concepts. Others may make only gross black/white distinctions, clustering concepts widely apart on the dimension.

Articulation has typically been examined as interconcept distance, category width, and standard deviations in judgment (Vannoy, 1965; Shrauger and Altrocchi, 1964). As Shrauger and Altrocchi point out, using variance along a dimension is problematic. The same score could result from vastly different cognitive styles: (1) High variance could indicate very fine distinctions at evenly dispersed points along the dimensions. (2) At the same time, high variance would also be achieved by lumping all the concepts to be judged into categories at extremes along the dimension. (3) Thirdly, high variance could also be the result of the distance or length along the dimension used. The effect of length and a comparison of measures is illustrated below.

Variance of the dimension. Let us take four dimensions. On two dimensions (A and B) 100 units were used. On two other dimensions (C and D) 1000 units were used. This will illustrate how variance may be affected by the number of units used along a dimension.

On one dimension of each length (A and C), five points will be placed with two at each endpoint and one in the center (low articulation). On the other dimensions (B and D), points will be almost equally distributed (high articulation). This arrangement produces one dimension of each length in each articulation pattern, as illustrated in Table 4.

As can be seen, high variance can result from both uneven distribution (low articulation) or from using a large part of a dimension. Additionally, there is no clear indicator of a highly articulated dimension.

Interpoint distances. A second approach which has been used to study articulation has been to use the variance of all interpoint distances. Using this method for the above dimensions and scale points

Table 4: Distribution of Points in High or Low Articulation on Dimensions of Different Lengths

	100 Units		1000 Units	
	A-Low	B-High	C-Low	D-High
Points				
1	100	100	1000	1000
2	99	75	990	750
3	50	50	500	500
4	2	25	20	250
5	1	1	10	10
$\bar{x}$	50.40	50.2	504.00	502.00
s^2	1921.04	1230.16	192104.00	123016.00
s.d.	43.8297	35.0736	438.2967	350.7364

produces the distances and statistics noted in Table 5. Each dimension has five points, and thus produces ten interconcept distances.

As before, a high score can be the result of low articulation or use of a large part of the dimension. Again, there is no clear indicator of a highly articulated dimension.

Variance of category width. In this study, the proposal is to begin by reducing the influence of the amount of the dimension used on concept scores assigned by subjects by normalizing the dimensions. Dimensions are standardized to a 100 point scale, with the lowest point score at zero, using the following formula:

$$(X + B)\frac{100}{A} = X'$$

where:

X = subject reported concept score
A = total distance used along the dimension

B = total distance used along the dimension below zero

X'= transformed score

Secondly, along the normalized dimension, the variance of the distance between adjacent concepts along the dimension, or the variance in category width, will be examined. As is illustrated in Table 6, the higher the articulation, the more equal the distribution of concepts, and the lower the obtained variance in category width.

Had the dimensions not been normalized, an effect would still be seen for length used along the dimension, as variances for the 1000 unit dimensions are 100 times those obtained for the 100 unit dimensions.

Table 5: Interpoint Distances for High and Low Articulation of Dimensions of Different Lengths

	100 Units		1000 Units	
	A-Low	B-High	C-Low	D-High
Inter-point Distance				
1-2	1	25	10	250
1-3	50	50	500	500
1-4	98	75	980	750
1-5	99	99	990	990
2-3	49	25	490	250
2-4	97	50	970	500
2-5	98	74	980	740
3-4	48	25	480	250
3-5	49	49	490	490
4-5	1	24	10	240
$\bar{X}$	59	49.6	590	496
s^2	1321.60	615.24	132160.00	61524.00
s.d.	36.3538	24.8040	363.5382	248.0403

In this approach, the high articulation case approaches a variance of zero, allowing a very clear measure of articulation. The higher the articulation, the lower the variance in category width.

Note that equal distribution is the ideal case of maximum articulation. To an extent, this distribution assumes that the quality of the dimension is or can be judged to be equally distributed throughout the concept set. That is, for an evaluative dimension, for example, all the concepts are not "good" or "bad", but there are some neutral concepts as well. It is important, therefore, to choose concepts for presentation which allow distribution across a dimension, which exhibit variety in characteristics to be judged. In this study, the assumption of distribution of qualities throughout the concept set was held constant for all subjects, and all subjects received the same concept pairs.

Integration

The notion of integration can be adapted to a multi-dimensional space in terms of the utility of the dimensions (see Chapter 1). If the space is highly centralized (Scott, 1969, 1974), the first factor will have a high eigenvalue, accounting for a large percentage of the variance in the space. On the other hand, if all the dimensions are used equally, then each dimension would have the same eigenvalue. In this second case, the variance between the eigenvalues (since they are the same) is zero. This approach is analogous to image comparability.

In this study, then, the variance between the absolute eigenvalues--or percentages of distance in the space accounted for by each dimension--will be taken for the six dimensions produced by the GALILEO™ output.

Table 6: Variance of Category Width for High and Low Articulation on Normalized 100 Unit Dimensions

	A-Low	B-High
Adjacent Interpoint Distances		
1-2	1	25
2-3	49	25
3-4	48	25
4-5	1	24
$\bar{X}$	24.75	24.75
s^2	564.1875	0.1875
s.d.	23.7526	0.4330

Data Analysis

Dependent Variables

The paired comparisons by subjects were used to produce an interconcept distance matrix for each of the experience groups in each domain. These matrices were input for GALILEO^{TM}, resulting in a multidimensional representation of the cognitive space for each group in each domain. Based on the results of GALILEO^{TM}, the number of dimensions needed to account for 85% of the variance in the space, the percentage of the distance in the space accounted for by each dimension, the variance of the adjacent interconcept distances along normalized dimensions, and the variance of the eigenvalues of the dimensions were the created dependent variables used to indicate the cognitive style of the aggregate.

Independence of Properties

A correlation matrix was run between the dependent variables to show the extent to which the above procedures were not independent. It is to be assumed that there exists some interrelation between the structural properties of cognitive style. For example, if a space were highly centralized, that is, if a large percentage of the variance in the space were accounted for by the first dimension, then the space would be defined as not high on the property of differentiation, since few dimensions would be needed to reach 85% of the variance in the space. The variance between the eigenvalues would also be high because the dimensions would be used unequally. By definition, then, a highly centralized space would also be described as low in integration.

Hypotheses

H_1: Cognitive structure is domain-specific; different cognitive structures would be expected for different cognitive domains.

The domain specificity hypothesis was tested through correlational techniques. The null hypothesis was that there would be no difference between the styles used in the interpersonal and mechanical domains. Therefore, correlations between the dependent variables in the two domains would be significant.

H_2: The structure of a cognitive space will vary as a function of experience in the domain being examined.

A multiple regression was used to test the influence of experience on each of the dependent variables.

Analysis of Imaginary Space

GALILEO™ is unique in that it does not yield a factorization which has been forced into real space. As one explanation for imaginary space, Woelfel (1974) points out that most scaling techniques rely on the assumption that:

> Concepts may be represented as points on a continuum or in a space. This assumption, however, is almost certainly overly rigid in almost all circumstances. What is more likely is that concepts or variables being scaled are representable more accurately by intervals on a scale or regions in a space (pp. 22-23).

If subjects report the distances between the near boundaries of the concept intervals, the result is a systematic reduction in the distance matrix which cannot be fit into real space. "By definition, a real space is one in which any three points i, j, and k must satisfy the relation:

$$d_{ij} + d_{ik} \geq d_{jk}$$

$$d_{ij} + d_{jk} \geq d_{ik}$$

$$d_{ik} + d_{jk} \geq d_{ij}$$

(Woelfel, 1974, p.23)."

If you think of the points i, j, and k as the points of a triangle, you can see that the length of any two sides must be at least equal to (or greater than) the third in order for all sides to meet. If we view concepts as occupying intervals in space, however, the distances among the concepts will often produce "triangle inequalities". These inequalities yield a negative matrix, and "factorization will yield negative eigenroots, signifying the projection of at least some of the variable vectors into imaginary space" (Woelfel, 1974, pp. 23-24).

As an exploration of the domain specificity of imaginary space, its relation to experience, and the relation of imaginary space to real space, the percentage of distance in imaginary space and the number of dimensions created in real space for each group in each domain were examined along with other dependent variables using correlational and multiple regression techniques.

Chapter Summary

In this study, the independent variables of experience in the interpersonal and experience in the mechanical domains were measured by assigning subjects to high or low experience groups in each domain based on the number of course credits in each domain and a rating of outside experiences on a one to 99 scale.

The dependent variables which are used to describe a cognitive structure were measured as follows:

(1) Differentiation was measured as the number of dimensions necessary to account for 85% of the variance in the space and the eigenvalue of each dimension. Differentiation increases as the number of dimensions needed to account for 85% of the variance increases.

(2) Articulation was measured as the variance in the adjacent interconcept distances along normalized dimensions. The higher the variance of the adjacent interconcept distances, the less equally dispersed the concepts are, and the less articulated the dimensions would be as measured for the concepts presented. A totally equal distribution of concepts would be highly articulated, with a variance in adjacent interconcept distances of zero.

(3) Integration was measured as the variance between the eigenvalues of the dimensions. The higher the variance, the less equally the dimensions are used to account for variance in the space, and the lower the integration of the structure.

Considerations in the construction of the instrument and aspects of GALILEO™ have been detailed. Correlation and regression techniques are suggested to analyze the hypotheses.

CHAPTER 3

RESULTS

In this chapter, the results of the analyses performed on the variables for structural properties and experience are presented. First, some of the descriptors of the data are examined. Then, each of the hypotheses and appropriate analyses are detailed. Finally, the interrelationships between properties are illustrated.

The Data

In Tables 7 and 8, the percentage of distance accounted for by each of the dimensions in each domain is presented.[1] The tables show that the shift from real space (shown as positive distances) to imaginary space (shown as negative figures) typically appears later in the mechanical space. Additionally, in the interpersonal domain, the first dimension typically accounts for a greater percentage of the distance than in the mechanical domain.

The presentations of the means and standard deviations of the independent variables in Table 9 reinforces the observations from Tables 7 and 8. The average number of dimensions needed to account for 85% of the variance in the space is not extremely different. Dimension 5 is in imaginary space in the interpersonal domain only. There are fewer dimensions in real space on the average in the

---

[1]Note: Although only six dimensions are used in the analyses, the computer output presents seven, one of which represents rounding error. This dimension accounts for zero or .001 percent of the distance in the space.

Table 7: Percentage of Distance in Space Accounted for by Each Dimension in the Interpersonal Domain

	Dimensions					
	D1	D2	D3	D4	D5	D6
Low Experience						
Cell 1						
Group						
1[a]	74.993	19.032	4.266	1.709	- 1.229	-17.007
2	73.756	23.995	2.249	-0.032	- 0.587	-37.480
3	75.621	19.021	4.895	0.463	-12.630	-30.673
4	52.545	25.594	12.997	8.864	- 6.449	-21.796
5	66.894	16.723	14.124	2.259	-13.532	-31.959
Cell 2						
Group						
6	51.715	22.141	16.950	9.194	- 4.174	- 5.906
7	68.296	21.572	6.637	3.495	- 2.690	- 6.009
8	71.903	18.440	5.467	3.198	0.992	-11.466
9	53.014	25.723	17.556	3.707	- 1.084	- 5.910
High Experience						
Cell 3						
Group						
10	68.138	20.304	9.923	1.635	- 4.601	-39.999
11	62.328	21.132	12.839	3.791	- 2.579	-16.320
12	78.983	20.585	0.347	0.085	-17.797	-20.084
13	72.928	17.471	9.602	-1.366	- 2.963	- 7.413
14	67.293	28.268	3.584	0.854	- 4.010	-23.271
Cell 4						
Group						
15	98.665	1.182	0.133	0.020	- 0.259	-68.590
16	67.761	19.877	12.362	-1.408	- 3.127	-14.975
17	73.318	20.876	5.806	-0.786	- 6.269	-15.004

[a]Groups vary from 4-5 subjects; see Table 3.

Table 8: Percentage of Distance in Space Accounted for by Each Dimension in the Mechanical Domain

	Dimensions					
	D1	D2	D3	D4	D5	D6
Low Experience						
Cell 1						
Group						
1[a]	46.276	31.108	12.049	6.066	4.501	- 2.717
2	88.435	8.225	2.411	0.929	- 0.893	-22.828
3	63.816	35.394	0.525	0.265	- 0.417	-26.560
4	87.125	8.475	4.003	0.397	- 1.379	-20.370
5	70.131	19.470	8.757	1.636	0.006	-16.298
Cell 3						
Group						
10	65.514	27.696	4.813	1.977	- 5.468	-19.474
11	59.221	33.861	5.727	1.191	- 1.235	-22.154
12	50.294	35.693	9.096	4.917	- 6.549	-24.396
13	52.861	27.015	14.432	5.350	0.341	-18.868
14	48.849	19.940	13.861	13.143	4.206	-14.210
High Experience						
Cell 2						
Group						
6	58.052	28.017	11.078	1.632	1.222	- 7.427
7	40.937	28.006	17.217	7.448	3.621	2.772
8	63.411	17.624	16.859	2.116	- 0.055	- 5.165
9	38.480	25.600	13.368	12.088	10.464	- 1.724
Cell 4						
Group						
15	51.941	32.370	10.439	4.896	0.355	-11.721
16	51.621	29.251	15.299	3.829	- 2.242	- 5.489
17	69.019	17.839	9.582	3.560	- 1.461	-11.855

[a]Groups vary from 4-5 subjects; see Table 3.

Table 9: Means and Standard Deviations of the Dependent Variables for Differentiation, Articulation, and Integration in Interpersonal and Mechanical Domains

Dependent Variable	Domain			
	Interpersonal		Mechanical	
	Mean	Standard Deviation	Mean	Standard Deviation
Differentiation[a]				
Number of Dimensions	2.235	.5623	2.471	.8745
Eigenvalues				
D1	69.303	11.188	59.176	14.136
D2	20.114	5.773	25.034	8.503
D3	8.220	5.542	9.971	5.059
D4	2.094	3.108	4.202	3.802
D5	- 4.882	5.162	0.295	3.914
D6	-21.992	16.138	-13.440	8.8997
Number of Real Dimensions	3.824	.529	4.529	.6243
Percent of Distance in Imaginary Space	27.143	17.011	14.762	9.606
Articulation[b]	321.984	99.225	256.549	77.256
Integration[c]	700.927	362.462	725.297	858.206

N = 17 groups

[a]Number of dimensions that account for 85% of the variance in the space.

[b]Mean of articulation scores, i.e., variance in adjacent interconcept distances along normalized dimensions, for the six dimensions in the domain.

[c]Variance in eigenvalues of the dimensions.

interpersonal domain. Articulation and integration scores are close across domains.

Hypothesis One

H_1: Cognitive structure is domain-specific; different cognitive structures would be expected for different cognitive domains.

In order to examine this hypothesis, correlations between the dependent variables in the two domains were calculated. These variables were: the number of dimensions needed to account for at least 85% of the distance in the space, the percentage of distance accounted for by each of the six dimensions, the number of dimensions which are in real space, the percentage of distance in imaginary space, the articulation of each dimension, the mean score of the dimension articulation scores, and the integration of the space (measured as the variance between the absolute value of the eigenvalues of the six dimensions). If cognitive structure is independent for each domain, then there should be no relationship between the properties as measured across domains.

As can be seen in Table 10, the variables which indicate dimensionality--the number of dimensions to account for at least 85% of the distance and the percentage accounted for by each factor--are not significantly related, except for the percentage of distance accounted for by Dimension 5. As can be seen in Tables 7 and 8, the fifth dimension is typically the first and smallest dimension in imaginary space or the last and smallest dimension in real space, although on the whole the fifth dimension is typically smaller in the mechanical space.

Table 10: Correlations of Structural Properties for the Interpersonal and Mechanical Domains

Dependent Variable	r
Differentiation	
Number of Dimensions[a]	-.2393
Eigenvalue Dimension	
1	-.1104
2	-.3905
3	.0657
4	-.1872
5	.4653*
6	.3996
Number of Dimensions in Real Space	.1114
Percent of Distance in Imaginary Space	.5353*
Articulation[b]	
Dimension	
1	-.1773
2	.3359
3	.1002
4	.1043
5	-.0301
6	.2125
Mean Articulation	.4325*
Integration[c]	.8825**

N = 17 groups   * $p \leq .05$ ** $p \leq .01$

[a]Number of dimensions that account for 85% of the variance in the space.

[b]Variance in adjacent interconcept distances along normalized dimensions.

[c]Variance in eigenvalues of the dimensions.

Articulation, the distribution of points along the dimension, is uncorrelated for each of the dimensions. However, when examined as a general trait for the space (i.e., the mean of the articulation scores for each of the dimensions), the spaces are moderately correlated ($r = .4325$). This correlation is significant at the $p \leq .05$ level.

Integration, that is, the variance between the percentage of distance accounted for by the dimensions, is highly correlated ($r = .8225$) across domains. This correlation is significant at the $p \leq .01$ level. This finding fails to reject the null hypothesis for domain specificity for the structural property of integration. Integration would appear to be a generalized, rather than domain specific, property.

A moderate significant correlation is obtained for the percentage of distance in imaginary space across domains. Whether this finding affects the hypothesis depends largely upon the interpretation of imaginary space. This issue will be discussed further in Chapter 4.

It appears, then, that the hypothesis has relatively little support, except in terms of differentiation and the articulation of the individual dimensions.

Hypothesis Two

H_2: The structure of a cognitive space will vary as a function of experience in the domain being examined.

Experience was measured by adding together the number of credits a subject had in domain-related courses and a rating of outside experiences on a scale of 1-99 (see Appendix B). Subjects were then divided into cells and randomly assigned to groups. A check on the assignment illustrates that the means for each group and cell are quite different between levels and consistent with levels (see Tables 11 and 12).

A correlation matrix was constructed to examine the effects of the experience variables on the dependent variables. As can be seen in Table 13, interpersonal and mechanical experiences are not significantly related to many of the independent variables. Interpersonal experience has a moderate negative correlation with the number of dimensions needed to account for 85% of the distance in the interpersonal space ($r = -.4067$, $p \leq .05$). The more experience in the interpersonal domain, the more centralized the space. Mechanical experience is not significantly related to the number of dimensions used to describe mechanical space, but the correlation is moderate and positive ($r = .3812$, $p \leq .066$). These findings lend moderate support to Hypothesis Two.

Mechanical experience also has a highly significant negative correlation with the percentage of distance in imaginary space ($r = -.721$, $p \leq .01$). That is, the more mechanical experience, the less reporting of triangle inequalities. The interaction is significantly related to the percentage of distance in imaginary space in the interpersonal domain ($r = .476$, $p \leq .05$) and integration in the mechanical domain ($r = .430$, $p \leq .05$). These correlations are moderate.

Regressions of the experience variables on the dependent variables in each of the domains are presented in Tables 14 and 15. As can be seen in Table 14, interpersonal experience has little notable effect on structural properties in the interpersonal space, except perhaps in the prediction of the percentage of distance in imaginary space. While the multiple correlation coefficient for this relation is not significant, it does explain almost 40% of the variance. In the

Table 11: Statistics for Experience Levels in the Interpersonal Domain[a]

Interpersonal Experience	Mechanical Experience: Low				High			
	Group	Mean	Standard Deviation	Range	Group	Mean	Standard Deviation	Range
Low	1	28.000	12.027	13-40	6	31.750	17.613	9-52
	2	37.250	15.945	22-52	7	30.000	7.843	20-38
	3	28.750	15.777	10-48	8	33.750	9.945	20-42
	4	26.500	10.908	15-40	9	40.000	9.924	23-48
	5	29.250	9.945	15-37				
	Cell	29.950	4.210	10-52	Cell	33.875	4.361	9-52
	Group	Mean	Standard Deviation	Range	Group	Mean	Standard Deviation	Range
High	10	94.200	30.011	61-125	15	55.000	7.071	65-145
	11	77.250	14.500	60-95	16	75.000	12.909	60-90
	12	62.500	8.660	55-75	17	81.000	22.748	65-120
	13	79.000	33.667	55-135				
	14	81.500	19.974	65-110				
	Cell	78.890	11.319	55-135	Cell	70.333	13.613	60-145

[a]For number of subjects in each group, see Table 3.

Table 12: Statistics for Experience in the Mechanical Domain[a]

	Mechanical Experience							
	Low				High			
Interpersonal Experience	Group	Mean	Standard Deviation	Range	Group	Mean	Standard Deviation	Range
Low	1	0.0	0.0	0	6	17.000	6.582	10-24
	2	0.0	0.0	0	7	27.000	12.489	10-40
	3	0.25	0.50	0-1	8	11.250	4.787	5-15
	4	0.0	0.0	0	9	15.400	13.221	4-35
	5	0.0	0.0	0				
	Cell	0.05	0.109	0-1	Cell	17.662	6.679	4-40
	Group	Mean	Standard Deviation	Range	Group	Mean	Standard Deviation	Range
High	10	0.0	0.0	0	15	28.200	17.991	5-50
	11	0.0	0.0	0	16	14.500	9.882	5-28
	12	0.0	0.0	0	17	32.000	28.635	5-75
	13	0.0	0.0	0				
	14	0.0	0.0	0				
	Cell	0.0	0.0	0	Cell	24.900	9.204	5-75

[a]For number of subjects in each group, see Table 3.

Table 13: Correlations of Experience Variables with Structural Properties

		Experience IP	Experience ME	Experience Interaction	# of Dimensions to 85% IP	# of Dimensions to 85% ME	# of Dimensions in Real Space IP	# of Dimensions in Real Space ME	% of Distance in Imaginary Space IP	% of Distance in Imaginary Space ME	Integration IP	Integration ME	Articulation IP	Articulation ME
Experience[a]	Interpersonal (IP)	1.0												
	Mechanical (ME)	-.070												
	Interaction	-.181	-.070											
Dimensions of 85%	IP	-.407*	-.142	-.191										
	ME	.172	.381	-.384	-.234									
Dimensions in Real Space	IP	-.365	.055	-.365	.148	.191								
	ME	-.079	.255	-.241	-.021	.095	.112							
% of Distance in Imaginary Space	IP	.241	-.307	.476*	-.442*	-.321	.010	.225						
	ME	.342	-.721**	.078	-.002	-.636**	-.174	-.624**	.535**					
Integration	IP	.342	.146	.291	-.841**	.148	-.029	.092	.667**	.042				
	ME	.159	.180	.430*	-.491*	-.132	.027	.005	.724**	.086	.826**			
Articulation	IP	.054	-.215	.371	-.341	-.224	.120	.012	.753**	.285	.629**	.676**		
	ME	-.143	-.371	.234	-.190	-.114	-.125	.269	.167	.183	.314	.284	.433*	1.0

N = 17 groups

* $p \leq .05$

** $p \leq .01$

[a] Experience was coded: 1 = Low, 2 = High for both domains

Table 14: Regression of Experience on Dependent Variables in the Interpersonal Domain

	No. of Dimensions to 85%		Dimension 1		Dimension 2		Dimension 3		Dimension 4		Dimension 5	
	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta
Interpersonal Exp.	-.517	-.473	9.927	.457	-3.656	-.326	-3.000	-.279	-3.647	-.604	-.492	-.049
Mechanical Exp.	-.217	-.196	1.226	.056	-3.239	-.285	1.394	.128	.270	.044	4.160	.409
Interaction	-.317	-.290	8.755	.403	-4.335	-.386	-2.553	-.237	-1.976	.182	-.987	-.098
Multiple R	.525		.548		.512		.368		.639		.431	
R^2	.275		.301		.262		.135		.408		.186	

	Dimension 6		No. of Dimensions in Real Space		% of Distance in Imaginary Space		Mean Articulation		Integration	
	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta
Interpersonal Exp.	-9.584	-.306	-.458	-.446	-10.451	.316	21.148	.110	299.816	.426
Mechanical Exp.	4.511	.142	-.833	-.008	- 8.320	-.248	-35.315	-.181	144.709	.203
Interaction	-15.950	-.509*	-.458	-.446	17.045	.516*	72.952	.378	269.431	.382
Multiple R	.576		.570		.630		.430		.535	
R^2	.332		.325		.397		.185		.287	

N = 17 groups

* $p \leq .05$

Table 15: Regression of Experience on Dependent Variables in the Mechanical Domain

	No. of Dimensions to 85%		Dimension 1		Dimension 2		Dimension 3		Dimension 4		Dimension 5	
	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta
Interpersonal Exp.	.233	.137	-4.251	-.155	4.991	.302	.591	.060	.866	.117	-3.517	-.462
Mechanical Exp.	.633	.367	-9.379	-.337	.962	.057	5.633	.565*	1.371	.183	2.037	.264
Interaction	-.567	-.333	11.558	.421	-3.316	-.201	-3.446	-.350	-2.592	-.351	-1.412	-.186
Multiple R	.540		.592		.395		.690*		.437		.558	
R^2	.292		.350		.156		.476		.191		.311	

	Dimension 6		No. of Dimensions in Real Space		% of Distance in Imaginary Space		Mean Articulation		Integration	
	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta
Interpersonal Exp.	-4.434	-.256	-.333	-.295	5.754	.308	-20.190	-.135	441.884	.265
Mechanical Exp.	12.500	.713*	.267	.217	-13.124	-.693**	-55.864	-.377	394.584	.233
Interaction	-2.368	-.137	-.333	-.275	1.576	.084	28.502	.190	824.431	.494
Multiple R	.787**		.433		.782**		.448		.545	
R^2	.619		.188		.611		.201		.297	

N = 17 groups

* $p \leq .05$

** $p \leq .01$

mechanical domain (Table 15), the results are similar. Experience affects a few of the dimensions and predicts the percentage of distance in imaginary space. Here, however, the beta weight for mechanical experience on the percentage of distance in imaginary space is significant. The multiple correlation coefficient is high and significant, and the correlation explains 61% of the variance.

From examination of Tables 14 and 15, experience is not strongly enough related to the structural properties of the space to reject the null hypothesis. Thus, the structure in the cognitive space for any domain would not be seen as a function of experience in that domain. Part of this conclusion, however, again depends on the interpretation of imaginary space, which will be discussed in Chapter 4.

Independence of Properties

Because the properties examined are not statistically independent, a strict $p \leq .05$ level was not maintained in the above analyses. To illustrate this interrelationship, correlation matrices between the dependent variables in each domain are presented in Tables 16 and 17. Some of these correlations are not surprising: the more dimensions that are needed to account for 85% of the distance in the space, the less of the distance that is accounted for by the first (largest real space) dimension; the percentage of variance in imaginary space is highly correlated with Dimension 6, the largest dimension in imaginary space; Dimension 4 is the dimension which is most often the real/imaginary space dividing line, and it correlates highly with the number of real dimensions.

Table 16: Correlations between Structural Variables in the Interpersonal Domain

		No. of Dimensions to 85%	D1	D2	D3	D4	D5	D6	No. Real Dimensions	% Imaginary	Mean Articulation	Integration
			Dimensions									
Dimensions	D1	-.888**										
	D2	-.571**	-.768**									
	D3	.831**	-.832**									
	D4	.691**	-.706**	.319	.571**							
	D5	-.173	-.035	-.068	.074	.081						
	D6	.541*	-.659*	.636	.472*	.294	.054					
No. Real Space Dimensions		.148	-.084	-.070	.002	.497*	-.016	-.019				
% Distance Imaginary Space		-.442*	.639**	-.585**	-.468*	-.316	-.347	-.9546**	.010			
Mean Articulation		-.341	.539*	-.606**	-.363	-.079	-.142	-.765	.120	.753**		
Integration		-.841**	.936**	-.838**	-.718**	-.528*	.148	-.751**	-.029	.667**	.629**	1.0

N = 17 groups

* $p \leq .05$

** $p \leq .01$

Table 17: Correlations between Structural Variables in the Mechanical Domain

		No. of Dimensions to 85%	D1	D2	D3	D4	D5	D6	No. Real Dimensions	% Imaginary	Mean Articulation	Integration
			Dimensions									
Dimensions	D1	-.846**										
	D2	.332	-.697**									
	D3	.771**	-.688**	.117								
	D4	.850**	-.732**	.125	.607**							
	D5	.653**	-.487**	-.058	.432	.675**						
	D6	.624**	-.570**	.039	.799**	.488*	.629**					
No. of Real Space Dimensions		.546*	-.596**	.168	.568**	.576**	.657**	.602**				
% Distance Imaginary Space		-.636**	.532*	.016	-.774**	-.476*	-.718**	-.908**	-.624**			
Mean Articulation		-.114	-.031	.226	-.229	-.086	.112	-.247	.269	.183		
Integration		-.132	.194	-.004	-.214	-.195	-.135	-.133	.005	.086	.284	1.0

N = 17 groups

* $p \leq .05$

** $P \leq .01$

Chapter Summary

In this chapter, descriptive statistics of the data were presented along with the results of correlation and multiple regression techniques. Moderate support was lent to the hypothesis that cognitive structure is domain specific. The hypothesis that cognitive structure is a function of experience in the domain was not supported.

CHAPTER 4

DISCUSSION

In view of the inconsistencies in the literature regarding cognitive complexity, this research is an attempt to separate cognitive structure into three properties: differentiation, articulation, and integration. The literature suggests that the type of structure exhibited by an individual may be a result of both the domain tested and the amount of experience in that domain.

In this study, students were assigned to groups on the basis of their experience in mechanical and interpersonal domains, and given a questionnaire asking them to compare concepts within each of the two domains. These comparisons were analyzed by a metric multidimensional scaling routine, GALILEO™. Descriptors of the spaces were developed to measure the three structural properties: differentiation, articulation, and integration.

Implications: Hypothesis One

H_1: Cognitive structure is domain-specific; different cognitive structures would be expected for different cognitive domains.

Correlations among structural properties in the two domains presented provide limited support for the first hypothesis. The first property, differentiation, is unrelated between the two domains and indicates support for the domain specificity of cognitive structures. For the second property, the way subjects articulate each dimension in the domain is uncorrelated between the two domains. However, the means of the six articulation scores for the six dimensions in each domain are moderately correlated between the domains. The correlation is statistically significant. These findings provide mixed support for the hypothesis, depending upon which measure of articulation is examined. Finally, integration, the third property, is highly correlated across domains. The correlation of integration scores between domains is statistically significant and thereby fails to reject the null hypothesis that cognitive style is generalizable across domains.

The above findings do support the initial proposition that cognitive complexity is not one factor, but rather a group of factors--those which I have defined as structural properties. It is important to recognize the long-standing controversy regarding the generalizability of cognitive complexity and subsequent conflicting findings. It would be logical to assume that some of the inconsistencies in the past research on the area of domain specificity/generalizability are a function of differences in conceptualizations of cognitive structure and resultant measurement techniques. The above analysis reinforces the proposal that differences in the conceptualization of cognitive structure is a factor in differing findings. Some of the properties are uncorrelated, while others (particularly integration) are highly and significantly correlated. The way in which cognition is conceptualized and consequently measured would affect the results of generalizability studies. This research suggests that certain structural properties are domain-specific, while others are generalizable across domains.

Implications: Hypothesis Two

H_2: The structure of a cognitive space will vary as a function of experience in the domain being examined.

In terms of the dependent variables--differentiation, articulation, and integration--the property of differentiation again provides the strongest support for the hypothesis. Differentiation is significantly related to experience in a domain. While there are some other significant relationships, they are not consistent nor conclusive. It seems that experience is not strongly enough related to the structural properties to say that structures differ with experience levels and reject the null hypothesis.

It is interesting to note that interpersonal experience leads subjects to use fewer dimensions to describe the interpersonal space, while mechanical experience leads subjects to use more dimensions to describe the mechanical space. This apparent inconsistency may, in part, support Hypothesis One, in that differentiation may be a function of the domains presented. It has been suggested by Scott (1974) that interpersonal spaces tend to rely more heavily on a central evaluative dimension. Interpersonal spaces tend to be centralized, with fewer dimensions and a higher percentage of variance on the first dimension. More scientific spaces tend to exhibit more image comparability, with more equal dimension use, more even distribution of variance, and thereby more dimensions.

Additionally, experience does seem to be a strong predictor of the percentage of distance in imaginary space. If imaginary space were considered as a structural property in future studies, it might be possible to more clearly define the way in which experience affects cognitive structure.

Imaginary Space

The percentage of distance in imaginary space is significantly related to the independent variable of experience in a domain. There are a number of interpretations of imaginary space, and some of them merit attention here.

The first possibility, mentioned in Chapter 1, suggests that cognitions are not points but rather regions in space. If distances were reported between the inner boundaries of the regions, the reports would systematically reduce the space and create triangle inequalities. The reported distances would not fit in Euclidian ("real") space.

A second interpretation suggests that imaginary spaces are the result of confusion, either about the concepts or the measurement technique. Subjects may not be familiar with the concepts to be compared, and therefore unable to report distances for concept pairs in which that element appears. Some subjects have difficulty with the measurement/ruler operation and are simply unable to consistently report distances. Less variance was found in imaginary space in the mechanical domain, especially for those with experience in the mechanical area. Since such experience would lend familiarity with numerical and geometric approaches, this explanation appears to have some credence.

A third explanation is that imaginary space is the result of cognitive dissonance and inconsistency. In order to make a relationship between concepts "fit", a subject may warp the space, so that the distance between two concepts is not over a flat plane, but rather over a warped configuration in the space. This would seem to be the case with the subject who reported his parents as 10,000 units apart from one another and yet each individually close to him. The subject's scores were kept, largely because other distance scores reported appeared valid and reasonable. That is, distances reported between other concept pairs were not extreme, but ordered, indicating that the subject did understand the instrument. For him, these distances were "true", and it was important to include them. It would seem logical that there is less consistency in interpersonal areas than in mechanical ones. The higher percentage of distance in imaginary space for the interpersonal domain would seem to confirm this.

A final interpretation of imaginary space brings into question some of the results of the study. Imaginary space may be the result of domain crossing. That is, it may be that when subjects are asked to compare concepts that for them are not elements in the same domain, or members of the same set, they find the concepts incomparable. Consequently, they report distances that do not fit into Euclidian space. For them, the concepts are members of different domains, and, therefore, different spaces. Herein lies a difficulty in defining domains in the present study. If, indeed, subjects were not presented with what they saw as clear domains, then the hypothesis of domain specificity remains untested.

Suggestions for Replication

Some problems in the design of the study may have resulted in the inconclusiveness of the findings. Changes in four aspects of the study design should be considered in future research.

The first important problem with the study is that the data were collected at one point in time. A longitudinal study would allow the examination of how style-committed an individual or aggregate is on the basis of some independent variables. This study does not allow for such an examination. More importantly, the majority of support for the hypotheses was found in the property of differentiation. In a longitudinal study, dimensions can be correlated across time for subjects. Those dimensions which correlate highly can be seen as consistent for that subject or aggregate, while dimensions which are the result of error are random and uncorrelated. In this study, differentiation was arbitrarily measured as the number of dimensions needed to account for 85% of the distance in the space. One cannot help but wonder how much of the significance of findings for the property of differentiation was impacted by the arbitrariness with which it was measured.

A second problem is the use of aggregate data. The use of individual data relies upon over-time collections to be reliable, and, therefore, was not feasible in this study. Nonetheless, with aggregate data, there is inevitably a subject in a group whose responses are extreme enough to affect the data for that group. As discussed earlier, one subject had relatively small distances between himself and each of his parents and reported his mother and father as 10,000 units apart. This report obviously distorted the mean and other statistics for the calculations of the group on that concept pair.

There may have been some problems in the choice of domains. There is a possibility that the definition of domain used in the study was too broad. It may be the case that liked persons and disliked persons are separate domains and more accurately surveyed as such than as the single domain of persons. Secondarily, for some subjects, the application of evaluative attributes to machines may have been difficult. It might be possible to have subjects to supply their own domains in future studies by asking them to provide concepts very much like or unlike a given concept. This possibility is certainly to be explored for future replications of the present study.

Finally, the experience measures used in this study were admittedly crude. Self-reports on experience levels may not provide accurate accounts of information levels, which are really more to be desired. More refined measures of experience and information levels would be expected to provide clearer support for the hypothesis.

A replication that dealt with each of these problems would provide a more precise test of the hypotheses in this study. Collecting data over time allows the use of individual data and the specification of dimensionality. Allowing subjects to specify domains would reduce error that might be the result of inappropriate comparisons. Measuring experience and information levels more precisely, perhaps by providing and monitoring information bits regarding a concept to be judged, would provide a clearer test of the hypothesis about the effect of information and experience.

Practical Implications

A good deal of communication theory stems from roots in cognitive style, dissonance, and information processing. Two practical applications of cognitive complexity have been explored by Fiedler and by Delia and Clark.

One particular comparison that comes to the fore is Fiedler's contingency model of leadership effectiveness. Fiedler (1967) presented subjects with a set of seventeen semantic differentials and asked them to rate their "least preferred co-worker (LPC)". The LPC studies indicate that leaders with low LPC scores (task-oriented) are most effective in extremely difficult or extremely easy situations. Leaders with high scores (interpersonal-oriented) are more effective in work situations of moderate difficulty. Follow-up work by Mitchell (1970) correlates the LPC score with cognitive complexity measures similar to those used by Scott. Mitchell examines cognition and leader perceptions of the behavior of co-workers. One logical use of the measures developed and tested in this research study is to examine group leaders and leadership styles, particularly the effect of experience and information in decision-making. Research in these areas could be used to develop management training programs based upon the changes in structure as a result of additional information, etc.

Delia and Clark (1977) have explored the relationship of cognitive style to other factors which may be of use in management training. They explored the relationship of cognitive complexity to social perception and listener-adapted communication, another link to supervisor-subordinate relations.

The area of cognition and the way in which it can be impacted upon is a research question requiring further study. The implications of cognitive frameworks as tools for explaining differences in interaction patterns is not new. Hopefully, the research presented here will encourage further study into the structure of cognition and its implications.

APPENDICES

APPENDIX A

DATA COLLECTION INSTRUMENT

APPENDIX A

DATA COLLECTION INSTRUMENT

MICHIGAN STATE UNIVERSITY

COLLEGE OF COMMUNICATION ARTS
DEPARTMENT OF COMMUNICATION

EAST LANSING, MICHIGAN 48824

Dear Participant:

In our daily lives, there are some people, things, and ideas we look at and work with all the time, and some we hardly use or examine at all. This study is designed to examine some ways in which the experiences we have with things affects the way we look at them.

Your cooperation is important. In the next few pages, you will be asked to make some comparisons between things and to give us some information about yourself. Please fill out the questionnaire as completely and honestly as possible. All of your answers are important.

When you have completed the questionnaire, I will be able to explain to you more fully the different aspects of the study.

Again, your help is important and greatly appreciated. Thank you for your cooperation.

Sincerely,

Jacqueline Ur Cooney

Jacqueline Ur Cooney
Department of Communication

INSTRUCTIONS

In filling out this questionnaire, you will be asked to make judgments about how different or how far apart you think certain people are from each other, and how different or how far apart you think certain machines are from each other. You will be making these judgments in terms of Relational Units.

In each of the following sections, there may be some people or machines that you think are very similar and some that you will feel are very different. For each group you will be given a relational distance rule.

For Example:

> The distance between the teacher you've had that you liked the most and the teacher that you disliked the most is 100 Relational Units.

You will be using this rule to make judgments about how different people are from each other. The more different you think they are, the larger the number of Relational Units. The less different they are, the smaller the number of Relational Units.

Here is an example. First you are given the rule, and then you are asked to make a judgment about the distance between the pairs of people.

IF THE DISTANCE BETWEEN THE TEACHER YOU'VE HAD THAT YOU LIKED THE MOST AND THE TEACHER THAT YOU DISLIKED THE MOST IS 100 RELATIONAL UNITS, HOW FAR APART ARE?

Your best friend and yourself	______units
Your best friend and your worst enemy	______units
Yourself and your worst enemy	______units

If you think you and your best friend are very much alike, then you would write a small number of Relational Units in the space provided. If you think you are very different, you would write a large number.

In the same way, if you think your worst enemy and your best friend are very far apart, you would write a large number in the space provided. If they are similar in many ways, you would write a smaller number of Relational Units.

FEEL FREE TO USE ANY NUMBER TO REPORT AS ACCURATELY AS POSSIBLE THE DISTANCE THAT YOU SEE BETWEEN THE TWO CONCEPTS. You may use a number over 100 if the distance between any two concepts is greater than the distance in the rule. If you perceive two concepts to be extremely similar, then report a very small number. If you think there is no difference between the concepts, then you may write zero (0) to represent no distance between them.

On the following pages, you will find lists of pairs of words similar to those shown above. Please write a number in the blank space after each pair of concepts. Ignore the column of numbers next to the blanks; they are for clerical use only.

Please try not to skip any item. Try to report some distance between each pair of concepts. Keep in mind that there is no one correct answer; all that is asked is that you give honest and careful responses about how you perceive the relations between the pairs.

If you have any questions, feel free to ask.

Thank you.

REMEMBER: IF THE BEST CAR YOU'VE EVER OWNED OR USED AND THE WORST CAR ("LEMON") YOU'VE EVER OWNED OR USED ARE 100 UNITS APART, HOW FAR APART ARE:

How far apart are:		DUP	1-6
		Card 04	7-8
Your refrigerator at home and the vending machine you use most often	_____units	0809	9-17
Your refrigerator at home and your telephone at home	_____units	0810	18-26
Your refrigerator at home and yourself	_____units	0811	27-35
Your refrigerator at home and your family's car or your own car (or the car you drive most often)	_____units	0812	36-44
Your refrigerator at home and the University administrative computer	_____units	0813	45-53
Your refrigerator at home and your stereo	_____units	0814	54-62
The vending machine you use most often and your telephone at home	_____units	0910	63-71

How far apart are:		DUP	1-6
		Card 05	7-8
The vending machine you use most often and yourself	_____units	0911	9-17
The vending machine you use most often and your car	_____units	0912	18-26
The vending machine you use most often and the University computer	_____units	0913	27-35
The vending machine you use most often and your stereo	_____units	0914	36-44
Your telephone at home and yourself	_____units	1011	45-53
Your telephone at home and your car	_____units	1012	54-62
Your telephone at home and the University administrative computer	_____units	1013	63-71

REMEMBER: IF THE BEST CAR YOU'VE EVER OWNED OR USED AND THE WORST CAR ("LEMON")YOU'VE EVER OWNED OR USED ARE 100 UNITS APART, HOW FAR APART ARE:

How far apart are:			
		DUP	1-6
		Card 06	7-8
Your telephone at home and your stereo	____units	1014	9-17
Yourself and your car	____units	1112	18-26
Yourself and the University administrative computer	____units	1113	27-35
Yourself and your stereo	____units	1114	36-44
Your car and the University administrative computer	____units	1213	45-53
Your car and your stereo	____units	1214	54-62
The University administrative computer and your stereo	____units	1314	63-71

REMEMBER: IF THE TEACHER YOU"VE HAD THAT YOU LIKED THE MOST AND THE TEACHER YOU"VE HAD THAT YOU DISLIKED THE MOST ARE 100 UNITS APART, HOW FAR APART ARE:

How far apart are:			
		ID	1-4
		Form	5-6
		Card 01	7-8
Your mother (or the person who has been most like a mother to you) and the person you know who makes you the most uncomfortable	_____units	0102	9-17
Your mother and the person you've met in the last six months that you would like to get to know better	_____units	0103	18-26
Your mother and yourself	_____units	0104	27-35
Your mother and your father (or the person who has been most like a father to you)	_____units	0105	36-44
Your mother and the teacher you disliked the most	_____units	0106	45-53
Your mother and the happiest person you know	_____units	0107	54-62
The person you know who makes you the most uncomfortable and the person you've met in the last six months that you would like to get to know better	_____units	0203	63-71

How far apart are:			
		DUP	1-6
		Card 02	7-8
The person you know who makes you the most uncomfortable and yourself	_____units	0204	9-17
The person you know who makes you the most uncomfortable and your father	_____units	0205	18-26
The person you know who makes you the most uncomfortable and the teacher that you dislike the most	_____units	0206	27-35
The person you know who makes you the most uncomfortable and the happiest person you know	_____units	0207	36-44
The person you've met in the last six months that you would like to get to know better and yourself	_____units	0304	45-53

REMEMBER: IF THE TEACHER YOU'VE HAD THAT YOU LIKED THE MOST AND THE TEACHER YOU'VE HAD THAT YOU DISLIKED THE MOST ARE 100 UNITS APART, HOW FAR APART ARE:

How far apart are:			
		DUP	1-6
		Card 02	7-8
The person you've met in the last six months that you would like to get to know better and your father	_____units	0305	54-62
The person you've met in the last six months that you would like to get to know better and the teacher that you disliked the most	_____units	0306	63-71

How far apart are:			
		DUP	1-6
		Card 03	7-8
The person you've met in the last six months that you would like to get to know better and the happiest person you know	_____units	0307	9-17
Yourself and your father	_____units	0405	18-26
Yourself and the teacher that you disliked the most	_____units	0406	27-35
Yourself and the happiest person you know	_____units	0407	36-44
Your father and the teacher that you disliked the most	_____units	0506	45-53
Your father and the happiest person you know	_____units	0507	54-62
The teacher that you disliked the most and the happiest person you know	_____units	0607	63-71

Thanks for your help so far. Now we need a little information about you.

What class are you in?

____Freshman ____Sophomore ____Junior ____Senior ____Grad

Are you male or female?

_____Male _____Female

How old are you? ______

How many credits do you have in areas which deal with interpersonal relations (e.g., communication, psychology, sociology, counseling)? ________

Do you have any outside interests (hobbies, volunteer work, a job) or a close relationship with someone in this field (family, spouse, friend) which give you experience in this area? If so, please describe. (Include some indication of time, such as hours/week, years, etc.)

____

____

How many credits do you have in areas which deal with mechanics (e.g., engineering, mechanics, drafting, physics)? ________________

Do you have any outside interests or relationships which give you experience in this area? Please explain (including time) ____________

____

____

Thank you again.

APPENDIX B

EXPERIENCE RATING AND CODING PROCEDURES

APPENDIX B

EXPERIENCE RATING AND CODING PROCEDURES

Three undergraduate students in Communication took 400-level independent study credits to code the questionnaires and to rate the experience reports. The questionnaire asked subjects to report the number of credits they had taken in subjects related to each of the domains. Courses in communication and psychology, for example, were counted in the interpersonal domain. Engineering and physics courses were among those included in the mechanical domain.

Subjects were also asked to report outside interests or close relationships which would give them experience in each of the areas. These experiences were rated on a scale of one to ninety-nine by one of the raters. The three students who were doing the ratings met as a group to discuss criteria for making judgments and to establish benchmarks to use in their ratings. The questionnaires were split among the three.

No questionnaires were evaluated by all three raters to allow an examination of interrater reliability. As an additional note, one student was unable to complete his assignment, and his work was reviewed and completed by another member of the team.

It may be useful to examine a few examples for clarification. In the interpersonal domain, a subject who worked as an advisor for a youth group twelve hours a week had previous work experience on a "rapline". The subject's experience was given a rating of 85. A student with experience in a crisis center on the suicide hotline was rated 75. Volunteer work at a radio station was rated 25. In the mechanical area, students received credit for working as an inspector in a steel mill (40), weekend work on cars (12), and experience in drafting (15). In general, relationships with people in the fields--particularly parents--were credited 20-30 points. Again, we were considering the messages and information about the domain, and these influences were considered significant.

The number of credits the subject had in the domain was added to the experience rating for a total experience score for each domain. The total scores were those used in the analyses of the data.

BIBLIOGRAPHY

BIBLIOGRAPHY

Allard, M., and Carlson, E.R. The generality of cognitive complexity. Journal of Social Psychology, 1963, 59, 73-75.

Barnett, G.A., and Woelfel, J. On the dimensionality of psychological processes. Paper presented at the Psychometric Society, April, 1976, Murray Hill, New Jersey.

Cody, M., Marlier, J., and Woelfel, J. A reconceptualization of multiple attribute measurement: The location of unidimensional scales in an n-dimensional space. Paper presented to the Eighth Annual Mathematical Psychology Meetings, August, 1975, Lafayette, Indiana.

Delia, J., and Clark, R.A. Cognitive complexity, social perception, and listener-adapted communication in six-, eight-, ten-, and twelve-year old boys. Unpublished paper, 1977.

Fiedler, F.E. A theory of leadership effectiveness. New York: McGraw-Hill, 1967.

Friendly, M.L., and Glucksberg, S. On the description of subcultural lexicons. Journal of Personality and Social Psychology, 1970, 14, 55-65.

Gordon, T.F., and DeLeo, H.C. Structural variation in "GALILEO" space: Effects of varying the criterion pair in metric multidimensional scaling. Unpublished paper, Temple University, 1975.

Kelly, G.A. The psychology of personal constructs. New York: Norton, 1955.

Lewin, K. Principles of topological psychology. New York: McGraw-Hill, 1936.

Mitchell, T.R. Leader complexity and leadership style. Journal of Personality and Social Psychology, 16 (1), 166-174.

Osgood, C.E., Suci, G.J., and Tannenbaum, P.H. The measurement of meaning. Urbana, Illinois: University of Illinois Press, 1957.

Pettigrew, T.F. The measurement and correlates of category width as a cognitive variable. Journal of Personality, 1958, 26, 532-544.

Schroder, H.M. Driver, M.J., and Streufert, S. Human information processing. Chicago: Holt, Rinehart, and Winston, 1967.

Scott, W.A. Cognitive complexity and cognitive balance. Sociometry, 1963, 26, 66-74.

Scott, W.A. Structure of natural cognition. Journal of Personality and Social Psychology, 1969, 12, 261-278.

Scott, W.A. Varieties of cognitive integration. Journal of Personality and Social Psychology, 1974, 30 (4), 563-578.

Shrauger, S., and Altrocchi, J. Personality of the perceiver and perception. Psychological Bulletin, 1964, 62, 289-308.

Tripodi, T., and Bieri, J. Cognitive complexity as a function of own and provided constructs. Psychological Reports, 1963, 13, 26.

Van de Geer, J.P. Introduction to multivariate analysis for the social sciences. San Francisco: W.H. Freeman and Co., 1971.

Vannoy, J.S. Generality of cognitive complexity - simplicity as a personality construct. Journal of Abnormal and Social Psychology, 1965, 2 (3), 385-396.

Ware, E.E. Relationship of intelligence and sex to diversity of individual semantic meaning spaces. Unpublished doctoral dissertation, University of Illinois, 1958.

Wegner, D.M. The development and articulation of attributes in person perception. Unpublished doctoral dissertation, Michigan State University, 1974.

Wicker, A. Cognitive complexity, school size, and participation in school behavior settings: A test of the frequency of interaction hypothesis. Journal of Educational Psychology, 1969, 60 (3), 200-203.

Woelfel, J. Procedures for the precise measurement of cultural processes. Unpublished paper, Michigan State University, 1974.

Zajonc, R.B. Cognitive tuning. Journal of Abnormal and Social Psychology, 1960, 61, 159-167.