BILINGUAL INFORMATION PROCESSING: THE EFFECTS OF COMMUNICATION ON SEMANTIC STRUCTURE

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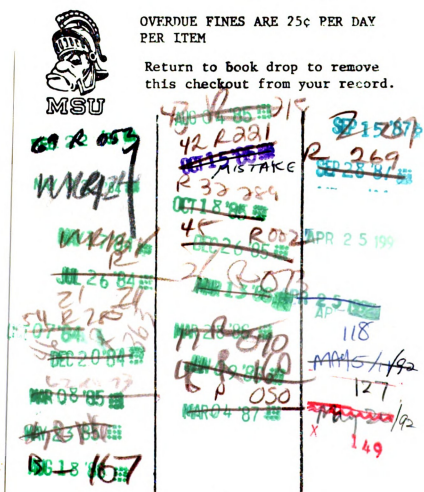
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ABSTRACT

BILINGUAL INFORMATION PROCESSING:
THE EFFECTS OF COMMUNICATION ON SEMANTIC STRUCTURE

by

GEORGE AARON BARNETT

Based upon social scientists and philosophers writings about the notion of meaning, a paradigm for the measurement of meaning is established. The four basic principles of the paradigm are that the meaning of any lexical item can only be determined through its relation with other symbols. The most important of these relations is semantic similarity. The other principles are that the measured meanings must be consensual, dynamic and empirically fruitful. Next, the existing methods for the measurement of meaning are critiqued. An argument is made that free association, free recall, Osgood's semantic differential and non-metric multidimensional scaling are inadequate because each fails to meet the established principles. However, a modified version of classical metric multidimensional scaling may be adopted as the paradigm for the measurement of meaning.

Next, a single substantive problem, the processing of information by bilingual individuals is discussed. This problem is of great social significance because of the bilingual's role in the transfer of information across linguistic boundaries. Bilinguals

have been studied by psycholinguists concerned with how these people process linguistic information so that they may gain insights into how all people process language. By and large, psychologists have not been overly successful. One of the reasons sociolinguists point out is that the bilingual is not viewed as a member of a speech community. The author concludes that both perspectives must be employed in order to describe the communication behavior of the bilingual.

Based upon these two lines of research and the presented paradigm, the author suggests and tests eight hypotheses dealing with bilingual information processing. Canadian college students either monolingual or bilingual in French and English made up the sample. Metric M.D.S. was used to measure semantic structure. The results indicated that the semantic properties of lexical items rather than the symbol's language are the primary organizing principles of a bilingual's semantic structure, although the language attribute was of secondary significance; that the semantic space of English and French monolinguals as well as bilinguals in either language are all significantly different but can be described by the same number of underlying dimensions. The degree of discrepancy between a space produced by a group of bilinguals and a group of monolinguals will be less than the difference between the two monolingual groups was partially supported.

The mass media usage patterns of the three groups were significantly different. The English-language group used the mass media significantly more than the French-language group with the exception of television, where the pattern was reversed. The bilinguals total number of media hours exceeds both monolingual groups. Bilinguals used interpersonal channels to a significantly greater degree than monolinguals.

Finally, the author was unable to predict aspects of the bilinguals' semantic system from their exposure to the media and interpersonal relations in each of their languages.

The results are interpreted in light of the bilingual's potential embeddedness in social networks, the concept of language shift and the theory of bilingualism presented earlier.

BILINGUAL INFORMATION PROCESSING: THE EFFECTS OF COMMUNICATION ON SEMANTIC STRUCTURE

by

George A. Barnett

A Dissertation

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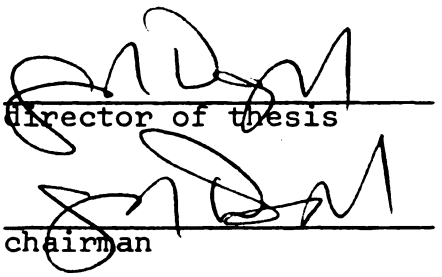

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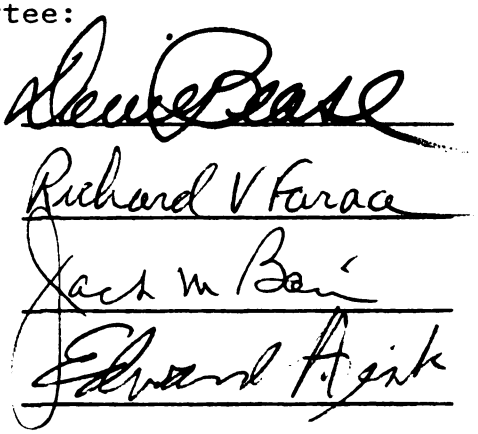

To my father,

Jacob B. Barnett

ACKNOWLEDGEMENTS

The process of generating scientific knowledge is never carried out by individuals acting in isolation. Explicit in the scientific method is the practice of building upon existing knowledge. Often this involves the synthesis of ideas from many seemingly unrelated disciplines and lines of research. It is the author's belief that this dissertation is part of a continuing product of a group of scholars all intimately involved in the persuit of knowledge. The author would like to thank a number of individuals for their ideas and feedback to mine. Among them are Donald P. Cushman, for his assistance in the development of the paradigm for the measurement of meaning; James A. Taylor, Kim B. Serota, Rolf T. Wigand, Timothy Maybee, Michael Cody and Franklin J. Boster for their assistance at all stages of the research including the reduction of task related stress. A special note of thanks is due to Thomas McPhail without whom this dissertation would still only be a dream.

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CHAPTER ONE

OVERVIEW

The question of how people process information has been a concern of scholars since antiquity. Aristotle wrote that three basic principles -- similarity, contrast and contiguity -- govern reasoning. In the seventeenth century, John Locke postulated the notion that the human mind begins as a blank slate and that all people process ideas based upon their past experiences. In the 19th century, the German psychophysicists, Fechner, Weber and Hemholtz began to apply rigorous laboratory principles to the problem of human sensation and perception. In the 20th century, the focus of the problem shifted away from the human mind and attention was brought to bare on why people behave the way they do. The work of the behaviorists, Watson and Skinner, explicitly ignored the organization of the mind and its impact upon behavior. It is with the work of the early psycholinguists in the 1950s, Osgood, Deese and others, that the notion of meaning as a theoretical concept that can have behavioral consequences reappears in psychology. Perhaps the key implication of their work was that meanings can be communicated through linguistic messages and that these meanings can motivate future behavior and the interpretation of future messages. At about the same time, psychometricians (Torgerson, Tucker and others) began to

systematically apply Euclidean distance models to the perception of stimuli: colors, sounds, and verbal symbols. It is the intent of this dissertation to build upon the ideas of these individuals.

Chapter two establishes a paradigm for the measurement of meaning. The four basic principles of this paradigm are that meanings can only be measured relationally, that is, the meaning of any given lexical item can only be determined through its relation with other symbols. The most important of these relations is semantic similarity. The other principles are that the measured meanings must be consensual. The measurement system must be dynamic. And, finally, it must be empirically fruitful. Chapter two continues by critiquing the existing methods for the measurement of meaning. An argument is made that free association, free recall and Osgood's semantic differential scale are inadequate because each fails to meet the principles established in the first section of the chapter. Next, the theory of multidimensional scaling (MDS) is presented. However, because of psychometricians concern with the individual case, and the methods they employed to compensate for this problem, one form of MDS, non-metric, is rejected also. Chapter two concludes by suggesting that a modified version of classical metric multidimensional scaling be adopted as the paradigm for the measurement of meaning. This scaling procedure would have the advantage of meeting the criteria established early in the chapter.

The next chapter (three) discusses a single substantive problem, the processing of information by bilingual individuals. This problem is of great social significance because of the need to transfer certain information across linguistic boundaries. The only way that this information can pass from one language group to another is through a bilingual. The problem is of critical importance where national development and social integration are concerned.

The bilingual individual has been the object of intensive investigation by the social sciences. He/she has been observed by psycholinguists who are concerned with how these people process linguistic information so that they may gain insights into how all people process language. By and large, the psychologists have not been overly successful at describing the bilingual's linguistic system. One of the reasons sociolinguists point out is that the bilingual is not viewed as a member of a speech community. They raise the general question of how the environment affects the way bilinguals use language. The author concludes that both perspectives must be brought into play if we are going to describe the communication patterns of the bilingual. Based upon these two lines of research, and ideas from contemporary communication theory, chapter three concludes with eight theoretical hypotheses, which constitute the basis for a theory of bilingual information processing.

Chapter four takes the hypotheses in chapter three and operationalizes them according to the paradigm for the measurement of meaning. Next, a study is designed to test these hypotheses in order to gain insights into how bilinguals process information. It is hoped that the study would also provide data which can be used to demonstrate the utility of the paradigm.

Chapter five provides the results of the test of the eight hypotheses.

Chapter six provides a discussion and a summary of the investigations presented in this volume. The first section of the chapter discusses the theory of bilingual information processing, as seems warranted based upon the results of the testing of the hypotheses. The second section discusses future research in the area of bilingualism. These ideas include a reconceptualization of the operationalization of one of the hypotheses which attempted to relate mass media exposure to semantic structure, a proposed time series analysis of emergent bilinguals and, finally, a network analysis of a bilingual community in order to describe their patterns of interaction. This chapter ends with a summary of the entire thesis.

CHAPTER TWO

A PARADIGM FOR THE MEASUREMENT OF MEANING

Introduction

Historically, philosophers, psychologists, linguists and sociologists have all been interested in the theoretical concept of meaning.[1] Problems of identifying a precise meaning for the word "meaning" has extended from single morphemes and words and individual sentences to entire code systems. Yet despite this attention, there has been little agreement between fields as to the definition of this construct. Even within each of the disciplines, the situation is no better. Gilbert Harman describes the current state of affairs in philosophy in the following manner (1968:590).

> Philosophers approach the theory of meaning in three different ways. (1) Carnap, Ayer, Lewis, Firth, Hempel, Sellars, Quine, etc. take meaning to be connected with evidence and inference, a function of the place an expression has in one's "conceptual scheme" or of its role in some inferential "language game." (2) Morris, Stevenson, Grice, Katz, etc. take meaning to be a matter of the idea, thought, feeling, or motion that an expression can be used to communicate. (3) Wittgenstein(?), Austin, Hare, Nowell-Smith, Searle, Alston, etc. take meaning to have something to do with the speech acts the expression can be used to perform.

Harman goes on to say that theories of the first type ignore the social aspects of language, i.e., its use as a communication tool. The second type suffers the

inadequacy of not separating thought and language, and the third approach ignores the creative aspects of language.

In psychology, there exists the now familiar conflict between the behavioralists Watson (1924, 1930), Skinner (1957) and Bousfield (1953) who discount any notion of an internal meaning and prefer to focus on the actions of individuals without inferring any state of consciousness, and the cognitively orientated psycholinguists such as Osgood (1952), Deese (1965), and Cofer (1965). They acknowledge an internal meaning system which mediates between incoming stimuli and behavioral responses.

The situation in theoretical linguistics is no better. While Bloomfield (1933) felt that an adequate description of meaning was beyond the scope of the natural and social sciences, Sapir (1921) and Whorf (1956) wrote that language structures thought and therefore contains elements of meaning. Chomsky (1965:4) writes,

> . . . in a technical sense, linguistic theory is mentalistic, since it is concerned with discovering a mental reality underlying actual behavior. Observed use of language or hypothesized dispositions to respond, habits, and so on, may provide evidence as to the nature of this mental reality, but surely cannot constitute the actual subject matter of linguistics, if this is to be a serious discipline.

Chomsky is the father of the linguistic school of generative grammar. He describes it as ". . . simply a system of rules that in some explicit and well-defined way assign structural (syntax) descriptions to sentences . . .

generative grammar does not, in itself prescribe the character or functioning of a perceptual model or a model of speech production (1965:8-9)." Compare Chomsky's conception of the role of meaning with the following quote from George Lakoff about generative semantics (1971:232).

> I would like to discuss some questions having to do with the theory of grammar. I assume that a grammar of a language is a system of rules that relates sounds in the language to their corresponding meanings, and that both phonetic and semantic representations are provided in language-independent way.

Meaning for the sociologist has two different and seemingly contradictory senses. While meanings must be shared and universal within a group in order to insure the ongoing nature of the social entity (Dewey: 1922), they must at the same time be established as part of a dynamic interactive process between the individuals. This G. H. Mead describes as follows: (1934:81)

> . . . meaning, as we have seen, is found to be implicit in the structure of the social act, implicit in the relations among its three basic individual components: namely, the triadic relation of a gesture of one individual, a response to that gesture by a second individual, and completion of the given social act initiated by the gesture of the first individual.

The above statement has been taken by Herbert Blumer (1966) and others as an implicit indication that the self (individual) plays the central role in the process of concept formation. This individualistic approach to sociological concept of meaning may be summarized by the following quote from Blumer (1966:548).

> . . . the meaning of the object is conferred on it by the way in which the individual is prepared to act toward it. Finally, all objects--whether a mountain, a house, a speech, a toothache, a dream, a memory, or a sensation--are located in the individual's environment in the legitimate sense that in being designated by the individual they stand over against him as the designator.

From Blumer's conceptualization, it seems nearly impossible for a society to develop what Durkheim (1938) calls the "collective representations" for the meaning of objects. These are shared meanings for linguistic utterances that exist outside the individual's consciousness. These signs are common for each member of society. There is normative pressure to act, think or feel in a similar manner in response to these symbols.

As Durkheim writes (1961:28-29):

> If, on the other hand, the categories are, as we believe they are, essentially collective representations, before all else, they should show the mental states of the group; they should depend upon the way in which this is founded and organized, upon its morphology, upon its religion, moral and economic institutions, etc. . . . Collective representations are the result of an immense co-operation, which stretches out not only into space but into time as well; to make them a multitude of minds have associated, united and combined their ideas and sentiments; for them long generations have accumulated their experience and their knowledge.

This lack of theoretical unity has led sociology into the schizophrenic nature of concentrating on situation-specific behaviors and at the same time attempting to identify patterns of behavior that are regular throughout society.[2]

The field of communication has its intellectual roots in the above mentioned disciplines. As a result, the lack of a unified approach to the concept of meaning is also manifest in this field. While Berlo (1960) takes an individualistic position by saying that, "Meanings are in people," Cushman and Whiting (1972) have taken the position that meanings are rule governed by their standardized usage. Simply, if the meaning of a signal is to be understood, it must be shared by the interactants.

It is the position of this paper that if there is going to be a science of communication then a single unified definition of meaning is a requirement. In order for the field to progress, there must be agreement as to what meaning is so that it can be recognized when it occurs, used as an independent variable which can be manipulated and controlled in order to predict changes in some resultant dependent variable, or as a dependent construct which can be predicted and explained as a function of a number of psychological and/or social factors. With a single clearly delineated subject matter focusing on specific aspects of the construct, it becomes possible to replicate research using the concept. Without it, it is impossible to develop a comparable body of knowledge with which to guide future research. This chapter will attempt to develop such a definition for the construct of meaning as it might be used for the field of communication.

The Fundamental Measurement of Meaning

Since there is a great deal of confusion regarding the theoretical concept of meaning, the author proposes that an original and fundamental system of measurement be developed for the concept's definition. This is known as an operational approach to science. Simply put, the meaning of any concept is nothing more than the operations by which it is measured. The concept may be taken to be the value or series of values that result from the measurement process. The advantages and disadvantages with this approach to theory construction have been discussed in great depth by G. R. Miller (1974). This has been the approach adopted by the natural sciences. Woelfel writes (1974:2), ". . . scientific theories have their ultimate roots in certain fundamental or primitive variables which cannot be defined in terms of yet more basic concepts, but rather are defined, by some a priori call to experience of observers." For example, in physics the fundamental variables are usually considered to be distance, time, mass or force and temperature. Of these, only time and distance can be directly observed. The others can only be defined as ratios to time and distance. Einstein (1961:5) describes the measurement of distance in the following manner:

> For the purpose (the measurement of distance) we require a "distance" (Rod S) which is to be used once and for all, and which we employ

> as a standard measure. If, now, A and B are two points on a rigid body, we can construct the line joining them according to the rules of geometry; then, starting from A, we can mark off the distance S time after time until we reach B. The number of these operations required is the numerical measure of the distance AB. This is the basis of all measurement of length.

Commenting on Einstein, Woelfel writes (1974: 4):

> Einstein's measurement procedure is two-staged: first, an arbitrary distance (or discrepancy, in the general case) is stipulated by the scientist. It is vital to note that rules for the perception or measurement of this initial measurement distance or discrepancy are not stated; rather the scientist must assume the subject and himself/herself share a common referent for the ordinary language symbol "distance" or "difference," and that the subject can make this initial recognition unaided by further definition. Ultimately it is this a priori call to common experience as codified in ordinary language symbols that establishes a link between the everyday experience of the observer and the scientific theory.
>
> Secondly, the scientist specifies a rule by which other instances of distance or discrepancy are to be compared to this unity. In this case, the observer is asked to make ratio comparisons of all other distances or discrepancies to this arbitrary standard. Clearly, fundamental measurement represents a joint activity of scientists and observer.

It is the intent of this chapter to propose a fundamental measurement system for the meaning of individual lexical items specifically for the science of human communication. What follows is not a totally inclusive system applicable to all the fields surveyed above, but rather, one designed to meet the assumptions and the needs of communication. G. R. Miller (1975:6) writes:

> But the crucial point to be emphasized is that the proponents of operationism realizes that the boundaries of meaning are dictated by the instrumental procedures employed, that there is a wider focus of meaning not encompassed by this operational definition.

The operational position toward definition may be contrasted with the Aristotelian, or essentialist approach, which holds that definitions are statements describing the essence or true meanings of an object. The term to be defined (definiendum) is a name for the essence of an object, while the defining formula (definitions) is the description of the essence. Miller considers this position is unacceptable for the following reasons (G. R. Miller, 1974). One, the notion that there is a correct or true meaning of a term is considered erroneous. Two, this position does not require that the attributes of the definiendum be directly observable in physical or social reality.[3] Three, essentialist definitions tend to be tautological. And, four, it implies that the underlying properties of an object are constant. If the description is altered, then the object is somehow not the same.

Woelfel and Barnett (1974:5-6) have discussed the point that the perception of a single object as an unique object implies an arbitrary categorization which renders discrete the continuous process of perceiving the environment, whereby an arbitrary segment of the continuum of stimulation is set aside and identified as an unique object. Thus, an attempt at identifying the unique attributes of an object or thought is doomed to failure.

The author proposes that any fundamental system of meaning meet the following requirements:

1. The measurement system must be relational. That is, it must measure the degree of the relationship between the individual lexical items.

2. The system must take into account the consensual nature of meaning.

3. It must be dynamic. It must be capable of measuring change over time. And,

4. The system must be empirically fruitful.

Each of these assertions is based upon the past literature in philosophy and the social sciences, and the author's conceptualization of the communication process. These points will now be discussed separately in light of the above areas.

The Relational Nature of Meaning

Associationism

The notion that individual events, objects, or words are associationally related in human memory has its roots in antiquity with the work of Aristotle. In "On Memory and Reminiscence," he write that there is something systematic in the chain of thought which results in the recollection of particular thoughts (Aristotle, 1941:614).

> This explains why it is that persons are supposed to recollect sometimes by starting from mnemonic loci. The cause is that they pass swiftly in thought from one point to another, e.g., from milk to white, from

> white to mist, and thence to moist, from which one remembers autumn (the "season of mists"), if this be the season he is trying to recollect.

In this essay, Aristotle also isolated three sorts of relationships that govern the process of remembering. They are similarity, contrast and contiguity of exemplars in past experience. For Aristotle the process of remembering is closely related to the perceptual process. Thus, while the process of definition or determining the specific meaning of an object for Aristotle was purely descriptive, his notion of memory implies a system of relations between individual objects or words.

These three basic principles: similarity, contrast and contiquity were also taken as the basis of British Associative Theory. Philosophers of the mind who are considered members of this school are John Locke, Thomas Hobbes, Bishop Berkeley, David Hume, David Hartley (the father of associationism), John and James Mill and Alexander Bain. For in depth discussions of their contributions to human information processing see Deese (1965), Schultz (1969) and Anderson and Bower (1973). While the contributions of these individuals to the discussion of human thought were great, for purposes of this paper their contribution was largely to bring the Aristotlean paradigm into modern thought by restating and clarifying the relational principles of the mind and thereby influencing contemporary psychological theory.

Two of the important advancements of this school of thought were that the structure of the mind at any one point in time is contingent on the individual's past experience (as opposed to each thought having an innate and proper locus in the mind), and Locke's atomistic notion that all knowledge could be derived from discrete simple ideas which through the associational process are combined into complex ideas. Simple ideas are thought to be elemental or unanalyzable. Hume discussed the notion of complex ideas further and said that they do not necessarily resemble simple ideas, since the complex ideas evolve from a combination of several ideas in some new and novel pattern. Complex ideas are compounded from simple ideas by the associational processes. This notion is similar to Barnett's (1975) conception of complex innovations.

Similarity.--The principle of similarity states that objects which are perceptually similar will be associated in an individual's mind. For example, thought of lemons may easily lead to thoughts of oranges, although it is likely that either might not be present with the other or appear in immediated succession (the principle of contiguity). What is apparent, however, is that the two objects are perceptually similar. They share certain attributes. Among them are shape, texture, internal physical structure, and color (before dying the skins for

marketing purposes). The principle of similarity is a synchronous association which combines simultaneous ideas into more complex ideas; in this case citrus fruits. The notion of similarity is structural because it relates the ideas of thought into a single coherent series of relations or structures.

The notion of word-substitution may be used for illustrative purposes in a discussion of the principle of similarity. If two words are synonyms, i.e., they are semantically identical, then the latter can replace the former without any alteration in the interrelationships among the symbols. If they are not, the words are semantically different, then the first symbol cannot be replaced by the second without altering the structure of the relations. The greater the dissimilarity between the terms, the greater the interrelationship among the symbols will be changed.

Similarity was taken as an irreducible law of association by Locke, Berkeley, Hume and Bain, although others, Hartley and James Mill viewed the relation as a tautology (things are similar because they are similar) and as a special case of the principle of contiguity (Anderson and Bower, 1973). Indeed, Deese (1965) takes this latter position. The present author takes the position that all words or ideas are related in the mind according to their degree of similarity. Objects are not similar because they are similar but rather (Locke's

position) ideas are structured because past experiences specify the relationship between the objects of thought. It is not the perceptual process directly which determines the organization of ideas in the mind. Certain metaphysical concepts have no perceptual referent, yet they are associated with the individual's other ideas. The location of these terms is a result of other information sources than direct experience, most notably the communication process and self-reflective activity.

The notion of similarity can and will be viewed identically to Einstein's conception of distance. As in the case of distance, it is impossible to describe the concept without making reference to the concept itself. Such is the case with all fundamental variables. It is this problem that produced Hartley's and Mill's difficulty with the construct and led them to view the notion of similarity as a tautology.

Contiguity.--The principle of contiguity stated by Deese (1965:12) is, "Two psychological processes occurring together in time or in immediate succession increases the probability that an associative connection between them will develop." This assertation is to time what the principle of similarity is to space.

Contrast.--The principle of contrast concerns the idea that associative links are formed between objects which are conceptual opposites. For example, thoughts of

black often lead to thoughts of white, large to small, good to bad, and so on. This principle may be viewed as a special case of the principle of similarity, where the concepts are maximally dissimilar. Given the pair of opposites hot and cold, it is not hard to think of the terms warm and cool which are moderately dissimilar to both the extremes. This gives rise to the notion of a dimension of (temperature) similarity with hot and cold at the extremes. Bipolars specify a single attribute, which in this case, is temperature. The terms become similar because of all the possible points for comparison, a single shared attribute was chosen. However, on this attribute the two terms are maximally dissimilar. The similarity between the bipolars is a function of the fact that they are defined in terms of the same attribute, even though they represent different values of that attribute. Both terms symbolize this identical attribute, although they focus attention on different segments of its range. Because both terms symbolize the same referent (i.e., the attribute in question, such as heat) it makes sense to think of what has been called contrast as a special case of similarity. Because contrast is a special case of similarity, it will be dropped from further consideration as an organizing principle of human cognition.

American Associationism.--It would be an understatement to say that American psychology has adopted

associationism as its major theoretical paradigm. Anderson and Bower (1973:26) write,

> Over the first half of this century, associationism in America has almost completely disintegrated as a coherent theoretical position. In America association very nearly died due to its wide acceptance in academic psychology. Just as a scientific theory can be killed by scientists' widely ignoring it, so can a theory die from neglect because everyone accepts its basic premises and proceeds to work on technical details within the framework of those premises . . . .

However, while associationism was adopted wholeheartedly, it has dealt almost exclusively with the principle of contiguity, (which may well be classified as a special case of similarity, i.e., similarity in location in a temporal sequence) viewing the notion of static organization of the mind and the notion of meaning as largely irrelevant. American associationism was also influenced to a large extent by the empirical psychologists on continental Europe. The learning theory of Ebbinghaus introduced the idea of nonsense syllables for control purposes. Pavlov's work in associative relations in dogs completed the transition from subjective ideas to behavior of animals, which he viewed as objective and quantifiable. Perhaps in the interest of objectivity, the central thrust of the problem--the organization of the human mind--was ignored. This stress was manifest in the behaviorism of Thorndike, Watson and Skinner, who were concerned with the paired association between a

stimulus S_i and a linked response R_j. To this school of psychology, the structure of knowledge could be considered as a coordinate with a set of S-R pairs: in situation S_i, make response R_j. What goes on in the individual's head to produce response R_j when S_i occurs is not relevant because the individual's psychological state is not directly observable. Thus due to behaviorism's pervasive influence in American psychology there is a lack of concern with the principle of similarity. As a result, it is not uncommon for a psychological theory of meaning to be developed stressing only time ordered relationships (Rommetveit, 1968). The psychological research that is most typical of this perspective are the pair association learning studies, which attempt to form links between various verbal stimuli.[4] These may be real lexical items or nonsense syllables. Hypotheses which are investigated are how does frequency and order or the reward value of the symbols of presentation effect discrimination, inter-pair association formative, positive or negative transference or semantic satiation. Within the last ten years, however, the structural properties of the stimulus list has become a typical independent variable. This included the inter-item similarity of the stimulus list. This may be either acoustical or conceptual similarity. For a complete review of the verbal learning literature see Eckert and Kanak (1974).

One of the reasons for the delay of the use of similarity was that there was not an adequate measure of similarity until the late 1950's. Another was that the notion of similarity of the symbols as an organizational mechanism of the mind had to be rediscovered. This was first noticed by Jenkins and Russell (1952) and Bousfield (1953) who found that words clustered by their semantic content in studies of free recall. But as Bousfield wrote (1953:229), "If clustering can be quantified, we are provided with a means for obtaining additional information on the nature of organization as it operates in the higher mental processes."

The many early attempts of quantifying the psychological "meaningfulness" of associative structures will be discussed later and have been reviewed by Creelman (1966). Today, the notion of similarity is frequently evoked in psychological research (Shepard, 1963, 1974; G. A. Miller, 1969). However, this has been at the expense of the dynamic nature of the contiguity principle. The reason is that while psychometricans have developed numerous measures of similarity, none of them have explored the problem of measuring change in the structure over time (Barnett, Serota and Taylor, 1964).

The work of Charles Osgood provides an important modification to American associationism. He reintroduced the notion of a mediating meaning structure in the mind by which an individual "interprets" incoming stimuli and

decides how to respond to them. The major proposition of mediation theory as stated by Osgood, Suci and Tannerbaum (1957:7) is,

> A pattern of stimulation which is not the significate is a sign of that significate if it evokes in the organism a mediating process, this process (a) being some fractional part of the total behavior elicited by the significate and (b) producing responses which would not occur without the previous contiguity of non-significate and significate patterns of stimulation.

It is not surprising that Osgood couched his theory in behavioral terms, given the state of affairs of psychology in the 1950's. In fact, he defines a significate, "as any stimulus which, in a given situation produces a predictable pattern of behavior" (1957:6). To Osgood, the mediating structure is learned (following Locke) in the same manner as all stimuli (S_i) are paired with responses (R_j) for the traditional behavioralists.

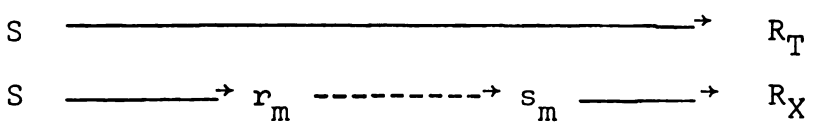
> Whenever some stimulus other than the significate is contiguous with the significate, it will acquire an increment of association with some portion of the total behavior elicited by the significate as a representational mediation process (1957:6).

What is new was that this learned association becomes a cognitive state, meaning, which influences the individual's future behavior. His theory is summarized in figure one.

Formal Logicians

The notion of meaning as the relationship between

A--Development of a Sign.



B--Development of an Assign.[a]

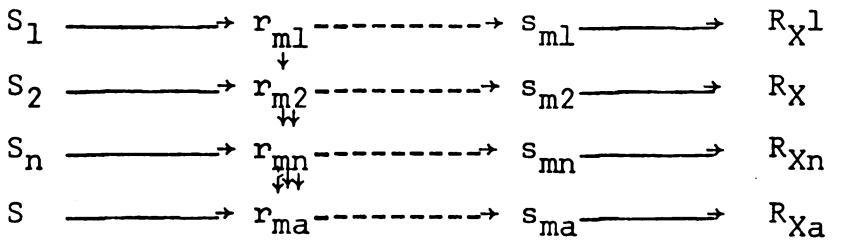


Figure 1.--Symbolic Account of the Development of Sign Processes.

[a]Charles Osgood, et. al., (1957:7).

symbols was also evoked by a different school of philosophers. They may be labelled the formal logicians. Representative of this tradition are Gottlob Frege and Ludwig Wittgenstein. To Frege (1970) meanings or senses emerge from the relationship between signs. He writes (1970:56-57),

> Now if we were to regard equality as a relation between that which the names "a" and "b" designate, it would seem that a=b could not differ from a=a (i.e. provided a=b is true). A relation would thereby be expressed of a think to itself, and indeed one in which each thing stands to itself but to no other thing. What is intended to be said by a=b seems to be that the signs or names "a" and "b" designate the same thing, so that those signs themselves would be under discussion; a relation between them would be asserted. But this relation would hold between the

> names or signs only in so far as they named or designated something. It would be mediated by the connexion of each of the two signs with the same designated thing. But this is arbitrary. Nobody can be forbidden to use any arbitrarily producible event or object as a sign for something. In that case the sentence a=b would no longer refer to the subject matter, but only to its mode of designation; we would express no proper knowledge by its means. But in many cases this is just what we want to do. If the sign "a" is distinguished from the sign "b" only as object (here, by means of its shape), not as sign (i.e. not by the manner in which it designates something), the cognitive value of a=a becomes essentially equal to that of a=b, provided a=b is true. A difference can arise only if the difference between the signs corresponds to a difference in the mode of presentation of that which is designated.

Since the chosen signs and their relationships are arbitrary, there is nothing to keep the connection between A and B from becoming A = B/C, or A = CB or any other functional relationship. In this way, the precise pair-wise association between A and B can be specified. The limiting condition to Frege is the truth of the relationship. Thus, for Frege meanings must be empirically testable.

When an object is named or designated as a member of a class, A, it implies the proposition A = B or $A = B_1X_1 + B_2X_2 + \ldots + B_nX_n$, where the X's are the various attributes of the object and the B's the specified relationships between the attributes and the object.[5] For example, when a lemon is specified as such, it implies that it is yellow, round and has a skin of a certain

texture. Likewise, for an orange, it becomes possible to specify the relationship between this object and its attributes. By comparing the relationship between the attributes, it becomes possible to specify the relationship between the objects. For purposes of this paper, this relation is similarity.

In the case of the lemon, if the object does not possess all the attributes necessary to become a member of the class of lemons (rather than being sour, the lemon is sweet), then A ≠ B. Two moves are then possible. One, the object is not a member of the class of lemons, A = C. Or, two, the class of objects must be redefined, A = B*, an altered set of attributes which now describe the object.

Frege's earlier discussion dealt only with pairwise relations. Later in the same volume he expands this notion to groups of concepts. He writes (1970:159) that precise meaning derives out of the relationships among groups of symbols.

> A definition of a concept (of a possible predicate) must be complete; it must unambiguously determine, as regards any object, whether or not it falls under the concept . . . . If we represent concepts in extension by areas on a plane, this is admittedly a picture that may be used only with caution, but here it can do us good service. To a concept without sharp boundary there would correspond an area that had not a sharp boundary-line all around, but in places just vaguely faded away into the background. This would not really be an area at all; and likewise a concept that is not sharply defined

> is wrongly termed a concept. Such quasi-conceptual constructions cannot be recognized as concepts by logic; it is impossible to lay down precise laws for them. The law of excluded middle is really just another form of the requirement that the concept should have a sharp boundary.

In Wittgenstein's Tractatus Logico Philosophicus (1922), he says that meaning or facts exist only as states of affairs which are dynamic and empirically testable. A state of affairs must be expressed by a proposition, such as, "the lemon is yellow." As such, a state of affairs implies a constellation or a series of relations among a group of objects. Objects make their appearance only with a space of possible states of affairs, as in the case where the lemon is yellow. This is only one of the possible states of affairs. The lemon could have been orange or green as well as yellow. Thus, states of affairs are contingent facts--they only happen to exist.

According to C. A. Van Peursen (1970:35-36), Wittgenstein wants to elucidate the logical structure of the world. This is accomplished in the following manner.

> He therefore tries to present states of affairs or as he also says, the connection of objects in the form of logical language. Just as in geometry it is possible to project objects on a plane, so a particular state of affairs can be projected in a logical picture. This is done by showing that certain logical elements are mutually related in a certain way. The glass is on the table, for example can be expressed in logical terms "aRb," where "a" and "b" indicate things and "R" indicates a relation. It is this kind of connection that indicates the facts within what Wittgenstein calls logical space. Logical space

> covers the field of the possible relations that may obtain between states of affairs, and that are realized in positive facts. "The glass is on the table" is an indication of such a positive fact, translatable in logical language as "aRb" or in terms of signs representing whole sentences (atomic propositions), a "p." These sentences, or, to use the more technical term, these "propositions," may occur in extensive constellations.

In Wittgenstein's later work (1953) he abandons his previous position that it is possible by means of logic to reveal the hidden structure of language. Rather than there being one definitie meaning for a single lexical item, there are in fact as many meanings in language as there are ways in which the symbol is employed in ordinary use. There are many language-games, each of which is justified within the human situation in which it is applied. Words acquire their meaning with the whole context of their use.

The notion that words can take on many different meanings depending on their context of use rather than forcing an abandonment of the earlier conceptualization warrants only a slight modification of the system of analysis. In any given context, a specific lexical item may be defined by its relationships with the other items that are used in that context. For example, in a fruit store, the lemon becomes defined by its relationship to other fruits, in a restaurant with other foods and drinks, and with regards to automobiles to other descriptors of the quality of vehicles. While it is possible to describe

the lemon in all those contexts simultaneously, this would only serve to confuse the issue. The selection of the concepts upon which to base a word's definition should be determined by the context in which it is potentially used. As such, the definition becomes context specific and empirically testable within that situation. Had one attempted to determine the degree of similarity between every lexical item for the entire range of situation in which the symbol is used, it would be nearly impossible to determine the truth-value of the proposition.

Communication

A similar position is taken from the perspective of contempory communication theory by Woelfel. He writes (1971:Chapter 5, page 4),

> The process of a definition is a process of relating objects of thought to each other. Fundamentally, this involves taking note of similarities and differences between objects, of identifying the attributes of an object with similar attributes of different objects, and differentiating the attributes of the object from those attributes of the object "which are different" . . . .

The perception of a single object as a unique object implies a process of categorization in that all the discrete stimuli which constitute the physiological mechanism of that perception are set apart from the totality of stimuli impinging on the individual at the time and designated as a single object of thought. The category renders discrete a continuous process of

exposure to the environment, whereby an arbitrary segment of a continuum of stimulation is set aside and identified as a unique object.

When an individual identifies two objects as "yellow," for example, it is not implied that they are the same color, only that they are similar enough to be described by the same linguistic symbol. The visual color spectrum covers the range from about 4,000 to 6,400 Angström units, and research indicates that color differences of only a few Angström units are perceivable (Munsell, Sloan and Godlove, 1933; Halsey, 1954); yet ordinary language does not provide color terms for all these differences. The ordinary language people speak (and for the most part the symbol system of social science) allows only a crudely approximate description of the perception of any object.

The continuous set of positive real numbers offers a potentially error-free language for the definition of any set of objects with a level of precision far greater than the limits imposed by human perception.

Woelfel states that (1972:11[Chapter 4]):

> Dissimilarities among objects (whatever those objects may be) may be represented by a continuous numbering system such that two objects considered to be completely identical are assigned a paired dissimilarity score or distance score of zero(0), and objects of increasing dissimilarity are represented by numbers of increasing value. Assuming that the definition of an object or concept is constituted by the pattern of its relationship to other objects, the

definition of any object may be represented by an 1 X n vector, S_{11}, S_{12}, S_{13}, . . ., S_{1n}, where S_{11} represents the distance or dissimilarity of object 1 from itself (thus $S_{11} = 0$ by definition), S_{12} represents the distance or dissimilarity between objects 1 and 2, and S_{1n} represents the distance between the 1st and nth objects. Similarly, the second object may be represented by a second vector, S_{21}, S_{22}, S_{23}, . . ., S_{2n}, and the definition of any set of concepts or objects may therefore be represented in terms of the matrix

$$\begin{matrix} S_{11}, S_{12}, \ldots, S_{1n} \\ S_{21}, S_{22}, \ldots, S_{2n} \\ \vdots \quad \vdots \quad \vdots \\ S_{n1}, S_{n2}, \ldots, S_{nn} \end{matrix}$$

where any entry S_{ij} represents the dissimilarity or distance between i and j.

This dissimilarity matrix describes the state of affairs (static structure) of the interrelationships among a set of objects at a point in time. The matrix is contingent on an individual's past information. There are an infinite number of possible relationships between the symbols, because the only limiting factor for any cell is that the dissimilarity be a positive real number. Thus, specific definitions are testable. Additionally, it has particularly attractive mathematical or formal properties, including a well-developed set of operations defined for such matrices. Finally, in order to determine the definition of a given term specific to a particular context, one only has to choose the symbols which describes

that context and determine the degree of similarity between these items.

In summary, this section of the chapter has discussed the historical development of the notion that the meaning of an object can be determined by its relationships to other objects. Specifically, the relation which most accurately describes a state of affairs is similarity. The structure of meaning at any one point in time is contingent upon an individual's past experiences and the context in which the symbol is used. In a later section of this paper, the measurement of similarity will be discussed.

The Consensual Nature of Meaning

The notion that meanings must be considered as consensual or shared relationships can be justified from philosophy, sociology, linguistics and contemporary thought within the field of communication. Indeed, if meaningful ideas are to be exchanged between two or more people, they must share common definitions for the symbols used in this transfer of information. Deese (1965) takes the position that when investigating "psychological meaning" one must look at normative responses rather than the idiosyncratic responses of individuals. In this way, the results will be more generalizable and indicate the symbol's communication value.

Philosophy

Wittgenstein (1953) takes the position in his later work that meaning does not derive from internal conditions of the individual mind, or from private a priori experiences, but rather, from the entire social convention which is public and based upon the rules that govern language. The meaning of a symbol can be determined by its use and the standard usage of an expression is shown by describing the place it was given (relationship to the other symbols) in what Wittgenstein calls a language-game. Language-games may be considered the various activities of life. The use of the symbol may vary between these situations and its meaning will also vary becoming subject to the rules that happen to be evoked in that particular situation.

Stephen Toulmin (1969:73) has summarized Wittgenstein's position as follows.

> Any expression owes its linguistic meaning (Wittgenstein taught) to having been given a standard rule-governed use or uses, in the context of such activities: in isolation from any activity of this sort, the expression itself would lose all linguistic status and would become a mere mark or noise--an "idle wheel," engaging in nothing.
>
> Language-games in turn, however, must be understood in their own broader context; and for those contexts Wittgenstein introduced the phrase "forms of life."

Later in the same essay Toulmin extends Wittgenstein's conceptualization of language to all non-linguistic behavior. However, he makes a minor qualification

to distinguish significant human actions from meaningful linguistic expression (1969:85).

> Quite apart from the actual use made of an expression on some particular occasion of utterance, we can discuss also its STANDARDIZED (conventional use), which arises out of the STANDARD LANGUAGE games in which it normally figures: this conventional use is what determines the "liberal" or dictionary meaning of the expression.

Following Toulmin, Cushman and Whiting write (1971:217),

> We believe there is a class of human actions whose significance is largely dependent on consensually shared rules. These rules control the unfolding of the action over time and constitute its meaning.

Sociology

For language these rules are embedded at a societal or cultural level. The meaning of a symbol is based upon its standardized usage. Language rules are indistinguishable from society's other norms. When an individual violates the rules of a language, they are subject to the same sanctions that result from the violation of other mores. In the case of language, this sanction is, among other things, non-reciprocated communication. Thus, a necessary condition for communication is that the linguistic rules are shared by the participants of the interaction. "Certain rules must be consensually held among communicating participants for the communication to occur" (Cushman and Whiting, 1972: 218).

In sociology, it is a given that society possesses properties which cannot be attributed to a single individual. One such social object is language. Durkheim (1953) takes the position that there are social facts that are in a sense independent of individuals and exterior to individual minds. These he labels collective representation.[6]

> . . . collective representations are exterior to individual minds, it means that they do not derive from them as such, but from association of minds, which is a very different thing. No doubt in the making of the whole each contributes his part, but private sentiments do not become social except by combination under the action of the sui generis forces developed in association. In such a combination with the mutual alterations involved, they become something else . . . . The resultant surpasses the individual as the whole part. It is in the whole as it is by the whole. In this sense it is exterior to the individual. No doubt each individual contains a part, but the whole is found in no one. In order to understand it as it is one must take the aggregate in its totality into consideration (1953:25-26).

Collective representations are formed during the communication process. In this sense, Durkheim shares Wittgenstein's position that meanings emerge out of the use of symbols, and G. H. Mead's (1934) notion that meaning arises out of the interactive process. However, Durkheim takes the position that once the collective representations, are formed they become a property of society. They are independent of the individual. For Mead, collective representations are possessed by a "generalized other." For

Durkheim, the representations are part of the "collective consciousness." As such, they are passed intergenerationaly and need not be derived through interaction for each individual as the generalized other.

Language like other social facts has very distinctive characteristics: ". . . it consists of ways of action, thinking (meaning), and feeling, external to the individual, and endowed with a power of coercion, . . ." (1938:3). Durkheim notes that (1938:10),

> . . . Currents of opinion, with an intensity vary according to the time and place, impel certain groups either to more marriages, for example, or to more suicides, or to a higher or lower birth-rate, etc. . . . Since each of these figures contain all the individual cases indiscriminately, the individual circumstances which may have had a share in the production of the phenomenon are neutralized and, consequently, do not contribute to its determination. The average, then expresses a certain state of the group mind.

Thus, it becomes possible to identify the collective representations or group meaning, by simply taking the average relationship between the symbols processed by all the users of a language.

Linguistics

In a sense the language of all individuals and the portion of that language that entails the semantic system is unique to that person. Since no two people use their language in exactly the same manner, there can be as many representations of the language as there are

human beings who use that language. Linguists have coined the term "idiolect" to describe the speech of a particular individual. By comparing the features of idiolects, linguists have come up with certain regularities for subgroups of a population which are not found in other subgroups. These groups linguists label dialects. These subgroups are usually determined by the clustering of individuals by geographical location or social class. In order to describe the collective representation of an entire language, one would have to determine the average idiolect for an entire culture.

In classical linguistic theory de Saussure (1959) distinguishes between la parole, the language of the individual and la langue, the cumulative, dynamic, consensually valid language that is used in communication. La langue must be described in terms of the cumulative la parole. He writes (1959:15), "Among all the individuals that are linked together by speech, some sort of average will be set up: all will reproduce--not exactly, of course, but approximately--the same signs united with the same concepts."

Commenting on the relationship between the language of the individual and one possessed by the collectivity, Edward Sapir (1921:148) writes,

> . . . there is something like an ideal linguistic entity dominating the speech habits of the members of each group, that the sense of almost unlimited freedom which each individual feels in the use of his language is held in leash by a tacitly directing

> norm. One individual plays on the norm in a way peculiar to himself, the next individual is nearer the dead average in that particular respect in which the first speaker most characteristically departs from it but in turn diverges from the average in a way peculiar to himself, and so on. What keeps the individual's variations from rising to dialectic importance is not merely the fact that they are in any event of small moment--there are well-marked dialectic variations that are of no greater magnitude than individual variations within a dialect--it is chiefly that they are silently "corrected" or canceled by the consensus of usage. If all the speakers of a given dialect were arranged in order in accordance with the degree of their conformity to average usage, there is little doubt that they would constitute a very finely intergrading series clustered about a well-defined center or norm.

In summary, this section of the paper has taken the position that the meaning of a lexical item lies in the collective consciousness of the society that uses the language. Meanings must be consensual in order for communication to occur. Language users are forced by society's norms to use the standard usage or meaning for any symbol. This standard meaning may be determined by taking the average representation held by the users of the language. Thus, combining the notions of the last two sections, the meaning of any set of lexical items at any one point in time for a given cultural system may be determined by the "average" dissimilarity matrix, where any entry S_{ij} is some measure of central tendency of the dissimilarity between objects i and j as seen by the members of a culture. Because of its mathematical

properties the chosen measure of central tendency should be the arithmetic mean estimate of a society's members.

The Dynamic Nature of Meaning

Communication has been defined as "a process of transmission of structure among the parts of a system which are identifiable in time and space" (Krippendorff, 1969:107).[7] As such, the communication scientist is obligated to study change in structure over time. Earlier in this paper, the point was made that the meaning of a set of objects at any one point in time may be taken to be the structure of the interrelationship among a set of symbols used in a particular context. From a communication perspective, the study of meaning would entail observing the changes in meaning structure over time as a function of the information made available to the social entity under investigation. If the structure of meaning processed by an individual is contingent upon the person's past experiences, then communication researchers are obligated to study the antecedent conditions that produced the relationship. This method has been the choice of the researchers of developmental processes such as language acquisition (Bloom, 1970) or status and occupational attainment (Woelfel and Haller, 1971). An alternative to this approach would be to investigate the change in meaning over a given interval of time and attempt to isolate the parameters which cause the structure

to be stable or volatile. The central concept in the construct process is a dimension of time and the change in the characteristics or properties of the structure between a series of time intervals. The notion of process as a communication concept and its implications for research has been discussed in great depth by Arundale (1971).

It was pointed out earlier that the association theorists have recognized this dimension of time. While they identified the approximate point in time when the cognitive structure changes, they have only indicated that an association was formed. How the interrelations between the various verbal stimuli were altered was not addressed.[8] Thus, from the position of this paper, the associational-behavioralist's notion of time may be considered incomplete.

Wittgenstein's (1922) notion that meanings exist only as states of affairs makes explicit the idea that meanings are dynamic and change as the structural relations among a constellation of objects are altered. States of affairs may be considered events; events which are contingent, happening to exist, but which may exist only given certain conditions at a prior point in time.

De Saussure (1959) posits two analytical branches of linguistics, synchronic and diachronic. They may be differentiated along two dimensions: one, internal-external, and two, static-historical study of language. Synchronic linguistics is internal and static,--it studies

language as an autonomous system, free from change and influence from external or historical factors. Synchronic linguistics studies the ". . . arrangement of linguistic elements for a given language state" (Hertzler, 1965:12).

Diachronic linguistics is concerned with the external aspects of a language. It deals with what is outside the language system, yet affects it, such as the relationship between historical events or a society's institutions and the language. While synchronic linguistics excludes the dimension of time, concentrating only on single states of affairs, diachronic linguistics is concerned with the evolutionary study of language. In de Saussure's own terms (1959:140),

> Diachronic linguistics is concerned with the "evolutionary phase," "the stream of language," with the divergences in time and the relations between successive terms that are substituted for each other within the system in time.

The synchronic aspects of semantics has already been discussed in great detail. The static internal relationship alone, however, cannot adequately describe the meaning of a given symbol. Besides the single symbol being embedded in a language, is the hierarchical arrangement that places language as part of a larger social system. Societies are dynamic. They change as a function of social upheavals such as war, natural disasters, and technological innovations. New needs place demands upon the institutions of society forcing them to be altered

in response to these demands. It is in this context that language is placed. Until the 1950's, the symbol "rock" was only related to the lexical items hard, building material, mineral, etc. Today, it has associations with music, drugs and loud noises.

Summarizing these notions Hertzler writes (1965: 142),

> We know, from many well-attested instances that, given time enough, every language in current use, even in the most remote and conservative communities, does succeed, by means of processes and devices, in accommodating itself sufficiently to the new elements of the environment, the new population elements, the new communal experiences, the new awarenesses, interests and needs especially in so far as these relate to technical and social achievement--so that it is able to serve its basic general and societal functions. At certain times and under certain circumstances, these changes are glacially slow and barely distinguishable, even to expert students of language; at other times and under other circumstances what has been referred to as a "linguistic revolution" is in progress, especially in certain aspects of the language.

To summarize, this section has presented the notion that meanings are part of a dynamic system--language. Meanings change as a function of new information being made available to the members of a social system. Communication has been defined as a process, and, as such, researchers in the field are obligated to take into account changes in the structure of relationships over time.

Summarizing the chapter so far, the structure of meaning (a state of affairs) of any set of lexical items at any one point in time may be determined, by the average dissimilarity matrix. Process may be recorded in successive matrices $\bar{S}_{t_0}$, $\bar{S}_{t_1}$,...$\bar{S}_{t_n}$, where the interval between time periods 0,1,2,...n, remain constant and the changes between the matrices calculated.[9] These intervals can be made as small as desired to increase the isomorphism with the continuous nature of process. The difference $S_{t_0}-S_{t_1}$ would represent the semantic change taking place over the interval from t_0 to t_1. The rate at which any definition is changing can be found by the derivative,

$$\frac{dx}{dt} = \underset{t_1-t_0}{\text{limit}} \rightarrow 0 \quad \frac{S_{t_1}-S_{t_0}}{t_1-t_0}$$

Empirical Fruitfulness

The notion of the empirical refers to a system of observation by which sensory data is transformed or mapped into a one-to-one correspondence to some score or scale value. By performing the operations which result in the scale value, it becomes possible to draw objective evidence allowing one to determine relationships between two or more variables. Once the relationship among a set of variables is specified through the measurement procedures, the researcher can test hypotheses about these relationships. Through the hypothesis testing

procedure, the researcher can then determine the truth-value of certain propositions. For example, if one states the proposition "the average dissimilarity held by a set of observers between red and white is 100 units," then, by performing a series of operations, it is determined that the average dissimilarity is a scale value of 90 units. With this information, the truth-value of the proposition can be rejected.

For Frege (1970) the truth value of a relationship is a necessary condition for sense or meaning. The theory of meaning is based on verification. If a proposition has no truth-value, then a statement becomes meaningless. Ayer (1946:5) describes the principle of verification as follows:

> The principle of verification is supposed to furnish a criterion by which it can be determined whether or not a sentence is meaningful. A simple way to formulate it would be to say that a sentence had literal meaning if and only if the proposition it expressed was either analytical or empirically verifiable.

Thus, any system of measurement of meaning must allow the researcher to determine whether a statement is true or false. This conceptualization was supported by Wittgenstein (1922), and the logical positivists. They asserted that there is an empirical reality from which one draws the data to test a proposition. While there are an almost infinite number of other ways to approach the notion of meaning, the author suggests only one. That

one is based on empirical measurement. The reasons are twofold. First, since meaning can be considered consensual, one must make a series of observations from a population in order to determine that consensus. But rather than this consensus being considered "real," it may be construed as the average observation of a group of observers. In this way, no call to a referrent is made. Rather, the relationship between the objects is analytical, coming from in some sense inside the observers heads. Where the observers obtain these conceptions is irrelevant. Verification, then, becomes based upon the agreement rather than reality. Since the relationship is derived from the observer's consciousness, it becomes possible to discuss abstract concepts that have no empirical referrent. Examples of these concepts are democracy, communism, God and good or bad. These terms could not be discussed or entered into relationships in a strict empirical position.

Second,is the notion of prediction. The empirical method does not end with the process of hypothesis testing. The scale value obtained through a measurement at one point in time allows the researcher to predict the value (specify the relationship) at a future point in time. The ultimate utility of any measurement system is its ability to predict the value or values of one or more variables from one or more variables at a previous point in time. The notion of predictability in some sense

parallels the concepts of replication and verification for science. If the actual relationship between the variables is changing, then it would be impossible to replicate the results of the study at a future point in time. Since there are social processes going on around us at all times, one might expect the relationships to be changing as a function of these processes. This is especially true of human phenomena. For example, in the 1940's, religious affiliation was an excellent predictor of political party identification (Lazarsfeld, Berelson and Gaudet, 1944). The reason was that a majority of a person's interpersonal communication about political topics took place within the context of the church. Today, religion is a poor predictor of political party preferences because the church no longer plays a central role in an individual's life. Thus, when one attempts to replicate or verify this relationship, one fails. This example dealt only with the relationship between two specific variables. Specific variables are those which are particular to an historical period or cultural entity. As such, their relations to other variables are expected to change as historical epochs end or cultures disintegrate. However, even the relationship taken from more general variables such as the relation between age and frequency of sexual intercourse may change over time as a function of population pressures, food supply and cultural norms. In some sense, one could get around the problem if it could be determined

the rate of change in the relationship among the variables.

Thus future scientists, rather than attempting to replicate findings, would attempt to predict some relationship. Verification becomes the process of prediction. After a series of predictions, it would become possible to determine the rate change in the relationship and make adjustments in the theory with considerations for the change.

The notion of operationalism is only partly related to the empirical. The operational method allows one to see a phenomenon when one performs a series of operations. It need not result in a value. The empirical method not only requires a series of operations to obtain a value or series of values, but requires that one look at the relationship among a group of variables, in order to determine the truth-value of some theoretical proposition which led one to investigate the relationship in the first place.

Thus, the ultimate criterion for a system of measurement of meaning would rest on its predictive power. Could one determine the relationships among a series of lexical symbols at a future point in time despite by taking into account intervening social events? This prediction is based upon the average score which resulted from a group of observers. It is not based on a "real" referrent, but rather, the collective or average consciousness of the observers.

The Measurement of Meaning

This section of the chapter asks the question, how has meaning been measured in the past? Since there is such a degree of confusion about what meaning is theoretically, one should adopt the position that the meaning of a lexical item is its measured relationship with other words that are used in the same context. This must be consensual--the average relationship among a series of language users. It must also be dynamic and capable of predicting change in the relationship over time.

Traditionally, there have been four major methods for the measurement of meaning of lexical items. They are free association, free recall, the semantic differential and multidimensional scaling.[10] This section of the thesis will review the brief history of each method, provide an example of each and finally, critique them on the criteria presented above. Finally, it will suggest that a modification of classical multidimensional scaling be adopted as a paradigm for the measurement of meaning.

Free Association

Free association, the technique of providing a subject with a verbal stimulus and recording his/her immediate response, was developed as a psychological measure by Carl Jung in 1904. Jung's work with association in absnormal individuals culminated with the publication of Studies in Word Association (1918). Kent and

Rosanoff (1910) obtained responses to a hundred common English words from over 1000 abnormal subject and modifications of their counts of response frequencies are still used as a normative base for contemporary studies of association. Historically, the majority of the work with free association has dealt with psychoanalytical or psychodynamic problems. They have only indifferently applied themselves to the description of intellectual structure.

Deese writes (1965:27),

> Armed with a number of ideas about the dynamic interpretation of dreams, associations, and the like, they have constructed pictures of personalities and the histories of personalities by linking together the bits and pieces they find in free expressive behavior. Free associations have been a favorite source of data because of the assumption that they, more nearly than any other intellectual product, escape the censoring of the ego. To the extent that dynamic theorists have been interested in intellectual content, they have concentrated on the deviat and unusual and in some instances, the symbolically interesting aspects of free association. Few dynamic and almost no psychoanalytical theorist wish to make anything of free associations of high frequency of occurrence. It is of little concern (save for such values as in normative information) that the most common response to man is woman or that the most common response to woman is man. These are obvious; they are given by nearly everyone. Therefore, they have not been regarded as providing much information about underlying dynamics.

This situation changed in the 1950's. Psychologists began to use free association to investigate the organization of the mind, and the psychology of language.

The assumption was that the meaning of any stimulus word could be described by the characteristics of the distribution of responses obtained from that symbol.

Jenkins and Cofer (1957) used free association to assess the overlap between response distributions to compound verbal stimuli as well as the elements of the compound. Rosen and Russell (1957) demonstrated that response hierarchies obtained from an individual giving successive associations to the same word was similar to the hierarchy obtained from single responses to the same word given by a group. This early work with free association is summarized in Marshall and Cofer (1963) and Creelman (1966). Important contributions were also made by Noble (1952), Bousfield, Whitmarsh and Berkowitz (1958), Jenkins, Mind and Russell (1958), Deese (1959), Marshall and Cofer (1963), Rothkopf and Coke (1961a,b). These articles all report attempts at converting the data gathered from associations to some sort of descriptive summary measures of similarity or word relatedness. The measures were all based on associative frequency and associative overlap among the stimuli. One conclusion which these studies agree upon was that words which are more similar tend to elicit each other. Their reasoning was that if the associative meaning of any stimulus is given by the distribution of the responses to that stimulus, then two stimuli may be said to have the same meaning when the distribution of associates is identical.

Two stimuli overlap or resemble one another in associative meaning to the extent they have the same distribution of associates. Or, in other words, the most common semantic relationship used in free association is synonymy. This notion of synonymy led Bousfield, Cohen and Whitmarch (1958) to the concept of implicit associated responses--a word elicits itself as an implicit response 100 percent of the time.

Deese (1962) performed a free association study used 19 words about nature as stimuli.[11] A matrix of associative overlap was constructed from the number of times a stimulus elicited one another or a response outside the set but common to both. The percentage of common responses was placed in each cell. On the diagonal was placed the number of subjects under the assumption of the implicit associated response, thus 100 percent. The matrix was then converted to overlap coefficients, rather than correlations, by taking the ratio of the sum of the overlapping response frequencies to any pair of stimuli to the maximum possible sum. The reason why correlation was rejected as a measure of association were because subjects get only one response and correlation would yield a measure of distribution rather than the extent to which frequencies are in common. Also the distributions are too steep to differentiate the words.

This new matrix was then factor analyzed to reveal six factors. When orthogonally rotated, the

resultant structure found the animate creatures on the first factor (moth, insect, wing, bird, fly, bug, cocoon, bees and butterfly). The second factor was composed of the words which did not have anything to do with the concepts on factor one (yellow, flower, color, blue, summer, sunshine, garden, sky, nature and spring). Factor three was made up of the concepts which loaded on the first dimension, but it split up bug, cocoon, butterfly and moth from the rest of the concepts. Factor four performed the same operation upon the second dimension, separating the color terms from the seasons. One important thing to notice was that due to the structure of the data input into the factor analysis, the loadings were either highly positive or negative or zero. The factors did not vary in magnitude. Thus, free association can provide an indication of semantic structure. Concepts which are more similar tend to load on the same factors due to their degree of associative overlap. However, this is a poor measure of structure at best.

One of the problems with free association as a measure of meaning is a result of the method's structure. The reliability of a response is inversely related to the degree of structure in the instrument. Free association is highly unstructured. As a result, the responses to a given stimulus are very unreliable. Unreliability may be somewhat ameliorated by increasing the number of subjects or the frequency of individual responses to a given

stimulus. The use of large numbers of subjects is very costly and time consuming. Additionally, the respondents free associations are very situation specific. The demand characteristics of the setting often determine the specific response. The instrument was developed in this manner so that psychodynamic researchers could investigate the volatile nature of personality states.

The later approach of having a subject respond a number of times to a given stimulus is also unacceptable because it leads to chaining (Deese, 1965; Rommetveit, 1968). Chaining occurs when the response at one time mediates the next response to the stimulus. Thus, it becomes impossible to determine the domain of associations an individual stimulus word possesses and its relationship to a given set of lexical items. An example of chaining would be when the stimulus word "lake" leads to "cabin" which mediates the future response "hiking," "hunting" and so on. Had the first response been "water" then the next could have been "drink," "swim," "bathe," and so on. Chaining has led a number of investigators to network models of language (Anderson and Bower, 1973; Collins and Quillen, 1972).

In terms of the criteria established in the first part of the thesis, free association is unacceptable as a measure of meaning. It does not describe the degree of association between a given set of concepts at any one time. Rather, it only indicates that an association

exists. Also, the basis of the associative relation may also be one of a number of types rather than similarity (Deese, 1965). Other semantic relations may be incompatibility (the set of colors), antonymy (big-small), hyponymy (tulip-flower), converse (buy-sell), or consequence (fire-smoke) Kintsch, 1972). However, as in the case of the principle of contrast, these associations may also be considered as special cases of similarity. They are similar on the dimension specified by Kintsch. As Deese (1962) pointed out, the structure of data gathered from association are too steep to determine magnitude of association. Thus, only clusters or groupings of symbols are revealed.

Inherent in this method is the idea that the associations are idiosyncratic for an individual. It is not designed to be a measure of consensual meaning. Additionally, since the structure of the results are very unstable, it would be next to impossible to separate true change from random fluxuations (unreliability) in the data. Thus the method is incapable of measuring change in meaning over time. Finally, since it is unable to measure change over time, it cannot be used as a predictive measure.

Free Recall

Free recall as an experimental method of studying memory is a decendent of the method of retained members. The method was first used by several investigators

prior to 1900. It involved either simultaneous or successive presentation to subjects a series of items (objects, pictures, words, syllables, geometric figures, letters or digits) either once or more and the recall by the subjects of as many of the responses corresponding to the presentated items as possible, usually immediately after the completion of the presentation. The order in which the subject recalled the items was not specified by the experimenter. It was quite a popular method. These early studies were conducted with recall of individual items as a function of variables such as the characteristics of individual items, amount of material presented, sensory modality of presentation, serial position, length of retention interval, nature of activities between presentation and recall and the demographic characteristics of the subjects. The popularity of the method was short lived because Ebbinghaus (1902) felt that it had only limited utility and that his measures of retention were more sensitive. This early history is reviewed in great depth by Tulving (1968).

The method regained its respectability as a measure of associative strength in the 1940's with the work of Postman, Egan and Davis (1948). Free recall, as the method was now labelled, was regarded as being sensitive to intermediate degrees of association. Also, its use became restricted to verbal learning research (Postman, Adams and Phillips, 1955; Bush and Mosteller, 1955;

Miller and McGill, 1952; Waugh and Smith, 1962) and the organization of verbal symbols in the mind as a function of past experiences (Bousfield, 1953; Bousfield and Cohen, 1953; Jenkins and Russell, 1952; Bousfield, et al., 1964).

The method of free recall operates as follows. A list of words (usually 40) is presented to a subject in serial order and the subject is told to recall the items in the order he/she thinks of them. The stimulus may be a list of random words (Tulving, 1962), groups of related words in random order (Cofer, 1959; Lambert, Ingnatow and Krauthamer, 1968), or related words blocked, some nonrandom order in which the stimuli are grouped for research purposes (Cofer, 1967; Puff, 1966). The list is presented either once (Bousfield and Cohen, 1953) or a number of times (Underwood, 1964; Tulving, 1964; Bousfield, 1964). The multitrial design is better for measuring the associative processes (Tulving, 1968). The two major dependent variables in this research have been the number of words recalled and the organization of recall. Tulving (1962) has shown that the measure of subjective organization is positively correlated with the number of words recalled. By subjective organization, Tulving means clustering.

One of the most interesting findings of this research is that the order of presentation is not a good predictor of the recall order. There is a tendency for

items which are related to one another to be recalled together even though the words were not contiguous during presentation. In single trial recall there is a tendency for subjects to recall late input items first, regardless of meaning (Bousfield, 1953). Also, there is a tendency for clustering to be the greatest in the middle output period. In attempting to explain this phenomenon, Shuell has written (1969:353),

> This discrepency between the order in which the items were presented and the order in which they were recalled is presumed to represent a tendency on the part of the subject to organize his recall on the basis of various second-order habits, that is, preexperimental associations or conceptual relationship. This tendency for related items to be recalled together has been termed clustering.

Clustering or subjective organization has been taken to indicate the notion of categorical arrangement of meaning. Each item within a given subset or cluster is assumed to be more similar in meaning to other words within the cluster than it is to any other item in other subsets. The measures of clustering in recall are reviewed in Tulving (1968). They are derived from the assumption that if the items in the total list are presented in random order, organization or clustering occurs when the items from a subset are recalled in immediately adjacent output positions more frequently than one would expect by chance. Thus structure in free recall is measured in terms of a series of probability statements.

Clustering has been shown to be a function of the number of repetitions of the material (Bousfield, Puff and Cowan, 1964; Tulving, 1962), strength of associative relations among words (Jenkins and Russell, 1952), number of categories presented in the material (G. A. Miller, 1956; Mandler, 1967), and the developmental level of the subjects (Jablonski, 1974). Reviews of the research using free recall as an indicator of the structure of associative meaning have been presented by Cofer (1965), Tulving (1968) and Shuell (1969). They conclude that the words cluster due to their similarity in meaning. However, rather than discussing these conclusions in light of an association theory, they have used the results to justify a notion of organization by categories, or what Tulving (1968) calls the principle of superordination. It should be noted that clustering will occur in the free recall if either method of organization (similarity or superordination) is used. Thus Cofer (1965:271) concludes ". . . such a contrast is neither useful or heuristic. In free recall, our evidence suggests subjects will find ways to organize recall even though the experimenter has not provided means in the list he presents." Since the method of organization used by the subject cannot be differentiated, this author feels that the notion of superordination be dropped and that only the principle of similarity be used. It is mathematically more powerful and provides a more holistic view of the structure of meaning.

Free recall provides a marked improvement over free association as a measure of meaning. This is due in part to its ability to sense intermediate degrees of structure rather than the nominal identification of association. In addition, because it prespecifies the domain of concepts to be recalled, it is much more structured and therefore a more reliable measure. However, it is still inadequate as a measure of the structure of meaning. The reason is that the measure is ordinal and therefore unable to provide an accurate configuration of association and the change in structure over time. As a result of these two problems, the method is not empirically fruitful because it cannot provide accurate predictions.

The results from a free recall trial produces a vector with each stimulus ranked according to its order of recall. Consensus is not a problem because given enough cases, the average order of recall can be determined. Clusters are next determined based upon these rank orders and a summary probability statement determined to describe the departure from randomness or the associative structure present in the list. Also order of presentation confounds recall order and therefore structure. Although controllable, it requires considerable expense to do so. Thus, while one can determine if associative structure exists and even the degree to which structure occurs, it cannot measure the strength

of the relationship between individual pairs of concepts. One only knows their frequency of occurrence in pairs not the degree of similarity between the items. One can only say that symbol "X" occurs more frequently with "Y" than it does with "Z." From this similarity must be inferred.

Because the items are only ordinally scaled, change as a function of time cannot be determined. Suppose recall trials are performed at two points in time with an intervening message designed to alter the relations among the stimuli words. Recall measures can only determine if a change in structure did occur. Concept "X" no longer clusters with "Y," but now with "Z." The degree to which the meaning changed cannot be calculated. Also, the measure is too insensitive to change within a cluster. It is conceivable that a change might go undetected if a cluster were strongly associated at the first trial. It is doubtful that concepts will disintegrate past associations due to some manipulation. However, this is not to say that some change in the strength of the association was not altered. The ordinal measure is incapable of determining this change. Due to this lack of sensitivity to change, free recall cannot be used as an accurate predictive measure. Thus, it is not empirically fruitful.

The Semantic Differential

Developed by Charles Osgood and his associates

explicitly as a measure of meaning in the 1950's, the semantic differential scale has obtained wide acceptance as a measurement technique in the fields of psychology and communication. The development and the early history of the method is reviewed by Osgood, et al., (1957). It was developed in conjunction with Osgood's mediational theory of meaning. Thus, it was intended to measure the strength of associations or the degree of similarity or difference between individual words at one point in time. These relationships were considered contingent on an individual's past experience.

They postulated that meaning can be described in terms of a semantic space of unknown dimensionality and Euclidean in nature. Each semantic scale, defined by a pair of polar adjectives, was assumed to represent a linear function that passes through the origin of this space, and a sample of such scales comprised a multidimensional space. The more bipolar scales that are used, the better the definition of the space. However, to describe this space with maximum efficiency, one needs to determine the minimum number of orthogonal dimensions which describes the space. "Difference in the meaning of two concepts is then merely a function of the differences in their respective allocations within the same space, i.e., it is a function of the multidimensional distance between two points" (1957:26). The individual concept's locus in the space has two properties--direction from the origin, and

distance from the origin. These may be identified as the quality and intensity of meaning. Another way to describe these two properties is, "direction in the space being equated to what mediators are evoked and distance from the origin being equated to how intensely these are evoked" (1957:29-30).

The method operates in the following manner. On a paper and pencil instrument, a series of bipolar adjectives are presented along with single word. The distance between the ends of each scale is broken into seven supposedly equal intervals. The subjects then rate a series of words on these set of scales. A typical semantic differential scale looks like this:

Father

Happy	___:___:___:___:___:___:___	Sad
Hard	___:___:___:___:___:___:___	Soft
Slow	___:___:___:___:___:___:___	Fast

Once the data is gathered, it generates a three-dimentional matrix of subject x scales x concepts. Subjects are summed, generating a single, square matrix of the scales for each concept. This matrix is then intercorrelated and factor analyzed revealing the dimensions of the semantic space. The three most prominent dimensions which have been found are evaluation, potency and activity. Osgood (1974) reports research into the semantic structure of some 27 different language-cultural communities. The

results produced loadings in the .8 to .9 range on the evaluative dimension, loadings from .4 to .7 for the potency factor and for the activity dimension, .3 to .7. From these results, he concludes, "This is rather convincing evidence for the universality of the affective meaning system" (33-34). He concludes that evaluation, potency and activity are universal dimensions used by all people to define the connative meaning of a word.

Just as Osgood's mediational theory was a significant improvement over behavioral associationism, so is the semantic differential scale an advancement over free recall and free association. The method is very reliable, and does not have the intervening variable of being attached to a serial learning task. Additionally, it was designed to measure meaning rather than learning or psychological states. This is accomplished in terms of a multidimensional space, which allows the various attributes which determine meaning to be revealed. Finally, the differences in meaning among words can be described in terms of their similarity or distance from one another.

However, there are a number of serious problems which render Osgood's semantic differential as less than ideal as a measure of meaning. At the scale's very foundation rests the assumption that the semantic space can be generated from a series of bipolar adjectives. Osgood asks that we intuitively accept these adjectives as being opposite in meaning. Wishner (1960:110) reports,

however, that results, "indicate that grammatical antonyms do not necessarily correspond to psychological opposites."

Danes and Woelfel (1975) present evidence that the bipolar descriptors used in the semantic differential are in fact not bipolar. Using metric multidimensional scaling, they determined that "good" was 45.39 units from the origin and "bad" 57.14; "favorable," 66.32 and "unfavorable," 51.98; "positive," 51.73, and "negative," 57.68. The differences in separation from the origin are substantial. Thus, rather than the concepts being polars, they are, in fact, far from it. The angles between these terms were next determined. If the concepts were truly opposites, the angle between them would be 180° and the cosine -1.0. The obtained cosine for good-bad = -.98 and its corresponding degrees = 168°; the obtained cosine for positive-negative = -.74 and its corresponding degrees = 152°; and the cosine obtained for favorable-unfavorable = -.88 and its corresponding angle = 138°. Thus, the assumptions upon which the semantic differential are tenuous. Similar findings are reported by Anderson (1970).

Another consequence of the use of the bipolar opposites to generate the dimensions is bounded semantic space. The subjects are forced to respond with a very limited range, +3 to -3. This has the effect of limiting the variance between responses. Thus, it appears as if the language is more homogeneous than might be otherwise. Because the space is bounded, it limits the instrument's

use as a dynamic measure. If the members of a culture evaluate a particular object very strong (+ or -3) at one point in time and later the symbol becomes increasingly positive or negative, the semantic differential will be incapable of showing that change. This is called the floor and ceiling effect. Because the range is so small, only seven points, this shortcoming becomes a major problem.

The semantic differential is only an ordinal scale. As with the free recall procedures this greatly limits its utility as an indicator of change. One can only say that symbol "X" became more or less on any of the three dimensions without any indication of how much more or less. It then becomes impossible to discuss the rate at which a concept is changing.

As is the case of all factor analytical solutions, the dimensions which emerge are a function of the variables which are input into the analysis. This problem is compounded because the semantic differential is generated with a series of scales bounded with grammatically bipolar opposite adjectives. Subjects are forced to describe the objects on the scales provided which may or may not be the dimensions and individual used to evaluate the symbol. Because Osgood (1974) always uses the same (or functionally translated equivalents) set of adjectives, it is no wonder that the same set of dimensions always emerge with varying degrees of explained variance.

It would cause some concern if this did not occur.

The instrument has the further property of being a discontinuous space. It goes from -3 to +3 with some mysterious properties occurring at the zero point. Osgood describes the origin, the point where all three dimensions are zero, as follows: "Like all self-respecting spaces, this one has a central origin--a locus of complete meaningless analogous to the neutral grey center of the color space" (1974:22). It seems that a concept at this point has connotative meaning but not on the three dimensions Osgood suggests. Other dimensions may be used by the subject to discriminate the object.

Finally, the semantic differential breaks down the total meaning into a large number of separate qualitative aspects, rather than integrating the dimensions into a holistic description. The reason for this is because with this method the stimuli are presented to the subjects one at a time. This leads to the stimuli being evaluated in isolation without benefit of the other objects which are to be scaled. Thus, rather than describing the interrelations among a set of lexical items, the semantic differential only locates the symbol along a series of bounded scales, which when factor analyzed can be described on three orthogonal dimensions.

In summary, despite the apparent generality of Osgood's affective semantic space as a theoretical and methodological device, there are serious shortcomings

which render it less than optimal for the study of meaning. First, it does not directly measure the relations among a set of lexical items. Second, the scale upon which the words are rated are not bipolar and only ordinal. These problems make it an inaccurate measure of change. Because it cannot accurately measure change, it becomes not empirically fruitful due to its inability to make accurate predictions.

Multidimensional Scaling (M.D.S.)

The logic behind M.D.S. has been described by Helm, Messick and Tucker (1959:14):

> . . . the fundamental concept in multidimensional scaling is psychological distance, which is usually estimated in terms of judgments of similarity among stimuli; i.e., two stimuli judged to be very similar are considered to be psychologically closer together than two stimuli judged to be very different. Given judgments of similarity among all the stimuli in a set, mathematical models exist which provide an interpretation of this psychological distance in terms of Euclidean geometry. The stimuli are treated as points in a Euclidean space, and analytical techniques are available to obtain the dimensionality of the space as well as stimulus scale values determined within a rotation and translation.

Multidimensional scaling models can be used in situations where the stimuli may vary simultaneously with respect to several underlying dimensions or attribute as in the case of the meaning of lexical items.[12] Some attributes are unidimensional, among them, weight and width. Spatial position on the surface of the earth

is also measured with three dimensions; altitude, longitude and latitude. Knowledge of the position of an object along any one or two dimensions will not locate it precisely in the space. All three dimensions must be known. Likewise, color is said to possess several underlying qualities. The color green can vary simultaneously according to hue, chroma and any other of several different qualities.

According to Torgerson (1958:248):

> . . . the notion of a single unidimensional, underlying continuum is replaced by the notion of an underlying multidimensional space. Instead of considering the stimuli to be represented by points along a single dimension, the stimuli are represented by points in a space of several dimensions. Instead of assigning a single number (scale value) to represent the position of the point along the dimension, as many numbers are assigned to each stimulus as there are independent dimensions in the relevant multidimensional space. Each number corresponds to the projections (scale value) of the points on one of the axes (dimensions) of the space.

The process is analogous to converting a matrix of city to city mileages to a graphic representation such as the map itself. In this special case, an n x n matrix of cities would be reduced to a 2-dimensional configuration.

While the similarity structure among a set of lexical symbols can be accurately described by a dissimilarity matrix, it is extremely cumbersome due to its size. The matrix is order n, where n equals the numbers of concepts described. N-1 is the maximum total number of

dimensions used by the sum of the individuals of a society to differentiate the objects, not the ones shared by the members of social system.[13] This matrix may be reduced to usable proportions and the uniquely shared underlying cultural dimensions identified.[14] This task can be performed by multidimensional scaling.

The development of M.D.S. has been described in great depth by Serota (1974:44-51). M.D.S. as a psychological measurement technique can be attributed primarily to the work of Torgerson (1951, 1958). Serota points out, (1974:24) "It also draws heavily on the theoretical construction of Gulliksen (1946) and Thurstone (1927), and the mathematic contributions of Hotelling (1933), Young and Householder (1939), and Garnett (1919)." Since Torgerson, there has been one major adjustment in the technique. That was the development of non-metric M.D.S. by Shepard (1962) and Kruskal (1964).

The mathematics of the procedure by which an underlying vector space (the number of independent dimensions and the concepts scaled values on these dimensions) is as follows. A dissimilarity matrix is gathered from a group of people, yielding a three dimensional concepts x concepts x subjects matrix. There are a number of ways to generate this matrix and they will be discussed later. This matrix is averaged across the $\underline{n}$ persons into a two dimensional concepts x concepts square symmetric matrix $\overline{S}$ where any entry s_{ij} represents the average distance

between concepts $\underline{i}$ and $\underline{j}$ as seen by the observers. This matrix $\bar{S}$ is transformed into a scalar products matrix B (Young and Householder, 1939), by premultiplying it by its transpose. However, it is generally the practice to "double-center" this matrix by establishing an origin for the space at the centroid of the distribution. This can be done simply during the construction of the scalar products matrix, and the transformation for any cell b_{ij} is given by the equation

$$b_{ij} = 1/2 \left(\frac{\sum_{i=1}^{n} d^2_{ij}}{n} + \frac{\sum_{j=1}^{n} d^2_{ij}}{n} - \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} d^2_{ij} - d^2_{ij}}{n^2} \right)$$

which is a straight-forward linear transformation that sacrifices none of the information present in the original matrix D (Torgerson, 1958).

This new centroid scalar products matrix is such that any entry:

$$b_{ij} = p_i p_j \cos\alpha_{ij} \text{ where}$$

p_i = the length of vector $\underline{i}$

p_j = the length of vector $\underline{j}$

α_{ij} = the angle between $\underline{i}$ and $\underline{j}$.

Consequently, when matrix B is reduced to its base by routine factorization (i.e., the application of any standard eigen routine, such as principal axis or Jacobi), the result is a factor matrix F, whose columns F_1, F_2, ... F_k are orthogonal vectors with their origin at the centroid of the vector space spanned by F and where any entry F_{ij} represents the projection (loading) of the ith

variable on the jth factor. This resultant matrix provides an accurate description of the structure possessed by a set of concepts at any one point in time. However, as mentioned above, there are a number of methods that one can use to generate the original dissimilarity matrix. The particular method chosen affects the ability of the technique to measure change in structure over time and the quality of the structural description.

Nonmetric.--There have been a number of ways to generate the basic dissimilarity matrix. Among them are sorting, triad combinations, and direct pair comparison, either bounded or unbounded. G. A. Miller (1969) had subjects sort 48 English nouns which are printed on 3 x 5 index cards. The subjects were instructed to sort the cards "on the basis of similarity of meaning." The subject was allowed to put them into piles which Miller took to represent associative clusters. This data was converted into an incidence matrix. The matrix was 48 x 48, and cell i, j represented the particular pair of nouns i and j. Cell i,j was assigned a one if that pair of nouns was put into the same cluster and a zero if they were in separate groups. The matrices, one for each judge, were added together and the resulting matrix was taken as the basis for further analysis. This matrix was symmetrical and could be regarded as a measure of similarity or proximity, where N_{ij} is a measure of the semantic proximity of noun i to noun j. It can be

converted into a distance matrix by using the formula

Dij = N-Nij.

While this method is quite reliable (Mandler and Pearlstone, 1966), it provides an inaccurate description of the data's structure. The reason is that the distance matrix is taken from the co-occurance of a particular pair within a given cluster. The estimate of the dissimilarity of two concepts from different clusters becomes inaccurate because the concepts are treated as if members of separate and discontinuous categories rather than within a single continuous domain. The actual distance between the terms is never determined. In addition, the matrix produces a bounded space with the distance between the terms limited to the number of subjects. Thus, the problems which limit the semantic differential's use as a measure of meaning also apply to M.D.S. with data generated from sorting procedures.

The method of triad combinations has been used by Henley (1969) and Szalay and Bryson (1974) to investigate the meaning of individual lexical items. Triad combinations operates in the following manner. Subjects are presented three words and asked to judge which two are most similar and which two are most different. Matrices of interstimulus similarities are obtained for each individual and converted to dissimilarities by subtracting from a constant. Henley (1969:180) reports reliability coefficients for the individual of .85 using triad

combinations. Also, results from this method correlate highly with other methods of data collection. This method is an improvement over sorting because it allows the respondent to directly compare the stimuli on similarity. However, it only allows the respondent to say that one concept is more similar than another, rather than how much more similar. The result is an ordinal scale with its inherent limitations. This method also results in a bounded space which restricts the dissimilarity among concepts and makes the method incapable of measuring change over time.

Henley (1969) also had her subjects rate pairs of stimulus words in the following manner. Subjects were presented all possible pairs of words, one pair at a time and were asked to make a judgment of the amount of dissimilarity between the two, on a scale from 0 (no difference) to 10 (maximal difference). A week later she had her subjects made the judgments again, this time with the pairs in opposite (within pair) order from the first session. The reliability coefficients for 21 subjects ranged from .29 to .85, with a median of .71. The reliability estimates obtained for the mean dissimilarity matrix was .97, "indicating both that order of presentation of stimuli does not affect reliability, and that Ss showing low reliability in their ratings do not cause low reliability in the overall matrix" (1969:178). The correlation of data obtained with this method and triad combinations was .90, indicating high agreement between the scaling methods.

While this method is an improvement over sorting because it has the subject make direct pair comparisons and the method of triads because it allows for variable similarity between the pairs of concepts, it suffers the drawback of forcing subjects to respond with a restricted range of 11 points. Thus, it cannot be used to measure change over time and may in fact provide a distorted picture of the structure at one point in time. If a subject rates one pair early in the task as a 10 and later comes to a pair that is even more dissimilar, he/she has no alternative but to settle for a rating value of 10 again.

In response to this problem, psychometricians Shepard (1962) and Kruskal (1964), have developed what has come to be known as nonmetric multidimensional scaling. These procedures take the Euclidean space resulting from the classical M.D.S. approach of Togerson (1958) and perform monotonic transformations based upon the rank order of the stimuli on a subset of the n-1 dimensions. If the resultant space is non-metric, the concepts loci are ". . . simply moves the points in such a way as to stretch those distances that are too small and compress those distances that are too large" (Shepard, 1962:128). The result is that the final space is ordinal and cannot be transformed back into the original dissimilarity matrix. This transformation, while providing perhaps a better description of the structure of the data at one point in

time, renders the method as useless as a dynamic measure. The reason is that the matrix has been destroyed for the description of the structure.

This form of M.D.S. has been used in the past to investigate the dimensions underlying the meaning of lexical items (Cliff, Pennell and Young, 1966; Henley, 1969; G. A. Miller, 1969; Fillenbaum and Rapoport, 1971), the perception of speech sounds (Miller and Nicely, 1955; Degerman, 1972), and the processing of information (Schroder, Driver and Streufert, 1967; Rips, Shoben and Smith, 1973; Rumelhart and Abrahamson, 1973; Szalay and Bryson, 1974).

Metric.--An alternative method of data collection exists which facilitates the study of dynamic processes. It can be called unbounded direct-pair comparisons. By using this method of a procedure, it is possible to compare metric M.D.S. structures across time intervals. It operates in the following manner. Subjects are presented a criterion pair which serves as a comparative standard along with the concepts to be scaled. The distance between the criterion pair is specified and the subjects are told to compare the dissimilarity between two concepts in relation to this standard. This can be accomplished by a question worded in the form: "If x and y are u units apart, how far apart are a and b?"

Such an item wording requests a dissimilarities judgment from a respondent (". . . how far apart are a and b?"). An example of this procedure would be, "If RED and WHITE are 100 units apart, how far apart are:

Applies and Oranges _____
Apples and Lemons _____
Oranges and Lemons _____
. .
. .

This is done until the entire n(n-1)/2 pairs have been estimated. The lower triangle of a n x n data matrix is filled.

In making the decision as to which pair of concepts to choose as the comparative standard, one should follow Woelfel's advise (1974:12),

> First, the standard should be relatively stable. Changes in the standard over time can confound time series measurements and prevent meaningful comparisons of measurements made at different times. Secondly, the standard should be the same for all observers regardless of reference points, i.e., two independent observers must both agree on the length, for example, of a meter of a kilometer. Less important, but nonetheless worthy of consideration, good practice for minimum error suggests using a standard approximately midway between the largest and smallest measurement likely to be encountered (measurement of astronomical distances in miles, for example, is cumbersome, as would be measure of terrestrial distances in fractions of light-years). These criteria, however, are never achieved in any science. No distance, for example, is truly invariant, no clock emits signals so that ". . . the duration between any two signals is (exactly) the same. . ." Thirdly, at least within the framework of relativistic physics, viewers in referent systems moving at differential velocities with regard to one another will not agree

> on distances or durations of time when viewing the same events. Whatever consequences failures to meet these criteria exactly may be for philosophy, they are not insuperable barriers to science.

Criterion distances which have been used are Red and White are 10 units apart (Barnett, 1972, 1974; Woelfel and Barnett, 1974; Barnett and Wigand, 1975) Dwight D. Eisenhower and John F. Kennedy are 50 units apart (Barnett, et al., 1974) and Dwight D. Eisenhower and John F. Kennedy are 10 units apart (Taylor, Barnett and Serota, 1975).

According to Woelfel (1974:13) this technique has several key advantages:

> First and foremost, no restrictions are placed upon the respondent, who may report any positive real value whatever for any pair. Thus the scale is unbounded at the high end and continuous across its entire range. Secondly, because the unit of measure is always the same (i.e., the unit is provided by the investigator in the conditional, "If x and y are u units apart," and thus every scale unit is $1/u$ units), and because the condition of zero distance represents identity between concepts and is hence a true zero, not at all arbitrary, this scale is what social scientists usually call a ratio scale, which allows the full range of standard arithmetic operations. Third, since the unit of measure is provided by the experimenter it is possible to maintain the same unit of measure from one measurement to another, both across samples and across time periods, which is crucially important since time is one of the primitive variables of scientific theory. These three characteristics taken together provide the capacity for comparative and time-series analyses at very high levels of precision.

While the technique suggested meets the scaling criterion, quite exactly, and in fact will be the technique

of choice in the measurement of aggregate cultural patterns, problems of unreliability may make it unsuitable for the measurement of individual's meaning. Since reliability of any scale is approximately proportional to the complexity of the judgmental task required of the respondent, and the technique of direct paired distance estimates requires a highly complex set of judgments from the respondent while providing virtually no structure, it is consequently unreliable for the individual (typical test-retest reliability correlations range in the .70's for individuals). Barnett (1972) and Gillham (1972) have shown that the format is extremely reliable on large samples and that consistency of measure increases as a function of sample size. The reason for this is that the error which occurs in measurement is random error rather than systematic bias producing invalidity. Such random error will be normally distributed in a series of measure. The law of large numbers and the central-limit theorem assure that the scores obtained will be normally distributed and that the sample mean will converge on the population mean as the sample size increases. Barnett (1972) reports test-retest reliability coefficients in the range of .90 with 75 cases. Thus, reliable measurement becomes only a function of the cost of gathering additional cases. Once the dissimilarity matrix is generated, the matrix is reduced according to the procedures presented earlier and outlined in Torgerson (1958). The reduced spatial manifold

or multidimensional space provides an undistorted picture of the structure at one point in time. Process can be recorded in the following manner. A series of spatial manifolds are generated at separate points in time. They can then be rotated to a least-square best fit congruence in order to calculate the change over time. Recent research indicates that a solution exact to within theoretical assumptions, by rotation to stable criterion exists (Woelfel, Saltiel, McPhee, Danes, Cody, Barnett, A. D. and Serota, 1975). This has the advantage over a simple least-square solution of increasing the stability of the vector space despite the extreme movement of a single concept. This technique is analogous to the heliocentric theory of motion of celestial bodies and its notion of measurement. In this system fixed reference points are established, against which all change is measured. It would operate by rotating the concepts whose meaning is theoretically assumed to be stable to a least-square best fit and then by simply subtracting the coordinate values for the non-stable concepts to determine their change over time.

This change may be expressed as velocities as given by:

$$v_i = \frac{d_i}{t} = \frac{\sum_{j=1}^{m} (a_{ij} - b_{ij})^2}{t_1 - t_0}$$

where,

v_i = the velocity of concept $\underline{i}$

d_i = the distance concept $\underline{i}$ has moved across the interval of time $\underline{t}$

t = time

a_j = the coordinate value of concept $\underline{i}$ on the $\underline{j}$th factor of the t_0 space

b_j = the coordinate value of concept $\underline{i}$ on the $\underline{j}$th factor of the t_1 space.

Given multiple time periods, the accelerations of the objects in space may also be calculated:

$$A_i = \frac{\Delta V_i}{\Delta t}$$

Or, for instantaneous accelerations,

$$A = \frac{dv}{dt}$$

These velocities and accelerations, necessary components of process (Arundale, 1971, 1973) are unmistakably measures of cultural change of very high precision. This is so since the culturally shared definition of any object is given by its location in the multidimensional space, and changes in the terms locus represent changes in its definition.[15]

The study of process was made possible with metric scaling because the data is ratio level and was not altered in a nonfunctional manner anywhere in its analysis.

Metric scaling provides the investigator of meaning a system of measurement which meets all four criteria presented in the first section of this paper. One,

a matrix of the interrelations among a set of lexical items is described, using the dissimilarity among the words as the basis. This relationship is not inferred from the terms association to some separate criterion. The degree of association amongst the items is ratio level and there is no loss of information by forcing the estimates into some prespecified system. Two, the consensual nature of meaning is taken into account at two points in the analysis. First, an average dissimilarity matrix is created. Second, the matrix is reduced through M.D.S. to those dimensions that are shared by the population of language users. Third, because the data generated are not bounded or ordinal, the dynamic nature of meaning may be taken into account. Finally, and perhaps most importantly, this system has demonstrated its use as a predictive tool. Taylor et al. (1975) used this system of measurement to predict change in political attitudes during an election campaign with extreme accuracy. Marlier (1974) found this method very accurate for a test of social judgment theory.

Summary

In summary, this chapter has proposed that a fundamental system of the measurement meet the following four requirements. This system must take into account the degree of relationship among a set of lexical items. It must be consensual and dynamic, and finally, be

empirical fruitful. Next, four general systems for measuring meaning were described and critiqued. Free association, free recall, the semantic differential and nonmetric multidimensional scaling were rejected for failure on one or more criteria. Finally, a modified version of classical multidimensional scaling was suggested because of is acceptability on all four criteria.

FOOTNOTES FOR CHAPTER TWO

[1]The enormous and varied literature on theories of meaning has been surveyed in great detail by Haney (1970). The author does not intend to review the entire literature, but to attempt to reconcile some of the conflict in the area for the science of communication.

[2]This controversy manifested itself in an exchange of articles by Hurbert Blumer and Robert F. Bales in the American Journal of Sociology, March, 1966. For an example of research using the individualistic perspective see Goffman (1959) and for an example of the social see Haller and Woelfel with Fink (1968).

[3]While this position is quite acceptable to philosophers interested in metaphysical problems and ones who deny the notion of a shared or perceived reality, it is unacceptable to scientists who consider agreement of this reality as an epistimological requirement.

[4]This is an obvious oversimplification. The author acknowledges that other theoretical perspectives have been evoked by American psychology. The example is intended to show one example of psychological research in the area of language with the potential of significant findings for the notion of meaning which ignore the organization of lexical items used in the research.

[5]For Frege this proposition must be in the form of a sentence. Words have sense (sinn) as opposed to reference (bedeutung) only if the conditions necessary to fulfill the truth-value of the proposition are met. False propositions, although conceptually possible, are meaningless.

[6]For an indepth discussion of Durkheim's notion of collective representations see Gillham (1972).

[7]The author does not suggest that this is in anyway an ideal definition of communication. It is only intended to serve as an example of the field's awareness of the notion of process. It could be improved by changing the words "transmission" to "exchange" and "parts" to "components." In this way, it would take into account the transactive nature of communication and the simultaneous exchange of information. Other definitions of communication which share the notion of process are Berlo (1960) and G. R. Miller (1966).

[8]It seems reasonable to assume that the dissimiliarity between the objects is reduced when an association is formed, although this point is not made explicit.

[9]If the time intervals between measurements are unequal, but they are known, the same information may be gained. However, a more complicated analysis is required. This problem is discussed in depth by Coleman (1968:437).

[10]This is not to take the position that these four are the only ways meaning can be measured, but only a convenient grouping under which most systems can be subsumed.

[11]The words were: moth, insect, wing, bird, fly, yellow, flower, bug, spring, cocoon, color, blue, bees, summer, sunshine, garden, sky, nature and butterfly.

[12]The author does not mean to imply that the notion of dimension and attributes are isomorphic. Attribute refers only to the systematic alignment of concepts where some property which they have commonly in varying degrees can be identified. Dimension refers only to the orthonomal reference vector which results from the mathematical procedures of orthogonal decomposition.

[13]Any two points (objects) may be connected by a line, yielding a single dimension differentiating the objects. Three objects may be connected by a plane. No information as to their differentiation would be lost by indicating the objects' scale values on the two dimensions. The same holds for four points in a cube (three dimensions) and n points in a hypersphere of n-1 dimensions. It should be noted, however, that if any three or more points lie along a continuum, fewer dimensions would be needed to precisely describe the system.

[14]Recent research by Joseph Woelfel suggests that the loss of information by using a space of reduced dimensionality is too great to warrant its use. He feels that all n-1 dimensions have meaning. The present author supports the liberal position and feels the reduced space is better to work with, because the ideosyncratic responses and the unreliability are removed.

[15]A Fortran IV computer program which accomplishes the calculations described in this paper is available at Michigan State University. It is know as Galileo Version 3 (Serota, 1974).

CHAPTER THREE

BILINGUAL INFORMATION PROCESSING -- THE EFFECTS OF COMMUNICATION ON SEMANTIC STRUCTURE

Overview

This chapter will describe a single substantive problem--the organization of semantic information by bilingual individuals. Bilinguals have been the object of intensive investigation by the social sciences. They have been studied from the psycholinguistic perspective which poses the general question, "How do bilinguals organize their language system?" It is hoped that by examining this phenomenon insights might be gained which would help psychologists and linguists describe the processing of language by people in general. Researchers in this area have not been overly successful in agreeing upon a description of the way in which the bilingual organizes his/her meaning system. One reason for this failure as explained in the last chapter has been the lack of a consistent theory of meaning and a measurement system derivable from such a conceptualization. The preceding chapter suggests that people organize their language system according to the meaning of the individual lexical items. Meaning may be taken as a series of fundamental measures based upon four principles, the most important of which is similarity.

Bilinguals have also been looked at by sociolinguists, who are concerned principally with how

contextual variables in a bilingual's environment affect the language that is used in any given situation. The previous chapter made explicit the point that the individual language-user is embedded within a social environment which affects the way in which he/she processes semantic information. Also, the individual's system of organizing meaning has been viewed as contingent upon his/her past experiences. These two notions have been ignored by psychologists interested in the bilingual, but have been investigated by sociolinguists. Based upon these two separate lines of research and the paradigm for the measurement of meaning described above, this chapter will conclude with a series of theoretical hypotheses which will apply this conceptualization to bilingual individuals in order to attribute validity to the general paradigm, describe the bilingual's linguistic system and how the semantic structure is affected by environmental influences such as the mass media and interpersonal relations. These hypotheses will be operationalized and a study designed to test them in Chapter 4.

Social Significance of the Bilingual

Today, throughout the developing world, there exists a communication problem of some magnitude. Typically, people speak only one language in a nation-state where many languages may be spoken by several indigenous cultural groups. In India, for example, there are over

17 different languages apoken. They are as diverse as the Indo-European languages, Hindi and Bengali, and the Dravidians, Kannadi and Tamil. Because the official national language is Hindi, people from other regions of the subcontinent are obligated to learn that language if they are to take an active part in the national political process. They are forced to become bilingual if they are to be integrated into the nation-state. Not having a common language often results in conflict between the cultural groups and may ultimately set the stage for the disintegration of a country. The independence of Bengladesh resulted in part from the differences over linguistic policy between the Bengalis and the Urdu speaking Pakistanis.

The problem does not end here. Scientific and technical material and the education of these subjects are mainly in western languages, usually French, English or German. If a society is going to industrialize and therefore achieve a degree of equity with the developed nations, this knowledge must be disseminated. However, before the information can be diffused must come the vehicle which carries the knowledge. This vehicle is inherently a second language. Thus, bilingualism must become a necessary state of affairs in the world of the future.

To a certain extent, this problem can also be found in the United States. According to the 1970 census, there are 42.5 million people in this country who speak a

language other than English. These people may be bilingual (English and some other language) or monolinguals in some language other than English. This amounts to a staggering 20.9 percent of our population. The largest of these groups, Spanish speakers, amount to about eight million or 18 percent of the non-English speakers. They are concentrated in southern Florida, the Southwest and urban barrios. This communication problem also applies to a lesser degree with Black Americans. This difference is not one of language, but one of the difference between dialects.

By and large, these people are poor and uneducated and trapped in a cycle of poverty. If they are to solve their social problems, certain information must be obtained. But where do people go for information, when they do not know the language in which the possible solutions are written--English? Education, formal or informal, is harder to obtain when the information necessary to alter one's living conditions are not available in a language one can understand.

Most often the non-English speaker is a recent immigrant to the United States. In the case of Spanish speakers, they have come from Mexico, Puerto Rico or Cuba. They have left their homes in order to better their quality of life, similar in their potential to the Europeans that arrived earlier in this century. While wanting to improve their standard of living, they want to

save certain aspects of their indigenous culture. It is this melting pot notion--the input of ideas, practices and artifacts from many different societies that has made this country the technical innovation center of the world.

There are two potential solutions to the problem of distributing the necessary information to non-English speakers. One, translate the knowledge into the other language, and two, teach these people English. Both solutions have been tried. The key idea to notice is that both processes require a bilingual to translate a message from one language to another. Exact ideas must be translated from one meaning system to another. The second language may have a profoundly different semantic structure, such that the wrong symbol may produce adverse behavioral associations in a member of the seconed culture.

Thus, the process by which information is transferred between cultures becomes critically important. An accurate psychological description of how bilinguals process information may facilitate the exchange of ideas across all cultural boundaries. This would have the advantage over some universal "Esperanto" because it also preserves the native language--one of the defining attributes of culture. By understanding the processing of information across language barriers, we can avoid potential misunderstandings which often develop into conflict. Accurate transfer of ideas interculturally may

provide certain necessary mechanisms for the improved quality of life for mankind.

The bilingual plays an important role in the process of acculturation. As the language of an immigrant group shifts from the one used in their native country to another used in their new home there is usually a period of time when the immigrant group may become a bilingual speech community. This usually takes as long as a generation to develop and lasts only an equal period of time, provided that the immigrants settle in close proximity. Lieberson (1970) describes this phenomenon in Canada with the change from French to English as the spoken language in certain regions and the integration into the English language society with later immigrants.

The bilingual individual may be considered as a link between two different cultural groups. These groups can be defined by their respective code systems, which are made up of both nonverbal codes, such as the artifacts of dress, or the meaning attributed to time and spatial relations, and the linguistic codes. Language has historically been one of the ways in which cultural entities have been identified. Thus, by definition, the bilingual is integrated into two different cultures.

What are the social psychological effects of being integrated into two different cultures simultaneously? Durkheim (1951) might suggest that these people would have a higher degree of anomie than monolinguals

because they might have a problem as to which culture's set of communication or linguistic rules to use. Children bilingual in French and English have been observed to use the English lexicon combined with the French syntax to produce a language unintelligible to anyone but the children themselves (Lambert, 1972). Indeed, this problem may extend to all the normative patterns of the bilingual's social environment. Thus, the bilingual is not completely integrated into either group; nor may he/she be capable because of his/her distinctive linguistic system.

Alternatively, Simmel (1950) might take the position that bilinguals because of their abilities to communicate with two different code systems are in some sense strangers to the social system in which they reside. Due to their psychological separation from the normative structure of society, they may be more objective than monolinguals and thus able to recognize the linguistic rules of both sectors of the social system. As a result, rather than having a greater degree of anomie, they are better able to incorporate both sets of norms.

Past Research

This section of the chapter will review the past research on bilinguals in psycholinguistics and sociolinguistics. It will show that both lines of research must be taken into account simultaneously in order to predict and explain the bilingual's communication behavior.

Psycholinguistics.--One theoretical problem which psycholinguistics has been concerned with is how language is stored. Since an infinite number of combinations of lexical items may be produced, each with a different meaning, theorists have proposed notions of economy of storage. They have asked the question, what is the most parsimonious way to store linguistic information (Chomsky, 1957, 1965; Watt, 1970)?

The last chapter discussed similarity of meaning as the basic organizational principles of language. Because the bilingual processes two different code systems, one for each language, psychologists have focused upon these individuals in an attempt to gain insight into this problem. Are the bilingual's language systems stored separately or is semantic information organized as one system with the linguistic utterance attached as a label or tag at some later point in the communication process? A related question has been how bilinguals organize their lexical information. Do they use a word's semantic content, its language, or both methods of organization?

Kolers (1963) performed a thematic analysis of free association data elicited with each of a bilingual's two languages. The subjects were German-English, Spanish-English or Thai-English bilinguals. His assumption was that

> ". . . if verbally defined past experiences were tagged and stored in a form specific to the language the individual used to define

> the experience to himself, a bilingual would have a different story of experiences to refer to for each of his two languages, or would be required to tag a given experience multiply, once in each language." (1963: 291)

Only about one-third of the responses in one language translated those in the other, and the proportion did not differ whether the associations were intralingual or interlingual. Of this proportion, two-thirds were lexically similar or translations in the interlingual test. The degree of similar associations changed sharply with the semantic category. Concrete referents produced more similar responses than abstract states or emotions. Kolers interpreted the data to mean that experiences were not stored in common in some superlinguistic form but are tagged and stored separately in the language the subject used to define the experience.

In a later study, Kolers (1965) presented French-English bilingual subjects with lists of words in a free recall situation. On some lists the words appeared in red or black; on other lists in French and English. On mixed lists, words appeared in two colors or were translated. The main finding was that only about half as many words were recalled from the list with respect to color as were recalled from the linguistically mixed list. These results were taken to suggest a single processing system rather than two separate ones for bilinguals.

Kolers (1966), based upon the finding that the

probability of recalling a word increases monotonically with its frequency of occurrence, had bilingual subjects recall linguistically mixed lists. He found that the probability of recalling a word when it and its translation are presented n/2 times in each of the bilingual's language (French and English) is approximately equal to its unilingual presentation n times. Since the words in the two languages are usually phonetically and visually distinct, these results may be taken to suggest a single conceptual system that permits this facilitation.

McNamara (1967) found that bilingual subjects read word lists in which the languages alternate systematically faster than lists that alternate randomly. This may be taken as evidence for the position of two separate storage systems. The mere knowledge of which language a word will be in helps the subjects. This implies a certain degree of functional separation between the languages.

Riegel, Ramsey and Riegel (1967) also found support for the notion of two separate systems in bilinguals. They compared conceptual-semantic structures of Spanish-English bilinguals by observing the overlap of responses produced by a series of restricted associations and found that distinctions made in the second language were less clear than those of the native speakers. They attributed the differences to the separate learning contexts of the languages.

Dalrymple-Alford (1967) used cued and uncued

verbal stimuli and speed of recall to gain evidence to suggest a single storage system. He assumed that the speed with which a bilingual identifies a word when it is presented should be faster if he/she is cued with its language, given that two separate systems exist. A single system model would predict no difference in reaction time between cued and uncued stimuli because no switching is involved. The speed with which bilinguals identified Arabic and English words was not affected by their being cued for the appropriate language.

Young and Saegert (1966) and Young and Webber (1967) investigated transfer from English to Spanish with bilingual individuals. For half of the subjects, a positive transfer paradigm A-B, A'-B' was employed. A' is the second language equivalent of A, and B', the second language equivalent of B. For the second half of the subjects an A-B, A'-B'r paradigm of negative transfer was used. That is, associations were learned in one language and then a second list composed of translations of the first list words was learned. In this case, the pairings of the translated words were not consistent with their pairings in the first list. Rather, the translated responses were paired with some stimulus other than the one translated from the first list. The results from both studies indicate that associations formed between the items of one list influence the learning of a subsequent list even though the second list is in another

language. Twenty-eight percent positive transfer occurred in the second study. These results may be taken to indicate a single semantic system. Young and Navar (1968) also employed a positive transfer paradigm with Spanish-English bilinguals and ". . . demonstrated that learning of associations in one language is related to the forgetting of associations in a second language and on this basis alone it can be concluded that the languages of a bilingual are interdependent and not independent" (1968: 115). Lopéz, Hicks and Young (1974) studied retroactive inhibition with Spanish-English bilinguals using a positive transfer paradigm. The results support an interdependence hypothesis of bilingual organization of memory.

Lambert and associates have performed a number of studies with French-English bilinguals in order to determine the way in which they organize linguistic information. They mark a significant turning point in research with bilinguals because they imply that bilinguals may use both language and semantic content to structure their memory. Lambert, Ignatow and Krauthamer (1968) used clustering in free recall of mixed language lists and found that ". . . for bilinguals, language is an ancillary means of organizing information in memory. The semantic categories appear as the powerful organizational schema" (1968:213). Results from another study (Nott and Lambert, 1968), indicate that bilinguals recalled fewer words from

mixed language lists than unilingual lists. The reason they suggest is that besides the semantic information, the bilingual must store the word's language tag, i.e., one semantic storage system with separate language tags. Segalowitz and Lambert (1969) used reaction time on mixed-language lists containing French and English synonyms of the concepts. Reaction latencies were used as indicators of within- and between-language semantic generalization. Subjects generalized their responses to both within-language and other-language synonyms, and used the semantic properties of words rather than language to determine category membership. Since bilinguals do generalize across language through meaning, these results may be taken in support of a single semantic system.

Tulving and Colotla (1970) report that subjects could not recall as many words from multilingual lists as from unilingual lists. They attribute this finding to the greater difficulty of forming higher-order memory units with multilingual lists. This may be taken as evidence for two separate semantic systems. Dalton (1973) presents contradictory results. She found that Spanish-English bilinguals recalled mixed language lists as well as unilingual lists.

Saegert, Obermeyer and Kazarian (1973) used an adaption of whole-part paradigm of negative transfer to investigate bilingual free recall. No differences were observed in whole-list learning between unilingual and

bilingual mixed lists. Part-list negative transfer was found in two unilingual conditions. Since the bilingual adaption of the whole-part paradigm provides a situation where discriminability between whole and part lists is high, the observation of negative transfer in one bilingual condition was taken as support for the position which considers the languages of a bilingual to be interdependent.

Dalrymple-Alford and Aamiry (1969) and Kintsch (1970) provide evidence that rather than either language or semantic content being the organizing principle of the mind, both mechanisms operate to structure the bilingual's memory. Dalrymple-Alford and Aamiry report two experiments using free recall of blocked bilingual lists. Analysis of clustering suggested that the main principle of organization was in terms of interlingual/intracategory groupings, rather than either intralingual or intercategory associations. Kintsch had German-English bilinguals perform a continuous recognition memory test. All items were repeated twice, either in the same or the other language. Results show that depending on task demands subjects could respond either on the basis of language-specific or general semantic cues. Thus, both mechanisms appear to be operating.

Another way which has been used to investigate the ways in which bilinguals organize their code system is through studies of interlingual interference or

semantic satiation. In this research the assumption is that if the languages are stored separately, then they would show different degrees of interference or satiation. Jakobovitz and Lambert (1961) studied verbal satiation with French-English bilinguals. Subjects repeated words or their translated equivalents for 15 seconds. Then semantic differential scales were administered to measure change in meaning. The results indicated that bilinguals were not susceptible to variable satiation in their two languages. Preston and Lambert (1969) performed a series of experiments to examine the functional relations between the bilingual's two languages. The question of interest centered around the following problem: Does the activation of one language system make the other language system inoperative? The results demonstrated that balanced bilinguals suffer interlingual interference in the Stroop color-word task.

Kintsch and Kintsch (1969) had bilinguals learn eight item paired-associate lists with four English and four German words as stimuli and the digits 1-8 as responses. Four translated word pairs were used as stimulus items for experimental lists and unrelated words for the control list. Interlingual interference was observed which was interpreted as a task specific phenomenon.

What has been presented is a rather lengthy review of the attempts to describe a bilingual's semantic structure. Of the 21 studies reported, six provide

evidence for separate storage systems for each language, twelve for one semantic system and three suggest the position that both language and semantic content explain the organization of a bilingual's linguistic system. There are a number of reasons for these contradictory findings. First, the subjects varied in their degree of competence in each of the languages. Kolers (1965, 1966) and Young and Navar (1968) used students of the second language, while Lambert et al. (1968), Nott and Lambert (1968) and Segalowitz and Lambert (1969) used bilinguals who may be considered native speakers of both languages. This is known as the compound-coordinate bilingual distinction.

These varieties of bilingualism were first described by Ervin and Osgood (1954). Couched in terms of Osgood's mediational theory, the distinction between compound and coordinate linguistic systems results from the associations formed while learning the languages. If only one set of associations is formed during the process of learning the two systems for coding meaning, then the person may be labelled a compound bilingual. This type is characteristic of bilingualism acquired by a child growing up in a home where two languages are spoken more or less interchangeably by the same people in the same situation. Neither language becomes dominant. In the case of coordinate bilingualism, a set of linguistic signs and responses appropriate to the other language

becomes associated with a somewhat different set of representations. This type is typical of an individual who learns a "second" language sometime after the first. The underlying distinction theorized according to Ervin and Osgood is summarized in figure two.

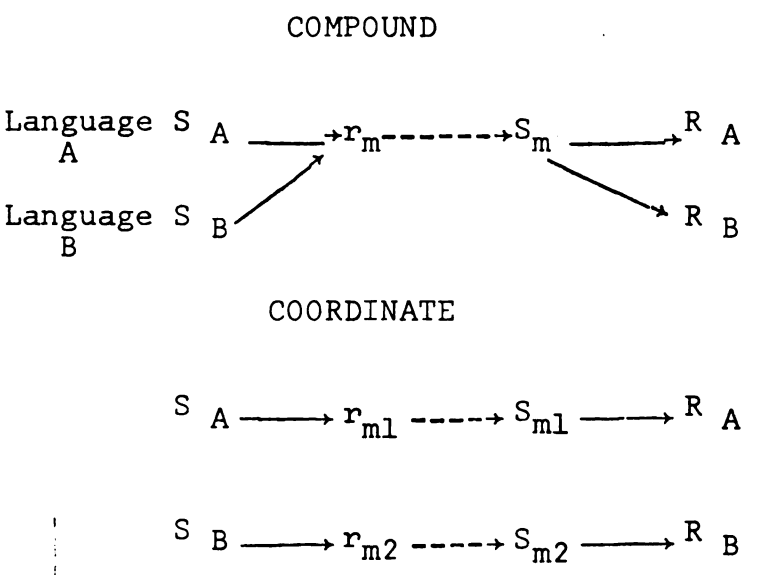


Figure 2.--The Compound-Coordinate Distinction

Using age and context of learning the second language as the criteria (less than age six, compound; greater than six, coordinate; school, coordinate and preschool, compound) Jakobovitz and Lambert (1969) found that compound bilinguals were less able to switch languages than coordinates in their study of semantic satiation. Earle (1967) studying Chinese-English bilinguals with semantic differential scales found differences in connotative meaning between compounds and coordinates. Lambert and Rawlings (1969) and Segalowitz and Lambert (1969) also

found distinctive differences between these two types. In the former study, compound and coordinate bilinguals, equally skilled in French and English, were compared for their ability to search out "core concepts," such as table, when given mixed language clues, such as chaise, food, desk, bois, and manger. Coordinates made more errors and were generally less successful in searching out the core concepts. The second study found that the semantic properties of test words played a more important role in organization of recall for coordinates than for compound bilinguals.

The second reason why inconclusive results are reported deals with the methodologies employed. At least part of the confusion may be due to the number of different techniques used and the variety of ways in which these methods were applied. Also, the methods themselves may be inadequate to answer the question which the researchers posed. Free recall was used in a number of studies, free or constrained association in others, and the semantic differential in two studies. These measures may provide a distorted picture of semantic structure and may lead to erroneous conclusions. Additionally, the methods employed were all unidimensional. The phenomenon under investigation may in fact be multidimensional. At least two factors, semantic content and language, have been suggested. Indeed, semantic content has been shown to be a multidimensional construct (G. A.

Miller, 1969; Henley, 1969; Szalzy and Bryson, 1974). If both of these mechanisms operate as Lambert, Kintsch and Dalrymple-Alford suggest, then the methods employed are inadequate to answer the posed question.

Third, an important variable, acoustic relatedness, was not controlled for in these studies. In free recall situations, words which sound similar and are not related in free association have been found to cluster (Fagan, 1969; Bousfield and Wickland, 1969). This may be of significance when critiquing the work of Young and associates with Spanish-English bilinguals and Lambert and his researchers in French and English. While these languages make considerable use of rhyme, English does not. In the romance languages, the gender of the noun determines its final phoneme and the ending of any related adjectives, such that the words will rhyme. For example, in Spanish pretty girl is translated as chica bonita and pretty boy, chico bonito. Thus, a possible intervening variable may be the gender of the words used in the recall studies.

Finally, the particular problem posed may, in fact, be unanswerable. Cofer (1965) noted that the fact of whether individuals organize their recall either by the principle of superordination or similarity of semantic content cannot be determined. In the case of bilinguals, language may be taken to be the superordinate mechanism.

It is the author's belief that both schemas operate and that both may be viewed as particular cases of a more general variable, similarity. Using cognitive similarity as the principle of organization, one can consider two words in the same language as more similar on that particular attribute. Likewise, semantic content may be described in terms of similarity on the attributes used by the bilinguals to differentiate the terms.

Sociolinguistics.--Commenting on the work of the psycholinguists, Fishman writes (1968:22),

> . . . The fact is that psychological studies of bilingualism have neither yielded an explicit model of bilingual functioning nor have they revealed the same componential sophistication as has shown in connection with psychological explanation of other behaviors.

The reason for this that Fishman suggests is that the psychological perspective is context free. It does not take into account that the bilingual is a member of a speech community. Fishman writes (1969a:152):

> Among the major messages of sociolinguistics is that which states that the individual should be viewed as a member of a speech community. A speech community is characterized by definite norms of language and behavior. These norms not only encompass the varieties or languages that exist within the speech community for its own internal communication needs but also relate them to the types of other than speech behaviors (e.g., the interactions, the mutual rights and obligations, the roles and statutes, the purposes and identification), in which various networks within the community are engaged.

As has been demonstrated, language is regulated by an individual's long-term storage system. Cicourel (1973) takes the position that the structure of the long-term stores are equivalent to socially distributed knowledge. Thus, when an individual interpretes the meaning of a lexical item, he is making use of society's general normative rules. Their use is however, dependent upon the social setting or communication environment in which the language user finds himself/herself. The meaning of a message can be considered context bound, but it is context that enables the individual to draw upon certain long-term stores. Thus, the particulars of an interaction setting can be subsumed under the more general set of normative rules.

Cicourel (1973:46) writes,

> Interpretive procedures are always operative within, or in reference to social settings, and their necessary use in making norms recognizable and relevant in particular and general cases means that semantic issues are not independent of syntatic, phonological and ecological features, or of situated body movements and gestures. Further, the properties making up interpretive procedures are not hypothetical, but can be derived from behavioral manipulations of socially organized settings.

By placing the bilingual in a communication environment, sociolinguists have been able to describe the interaction within a community. Their primary question has been, "what are the different varieties of language and who uses them and when?" A research team headed by

Fishman studied language behavior in a Puerto Rican neighborhood in Jersey City, New Jersey. Four hundred thirty-one people of Puerto Rican birth or extraction constituted the target or core population. The researchers lived there for four months. The results of this comprehensive investigation can be found in Bilingualism in the Barrio, edited by Fishman, Cooper and Ma (1971). Among the conclusions of this research was: that the particular language used (English or Spanish) was determined by context. Edelman (1969) found that children used more Spanish when talking to other bilinguals in the contexts of family and neighborhood than they did in educational or religious situations. Findling (1969) found that Spanish was used less in situations which expressed future orientation and need affiliation. Greenfield and Fishman (1971) found that bilinguals used Spanish when interacting in informal situations with family and friends (e.g. when at home or the beach), and English in formal conversations (e.g. with priests, teachers or employers, in situations of church, school, or work). Fertig and Fishman (1969) report that a significant overall difference in frequency of use between English and Spanish as well as a significant language by domain interaction between home domain words and school domain words. Fishman (1969b) and Cooper (1969a) report that the use of a particular language is context specific. English is used in formal situations and Spanish in informal. Finally,

Cooper and Greenfield (1969) report that young people speaking among themselves use English more often than Spanish in all domains, including the family, suggesting that the language in the community under study was characterized by language shift. That is, acculturation into the American society is taking place, which can be identified by the change in the spoken language.

Lieberson (1965) who found no intermixing among linguistic groups in Montreal and that a stable proportion of the population has been bilingual since 1920. Rubin (1968), studying Native American-Spanish bilinguals in Paraguay, found that choice of language was determined by age, sex, kinship, relations, occupation, wealth, education, religion, family background, the social setting, the content of the conversation, the history of the social interaction and the presence of a third speaker. In order of importance of determining language use the dimensions isolated were: location, formality, intimacy, seriousness of the situation and sex. Lieberson (1970) studied the social class differences between monolinguals and bilinguals in Canada. He found that bilinguals tended to have higher incomes than francophones and that one of the forces which induced French monolinguals to learn English was employment pressure. A greater variety of occupations with higher salaries were available for the bilingual.

While the sociolinguists have included many

variables present in a bilingual's environment to account for their use of two different languages, one factor, the mass media, has been almost ignored. Mackey (1968: 562) writes:

> Radio, television, the cinema, recordings, newspapers, books, and magazines are powerful media in the maintenance of bilingualism. Access to these media may be the main factor in maintaining one of the languages of a bilingual, especially if his other language is spoken in the area. Regular attendance at foreign film programmes and the daily reading of foreign books and magazines may be the only factor in maintaining a person's comprehension of a foreign language which he once knew. Reading is often the contact that a person may have with the second language.

In addition, the mass media may be an important mechanism for the learning of a second language. This is particularly true where the media is in a different language than an individual speaks. Yet despite the recognition of the importance of the channels of mass communication, there has been little research in this area. The exception is Woelfel, Woelfel, Gillham and McPhail (1974) who have found differential patterns of media use and interpersonal interaction between monolinguals and bilinguals in Montreal. This resulted in differential attitudes toward separation of Wuebec from the Confederation of Canada. While the Woelfel et al. piece is a beginning at describing the relationship between mass media exposure and psychological processes, it failed to explicitly relate mass media usage to the manner in

which bilinguals process information.

Theoretical Hypotheses.--In the review of the psycholinguistic literature, it was concluded that bilingual subjects organize their semantic structure according to the semantic similarity of the symbols used. Two of the mechanisms (attributes) which the psychologists suggest are semantic content and language.

Based on the paradigm for the measurement of meaning, the following assumption can be made.

> Assumption: Symbols will cluster in a semantic structure according to the semantic content for any one given language.

Based on the psychological literature and the above assumption the following theoretical hypothesis can be justified:

> H_1: In a mixed semantic structure (symbols from two different languages are present), the symbols will cluster according to the semantic content, but with the introduction of an additional language dimension, separating the symbols of one language from the other.

On the basis of his investigation of Native American languages (Eskimo, Aztec, Navaho, and Hopi) Whorf (1956) concluded that speakers of these languages organize their experiences differently than speakers of English. This has become known as the notion of linguistic relativity. It has been discussed by Chapman and Kowieski (1975). Because of these cultural differences a word in one language may have a different set of associations

than its translated equivalent. Thus, a lexical item in one language may cover a different domain than its translated counterpart and therefore both symbols will have a different set of relationships with the other words in both languages. The semantic structures will be different.

Rosenzweig (1957) compared the associational responses of groups of American and French students. He noted that the French group gave more diversified responses than the American group and that the two groups had equivalent responses in only half of the cases. In a later study, Rosenzweig (1959) used free association tests to compare word associations between English and French speaking populations. He found that the degree of overlap (the relative frequency of associative equivalence of French and English words with a given stimulus term) to be high. He concluded ". . . that associative habits tend to be held in common among different language communities." (1959:347) These results were substantiated in a later study (Rosenzweig, 1961) with French, Italian, German and American subjects.

Similar conclusions are reported by Osgood (1974) based on data from 27 countries with the semantic differential. He reports that three dimensions, evaluative, activity and potency can be found in varying degrees in the affective semantic spaces of all languages. The loadings on these dimensions were in the .8 to .9 range

on the evaluative dimension, .4 to .7 for the potency factor and .3 to .7 for the activity dimension. From these results, Osgood concluded, "This is rather convincing evidence for the universality of the affective meaning system (1974: 33-34)."

Thus, while the individual responses may vary by degree between different cultures, the process by which language is organized is identical despite cultural differences. This would be as expected because we are all people with the same physiological makeup. As a result, the process of communication is not likely to work in a totally discrepant manner despite cultural variation. Additionally, in this discussion the medium of communication has been limited to language which requires the same sensory-motor mechanisms to operate in order for the exchange of ideas to be completed. What may be considered unique to each language is the cultural context in which associations between the label and referent are formed, although similarity may be taken to be the primary principle of organization of semantic information in all societies. Thus, while the linguistic process by which information is communicated and meaning attributed to objects and relations can be considered identical across language boundaries, culture produces individual variation in the semantic structure of a language to render it significantly different from any other.

This discussion suggests the following theoretical hypotheses.

H_2: The semantic structure generated by symbols from one language will be significantly different from the structure generated from its translated equivalents, for monolingual subjects.

H_3: The semantic structure generated by symbols from one language will be described by the same number of underlying dimensions as the semantic structure generated by its translated equivalents.

There is some support for these two hypotheses. Barnett and Wigand (1975) used M.D.S. and found little difference between two English language societies (United States and South Africa) and greater discrepancy between the English and Spanish (Mexico) speaking cultures. However, in all cases, four dimensions provided the best description of the data.

In the case of the United States samples, this explained 77.4 percent of the "real" variance; for Mexico 88.8 percent; and for South Africa 76.8 percent. These results were determined by the use of a scree test (Tatsuoka, 1971: 147).[1]

The bilingual individual has the ability to receive information from two different language groups. This suggests that he/she forms associations in a manner that takes into account both languages, resulting in a semantic structure significantly different from both but not nearly as different as the two are from each other.

Lambert and Moore (1966), using free association, found that bilinguals living in the same environment have intermediate degrees of response similarity between monolinguals in French and English.

> In communication, the two monolingual groups could easily miss the full significance of one another's messages because such associational discordance color the meaning and shunt the line of associations off on quite different routes. In this example, the bilinguals would likely transmit the discrepancy with fidelity from one monolingual group to another, switching from one associational network to another as they change languages (Lambert and Moore, 1966:319).

The notion that the bilinguals' semantic structure will be significantly different from both the groups from which they obtain their language is perhaps a linguistic manifestation of Durkheim's (1951) notion of anomie. Bilinguals may in fact be incapable of internalizing the semantic rules of either language due to their use of both. McLuhan (1962) has shown how the phenomenon Durkheim observed could have resulted from the change in communication technology in the later portion of the 19th century. Given that anomie may result from a change in the overall communication media, it seems reasonable to suggest that semantic normlessness may result from the change in language or the simultaneous use of two significantly different semantic systems.

It should be pointed out that bilinguals can communicate successfully in either of their two languages.

This suggests that they have the ability to switch codes or, at the least, use that language's semantic rules when speaking in that language. Thus, the bilingual's semantic structure while using one language would be more similar to that language's monolinguals than to people who use the other language.

Based upon the above discussion, the following hypotheses seem justified.

H_4: The semantic structure generated by symbols from one of a bilingual's languages will be significantly different from the semantic structure generated by symbols from the other language.

H_5: The degree of discrepancy between the semantic structure produced by a group of bilinguals (in either of their two languages) and a group of monolinguals in one of the bilingual's languages will be less than the discrepancy between the two monolingual groups.

H_6: The degree of discrepancy between semantic structures of equivalent terms will be ordered in the following manner: monolingual language A, bilingual in A, bilingual in B, and monolingual in B.

Research on bilingualism has ignored how mass media exposure has influenced the way in which these people process information. McLuhan (1964) has written that the form of the media affects ". . . the way in which individuals organize experience and fix perceptions" (Carey, 1967: 17). There has been little research dealing with how the form of the medium upon which a message is

transferred affects the receiver of that message. Wilkus, Woelfel, Barnett and Fontes (1973) failed to find any effect on pattern recognition ability that might be attributed to exposure to a variety of different media within a given medium, Watt and Krull (1974) found that two dimensions of the structural or form characteristics of television programs, dynamics and unfamiliarity, could be used to predict viewing patterns as well or better than measures of content.

One aspect of form (as opposed to content) is the language in which the message is presented. Might language not also be a predictor of media usage patterns? Woelfel et al. (1974) found differential patterns of media use and interpersonal interaction between monolinguals and bilinguals in Montreal. Thus, given the potential for unequal distribution of media content in each of a bilingual's language the following hypothesis seems justified.

> H_7: The patterns of media usage will be significantly different for monolinguals in language A, monolinguals in B and bilinguals living in the same geographical location.

Given that the above hypothesis concerning the mass media exposure can be confirmed, the following question can be raised. How does exposure to the mass media and interpersonal relations in each of a bilingual's language affect the way in which he/she processes information? More specifically, how is an individual's semantic

structure affected by the variable exposure to both languages? It was pointed out in chapter two that the semantic structure of an individual was contingent upon his/her past experiences. Clearly, when dealing with linguistic information, the past experiences with each of the two languages should affect the structuring of the semantic components of the bilingual's language.

> H_8: The greater the proportion of mass media and interpersonal exposure in language A (the less the proportion of exposure in language B), the greater the discrepancy of the semantic structure of the individual from the "ideal type" of monolingual in language B (average structure of language B) and the less the discrepancy from the average structure produced from the mean space of language A. This is for a semantic structure produced by translated equivalents.

Summary

In summary, this chapter has described a single substantive problem, the organization of the semantic structure of bilingual individuals. After a description of the extent of the problem and the social significance of the bilingual, the chapter reviewed the literature in two separate but complementary disciplines, psycholinguistics and sociolinguistics. It concluded that both lines of research are necessary in order to describe how bilinguals process semantic information. The chapter then concluded with eight theoretical hypotheses which derive from past research with bilinguals, the paradigm

for the measurement of meaning presented in chapter two and the discussions relevant to each specific hypothesis.

FOOTNOTES FOR CHAPTER THREE

[1]The scree test was performed on the positive roots only. Because metric scaling results in a non-positive semi-definite matrix (it has negative eigen-roots), this test may lead to erroneous findings. One possible improvement might be to perform the scree test on the absolute values of all the roots. This may explain more reliable variance and might not distort the findings.

CHAPTER FOUR

METHODS

Overview

This chapter will propose a study to test the theoretical hypotheses presented in the preceding chapter, through the use of the methods outlined in chapter 2, a paradigm for the measurement of meaning. It will restate the hypotheses in operational form, describe the setting for the research, the sample, the instrumentation, the problems of instrument translation and the design to test the hypotheses.

Operationalization

The cognitive-semantic structure (meaning system) of an individual may be measured as a fundamental theoretical variable through the use of metric multidimensional scaling (M.D.S.). An in-depth discussion of the theoretical significance and the advantages of this method were presented in chapter 2. Barnett (1972) reported reliability coefficients for the method of .90 with groups of 75 cases and discussed ways of increasing the over-time reliability by the number and selection of concepts. The predictive validity of time series M.D.S. has been demonstrated by Marlier (1974) in a test of social judgment theory, and Taylor, Barnett and Serota (1975) who demonstrated that the outcome of a political campaign could

be accurately predicted with the method.

Multidimensional scaling has been used successfully with subjects from non-English speaking cultures. The languages in which the research has been conducted were: Japanese (Kuno and Suga, 1966), Dutch (Van Der Kamp and Pols, 1971), Swedish (Ekman, 1955; Hanson, 1963), Finnish (Nordenstreng, 1968) and Spanish (D'Andrade, et al., 1972; Barnett and Wigand, 1975). Heider and Olivier (1972) used M.D.S. for cross-cultural comparisons to test the Whorfian hypothesis concerning the relation between cognitive and linguistic structure. Subjects from the United States and the Dani culture of New Guinea were asked to perform two tasks. One involved scaling color names and the other Munsell color chips. M.D.S. on the four data sets yielded structures that were more similar under the cognitive conditions than the naming condition. In neither culture were distinct colors confused in memory more than across name boundaries. Thus, retention of color images appears to be unaffected by cultural differences in the semantic reference of color words.

Restating the first theoretical hypotheses into operational terms would look like this:

> H_1: In a mixed language space (symbols from two different languages are present) the symbols will cluster according to the semantic content. Additionally, there will be the introduction of an additional language dimension separating the symbols of one language from another.

In order to test this hypothesis, one must first generate a multidimensional space from a group of symbols from both of the bilingual's languages. The specific language of each concept would be randomly determined from the pool of lexical items which will be used to test the rest of the hypotheses. From this space it would be determined if on one or more dimensions the concepts of one language were polar opposites from the concepts in the other language. Since it is not likely that the language attribute would be orthogonal from the others used to differentiate the concepts, one would next attempt to regress a language dimension through the space. This is done by treating the dimensions of the space as a series of independent variables with the loadings of the concepts on each vector as the scores of the case on that variable. A vector of zeros and ones would comprise the dependent variable. Zero would signify that the term was in one language and one, the other. Concepts, not subjects, would be the unit of analysis. Thus, an attempt to predict the loadings on the language vector from the dimensions of the space is occurring. If there is a language attribute present and it can be used to differentiate the concepts in the space then it will be reflected in the multiple correlation.

Theoretical hypothesis two becomes:

H_2: A space generated by symbols from one language will be significantly different from a space generated from its

translated equivalents, for monolingual subjects.

It can be tested in the following manner. Generate spaces in two different languages from a series of translated equivalents. Next, through a series of translations and rotations place the two spaces to a least-square best fit.[1] Then, through the use of t-tests using concepts as the unit of analysis, see if the differences between the spaces differ significantly from zero. The null hypothesis would be that the two spaces are not significantly different.[2]

H_3: The space generated by symbols from one language will be described by the same number of underlying dimensions as a space generated by its translated equivalents.

Hypothesis three can be tested through the use of the scree test (Tatsuoka, 1971). It operates as follows. Plot the absolute values of the eigenroots for each dimension of each space.[3] Then connect these values. The number of underlying dimensions is determined where there is a drastic change in the slope of the line, an "elbow" in the graph. This quantity is the number of dimensions which lie off the line connecting the smallest root to this point (Tatsuoka, 1971).

Theoretical hypothesis four then becomes:

H_4: The space generated by symbols from one of a bilingual's languages will be significantly different from the space generated by symbols from the other language.

Hypothesis four can be tested in the same manner as hypothesis two.

Theoretical hypothesis five becomes:

> H_5: The degree of discrepancy between a space produced by a group of bilinguals (in either of their two languages) and a group of monolinguals in one of the bilingual's languages will be less than the discrepancy between the two monolingual groups.

H_5 can be tested as follows. Rotate all three spaces to a least-squared best fit, with the bilingual space placed between the monolingual spaces. Then perform a t-test to see if the degree of discrepancy between the bilingual space and one of the monolingual spaces is significantly less than the discrepancy between the two monolingual spaces. Again the unit of analysis is concepts.

> H_6: The order of discrepancy between spaces of equivalent terms will increase in the following manner: monolingual language A, bilingual in language A, bilingual in B, and monolingual in language B.

H_6 can be tested through the use of trend analysis. The hypothesis as stated only indicates a monotonic relationship between the discrepancy and their rank orders. As such, a linear function may provide the best estimate of the relation. Thus, linear trend analysis will be the method of choice. It is discussed in depth by Hays (1973: 691-694). Linear trend analysis operates in the same manner as any comparison among means. However, since analysis of variance in the linear case agrees exactly

with linear regression, the later method may be used. The significance test will be performed on the correlation between the predicted rank order and the discrepancy scores among the spaces.

> H_7: The pattern of media usage will be significantly different for monolinguals in language A, monolinguals in B and bilinguals living in the same geographic location.

H_7 can be tested by gathering media exposure data through a series of items on a questionnaire and then comparing the groups on these items. The items may be worded as follows:

> On the average, how many hours per week total do you spend with newspapers? _____ Of these hours, how many are in language A? _____ Of those hours, how many are in language B? _____

A question of this general form may be asked for seven different media (newspapers, television, film, radio, books, magazines and records or tapes). This question's form may also be used to gather data on the frequency of interpersonal communication in each language.

Theoretical hypothesis eight becomes:

> H_8: The greater the proportion of mass media and interpersonal exposure in language A (the less the proportion of exposure in language B), the greater the discrepancy of the space of the individual bilingual from the mean space of language B monolinguals and the less the discrepancy from the average space of language A monolinguals. This is for a space produced by translated equivalents.

This hypothesis may be tested in the following

manner. First determine the mean space for the two monolingual groups. Then compare each individual bilingual space to the monolingual spaces. This is performed by a series of rotations and translations on the underlying coordinates.[4] The difference or separation between the space of the individual bilingual and the average monolingual space is then determined by simple subtraction of the coordinate values. This value is then entered in a multiple regression as the dependent variable with the hours of media exposure as the independent variables. The correlation between the variables will be the statistic used to infer the test of the hypothesis.

The setting.--The setting for the test of the above hypotheses will be Canada's capital, Ottawa, and its sister city, Hull. This metropolis rests on the border between Quebec, and its francophone culture and the English language culture of Ontario. Here both cultures meet and their languages mix. According to the Royal Commission on Bilingualism and Biculturalism (1969: 35), 30.8 percent consider English to be their mother tongue and 37.7 percent, French. 55.8 percent are anglophones and 13.2 percent are francophones, while the remaining 30.8 percent are bilingual (RCBB, 1969: 35). Of the bilinguals, less than 15 percent of the English ethnics speak both languages, while almost 85 percent of the French are bilingual. Thus, French and English will be the languages used to test the hypotheses.

Mass Media.--The mass media also reflects this unequal distribution. There is more English language content available than French. Certain content may only be available in English. This is probably the case with television. Programs from the United States are only available in English. The same is true of movies, because of the importance of Hollywood productions. At the time of the study, there were 14 different television stations broadcasting on cable in Ottawa. Of this total, three were in French, and 11 were in English. Of these 11, four were emnating from the United States, and seven from Canada. There are a total of 21 movie theatres in Ottawa-Hull, 18 featuring English language pictures and three French language. Radio is balanced. There are a total of 12 stations which can be received, 6 AM and 6 FM. On the AM band, there are two French and four English stations and on the FM frequencies, four French and two English. Three daily newspapers are published in Ottawa. The English are the Ottawa Journal and The Citizen. Le Droit is published in French. In addition, newspapers from both Toronto and Montreal are available.[5] Thus, although there is an unequal distribution of the media in each language, both French and English material are readily available. The media available in each language is summarized in Table One.

Table One About Here

Table 1. The Available Mass Media in Ottawa-Hull, February, 1975.

	Total	English		French
Television	14	11	(4 US)	3
Theatres (film)	21	18		3
Radio	12	6		6
		4	AM	2
		2	FM	4
Newspapers	3	2		1

Instrumentation

The English language version of the instrument for the research is located in Appendix A. It is composed of two sections. The first contains a series of unidimensional items including a series of demographic questions, and language use questions. Also included are preference of the media and a series of media usage questions. These attempt to describe the individual's pattern of media exposure in both French and English. Additionally, there are questions concerning the language of interaction with friends and family. Bilinguals are asked when and where the second language was learned. Finally, this section is concluded with two questions attempting to get at the variable enjoyment and effort for each of the bilingual's languages. These questions can all be justified from the socio-linguistic literature with the exception of the two questions dealing with the time and place of the learning of the second language. Those can be justified from the research on the compound-coordinate distinction.

The second section of the instrument was composed of 45 direct pair comparisons based on ten different concepts, using the criterion standard of red and white as 100 "galileos" apart. These will be used to generate a multidimensional space to examine the perception of the mass media. The concepts were:

1. Books
2. Magazines
3. Newspapers
4. Music
5. Radio
6. Television
7. Sports
8. Movies
9. Information
10. Entertainment

These concepts were chosen for a number of reasons. First, since the eighth hypothesis attempted to relate media exposure to semantic structure, among the logical domain of concepts which would be affected by the variable use of the mass media would be the perception of that institution itself. Thus, six different media were chosen, two functions of the media, entertainment and information, and two terms which dealt with the content of the media, sports and music. Terms which dealt with the perception of the media were used by Barnett and Wigand (1975), with success in three different countries. Additional data concerned with the perception of the media are being gathered in five additional countries, including Micronesia, Israel, Great Britain, Australia and Nigeria. This has been planned so that the Canadian data will be comparable to this multinational study.

The second reason for the choice of these terms dealt with the gender of the concepts in French and their frequency of use in English. The need to control the gender of the terms in French has already been discussed. Additionally, it was felt that frequency of use may affect a symbol's degree of association with related terms. The specific concepts were generated in the following manner. Using Thorndike and Lorge (1944) and Carroll, Davies and Richman (1971), a pool of potential terms were divided into high frequency of use (more than 100 times per million), moderate use (50-100 times per

million) and low frequency of use (less than 50 times per million). Next, the gender of each word in French was determined in order to control for the potential acoustic relatedness of the items. Finally, the cells of the matrix presented below were filled such that concepts from both domains (media names and media functions or content) were present, and at least one male or female term at each level of use. Finally, the concepts were placed in random order in the form presented on the questionnaire so as to minimize the effects of order on the scale values.

	Domain 1 Media Names		Domain 2 Media Functions & Content	
	Male	Female	Male	Female
Hi $\geq 100/10^6$	Newspapers Books			Music
Med $50\text{-}100/10^6$	Movies Magazines	Television	Information	
Low $\leq 50/10^6$		Radio	Sports	Entertainment

Translation

The questionnaire was translated into French following the back-translation procedure. This is done as follows: More than one bilingual individual translates the instrument from English into the language into which the research will be performed, in this case French. The reason for the use of multiple translations is to provide checks on the reliability and validity of the translation

(Ervin and Bower, 1952). Then, a second set of bilinguals translate the tentative instrument back into English. Next, the results are compared. Did the back-translations produce the original terms exactly in all cases? If the answer is yes, the terms are retained. Where there are discrepancies, both sets of translators should meet to discuss the differences to see if a consensus can be reached. If consensus is reached, then that item should be translated back into English by an independent translator to insure validity. If it becomes impossible to agree upon one translation, the item should be deleted. Variations of this procedure have been used by Kumata and Schramm (1956), Trandis and Osgood (1958), Tanaka, Oyama and Osgood (1963), and Sarbaugh (1967).

For this study, an undergraduate French major and a Ph.D. candidate in communication familiar in survey research translated the questionnaire from English into French and then two undergraduates translated it back into English.[6] Only slight disagreements were present. They were resolved upon discussion. This high degree of agreement should be expected with French and English, owing to their similarity and popularity among students. The instruments were then sent to Canada to allow the opportunity for modifications in the French questionnaire to conform to the French-Canadian vernacular. No changes were made. The French language version of the instrument is also located in Appendix A.

Design.--The design for the study outlined above would include five groups.

1. English monolinguals
2. French monolinguals
3. Bilinguals with an English instrument
4. Bilinguals with a French instrument
5. Bilinguals with a mixed-language instrument

The bilinguals (groups three and four) will emerge out of the presentation of the questionnaire in either language to large groups of subjects. This is made possible because of the large numbers of bilinguals and their high degree of integration into Ottawa area. The English language instrument was administered to a large group of English speaking subjects, some of whom are monolingual and others bilingual in French. Likewise, the French language instrument was given to a sample of French speakers, some of whom are francophones and others bilingual in English. On the top of page 4 of the questionnaire is a set of instructions which reads, "If you speak both French and English, please complete this page. If not, go on to the next page. Thank you." In this way bilinguals can be sorted out from the anglophones and francophones. While this may seem a poor method to separate bilinguals from monolinguals because it does not take into account their competence in the two languages, it should be noted that in Canada, generally and specifically in Ottawa, there are strong social norms connected with bilingualism. Thus, it is not likely that subjects would take lightly a series of questions

concerning their use of a second language. It should be noted that the Canadian census only asks three questions relating to language. They concern the respondents ethnicity, his/her parents language, and his/her knowledge of the two official languages, French and English. The last question is the only direct measure of bilingualism in the census (Macrae, 1969). These were questions 15 and 16 and the sorting procedure on page 4 of the questionnaire. Additionally, the questions on effort and enjoyment could serve as a validity check on the sorting process.

An additional design manipulation check was performed. The author examined all the bilinguals' completed questionnaires and then noted if the respondent made any use of the second language. If the language of mass media usage and interpersonal communication were all in a single language, then that potential bilingual was reclassified as a monolingual. This was a very minimal criterion for a bilingual because as will be explained in chapter 5 most monolinguals make at least some use of the second language.

In this study, bilingualism has been treated as a dicothomous variable. Subjects were labelled as either bilingual or monolingual. Perhaps, it would have been more accurate to conceptualize the variable continuously, as the degree of bilingualism. However, to gather an adequate measure would have required a great deal of time and effort and have been of questionable

utility concerning the hypotheses in question.

These have been a number of measures of bilingualism which taken into account an individual's variable ability to communicate in each of his/her languages. They have been reviewed by Macnamara (1969) and Cooper (1969b). Because of the complexity of linguistic ability there are no direct measures of bilingual competence. Rather, there are a number of tests which indirectly tap some component of an individual's communication skills in the languages. Among them are self-rating scales, tests of verbal fluency (speed of responding to verbal stimuli, speed of verbal production in two languages, word completion tests, speed of reading and word naming), measures of flexibility in each language or dominance of one language over another. Theoretically, these have been designed to take into account one or more aspect of encoding (speaking or writing) and/or decoding (listing or reading) skills in both languages.

Because these measures may tap a number of dimensions other than the individual's ability to communicate with both languages, one would next have to construct some sort of factor weighted index as the measure of the degree of bilingualism. Mackey (1969) questions whether these measures accurately reflect the bilingual's ability in each language. Cooper (1969b: 194) notes, "There have been few attempts to relate the verbal traits which have been studied to social correlates." They are

therefore of questionable validity. Lieberson (1969) questions whether the benefits gained from this sort of data is worth the potential hazards in respondent fatigue in a survey situation. Perhaps in an experimental setting these measures would have more utility. But due to the time constraints and the limits of the number of questions that could be asked in a questionnaire, the benefit that might have been gained by this conceptualization is limited.

One of the problems in evaluating the past research was that there was no attempt to control for the differential ability in both of the bilingual's languages. No standard operationalization of bilingualism was applied. This same criticism may also be levelled at this study. Also, no attempt was made to control for the compound-coordinate distinction. However, all the bilingual subjects were coordinates.

The subjects for group five, bilingual subjects with a mixed-language instrument, would have to be gathered separately. Before receiving the questionnaire, subjects were asked if they were bilingual. A positive response was necessary to obtain this version of the questionnaire. For this group, the concepts in the direct-pair comparison section were in the format outlined in the methods chapter, page 119. This portion of the questionnaire is also located in Appendix A.

On February 10, 11 and 12, 1975, questionnaires were administered to a series of large university classes in Ottawa. The administration took 30 minutes. The institutions were Carleton University, where the language of instruction is English, the University of Ottawa and St. Paul's University, where French is used in the classroom.[7] The present author administered the questionnaires at Carleton and a bilingual professor performed this function at Ottawa and St. Paul's after being briefed at great length by this author.[8]

Subjects.--The subjects for this study were all students at the above mentioned Canadian universities in Ottawa. This, of course, has its obvious limits to generalizability, but has been the method of choice due to the subjects' availability and restrictions due to cost.

The total sample consisted of 324 subjects, 232 students at Carleton and 92 at Ottawa and St. Paul's. Of the 232 students at Carleton who participated in the study 150 (64 percent) were monolingual in English and 82 (36 percent) were bilingual. Of the 92 students at Ottawa and St. Paul's who served as subjects, 15 (16 percent) were francophones, and 77 (84 percent) were bilinguals. This is in line with what Lieberson (1970) describes as the language usage patterns for Ottawa. More of the English-background subjects are bilingual than one might expect from the general population. This is probably due

to the fact that the subjects are college students, who typically are required to learn French as a second language.

The overall sample was disproportionately male (57.7 percent male to 42.3 percent female), and almost entirely white, (95.3 percent). The average subject had completed 14.27 years of school. On these variables, the anglophones, francophones and bilinguals did not differ significantly. Comparing the three groups, the French language subjects tended to be younger than the other groups. Also, they differed significantly by religion and socioeconomic status. While the total sample had a mean age of 20.8 years, the English average was 21.6, the bilinguals, 20.2, and the French 19.8 years. This difference is significant at the .05 level. However, it is not clear what effect, if any, this difference should have on the results of this study. As expected, the francophones were all Catholic, while the bilinguals were 59.2 percent Catholic, 17.2 percent Protestant, 5.1 percent Jewish and 17.2 percent Atheists or other. The anglophones were 25.3 percent Catholic, 47.3 percent Protestant, 2.0 percent Jewish and 25.3 percent Atheists or other. The fathers of the English language sample had significantly more years of education ($p \leq .05$) than the bilinguals and the francophones. The anglophones' fathers had significantly higher occupational status ($p \leq .05$) and income $p \leq .05$) than the French group but did not differ from the

bilinguals on these variables. However, the bilinguals had significantly higher social status than the francophones on these two variables ($p \leq .05$ on both). Following Lieberson (1970), these relationships were expected.

Summary

To summarize, this chapter has proposed a study to test the theoretical hypotheses presented in chapter 3, through the use of the methods outlined in chapter 2. It restated the hypotheses in operational form, described the setting where the hypotheses will be tested, the construction of the instrumentation for the test, the procedures for the translation of the questionnaire into French, the design to gain the necessary data, and finally, it described the sample of university students which were used as the subjects for this study.

FOOTNOTES FOR CHAPTER FOUR

[1]A computer program (Galileo, version 3) which accomplishes the calculations necessary to rotate two or more spaces to a least-square congruence is available at Michigan State University, Department of Communication. For an in-depth discussion of the procedures see Serota (1974). A number of rotational algorithms exist which provide variable quality of solution. At present, the least-squares best-fit seems to provide an optimum result compared to other rotations. Inherent in this procedure is the problem of overestimating some changes while underestimating others. The author is currently involved in the testing of a new procedure in which a theoretically defined set of concepts is held constant (this subset is rotated to a least-squares best-fit) and the remaining concepts are positioned accordingly. It is identical to the heliocentric notion for calculating the motions of celestial bodies. For an indepth discussion of this topic see Woelfel, et al. (1975). While the least-squares rotation is appropriate for the comparisons of static samples like these, the overtime analysis of changes requires the alternative procedures suggested by Woelfel et al. (1975).

[2]The use of significance tests and inferential statistics of any sort runs against the spirit of the method. Chapter 2 pointed out that metric M.D.S. is a series of continuous ratio scaled distance estimates. It assumes the height of absurdity to reduce these estimates to a dichotomous decision of an acceptance or rejection of the null hypotheses. These data can and should be used as a description of the structure of the semantic space of individuals or groups. Thus, one could say they describe a certain relationship without attempting to infer beyond the sample of subjects or concepts. Additionally, these data are based on a large number of independent observations of the relationship between a particular pair of concepts. This notion is not taken into account by this significance test, where the unit of analysis is the number of concepts or spaces and thus the degrees of freedom are some small numbers rather than the number of independent observations.

At the present time there does not exist an adequate significance test for the differences between multidimensional spaces or for that matter factor structures. Although there have been a number of notable attempts (among them Lawley and Maxwell, 1963), these have been inadequate. The Lawley and Maxwell solution takes the natural log of the determinant of one matrix (factor structure) and subtracts it from the log of the other. The resultant value may be then tested for significance by

the use of the chi square distribution. This solution is inappropriate because the structure of the M.D.S. produces a singular matrix. It is of rank N-1. It has one column of zeros making the determinant zero by definition and the test inapplicable. The test presented in the text will serve in this dissertation but the author's reservations concerning the use of any test of statistical inference should be noted.

[3]The reason why the absolute values of the eigenroots are used is because metric scaling inherently results in a non-positive semi-definite matrix. The multidimensional space is non-Euclidean. When this matrix is orthogonally decomposed, negative roots result. These imaginary roots are reliable and meaning can be attributed to them (Danes and Woelfel, 1975). As a result their absolute value rather than signed-value should be used in the scree test.

[4]These calculations can also be performed by Galileo, version 3, see footnote 1 above.

[5]Data on the availability of the media were gathered by the author in a number of ways: Through newspaper advertisements and listings, the listings in the Ottawa-Hull telephone book and direct participation with the media.

[6]The author would like to thank Timothy Mabee and Elizabeth Ekdahl for their help in the translation of the instrument into French.

[7]The author would like to thank Dr. Thomas McPhail, School of Journalism, Carleton University, Ottawa, Canada, for making all the necessary arrangements at Carleton, the University of Ottawa and St. Paul's University. Without Dr. McPhail this dissertation would only be a dream. The author also would like to thank Dr. Roger Byrd, and Dr. Peter Johansen, Carleton University, Dr. Ross Hastings, University of Ottawa and Dr. Andrew Ruszkowski, St. Paul's University for the use of their classes.

[8]Dr. Hastings administered the questionnaire at the University of Ottawa and Dr. Ruszkowski at St. Paul's University.

CHAPTER FIVE

RESULTS

Overview

The objective of this chapter will be to report the results of the February, 1975, data collection. It was designed to test the hypotheses presented in the previous chapter. This chapter will proceed hypothesis by hypothesis. From these results inferences can be drawn which may help demonstrate the usefulness of the paradigm presented in chapter two and its applicability to the substantive problem of how bilinguals organize their semantic system.

Hypothesis One

> H_1: In a mixed space (symbols from English and French are present) the symbols will be organized according to the semantic content. Additionally, there will be the introduction of an additional language dimensions, separating the symbols of one language from the other.

Fifteen students at Carleton University filled out the mixed-language questionnaire during the February data collection. The results of this set of data produced the mean distance matrix presented in table two, and the spatial coordinate matrix presented in table three. Through the use of a scree test, it was determined that only the two largest positive dimensions should be retained in the multidimensional space. They accounted

for 75.1 percent of the variance in this space. The graphic representation of this spatial manifold is presented in figure one. These two dimensions may be labelled as evaluative (books to sports) and entertainment-information.[1] Further, the first dimension separated the electronic media from printed media.

Tables Two and Three and Figure Three About Here

Neither of these two dimensions nor any of the remaining seven can be easily labelled a language dimension. The reason is that on none of the factors are the English concepts at one end and the French, at the other. This can readily be verified by comparing the signs of the factor loadings. On no dimension do the English concepts (books, magazines, radio, sports and entertainment) share the same sign, while the French terms (des journaux, la musique, la télévision, cinéma and l'information) have the opposite.

The results of the attempt to predict the language vector from the spatial manifold also met with failure. First, each of the nine vectors were correlated with the language vector, producing the coefficients in table four.[2] Because the multiple correlation of all nine factors with the language vector with 1.0, only the factors with an r^2 of .15 or better were entered into a multiple regression.[3] These were dimensions four, five and six. It should be noted that these factors would not have been retained after the scree test, which would make

Table 2. Mean Distance Matrix for Bilinguals in a Mixed Language Condition

	1	2	3	4	5	6	7	8	9	10
1. Books	0.0									
2. Magazines	60.80	0.0								
3. Des Journaux	79.93	40.20	0.0							
4. La Musique	96.73	91.46	94.00	0.0						
5. Radio	105.85	88.71	67.50	25.71	0.0					
6. La Télévision	108.43	92.36	68.64	54.57	48.27	0.0				
7. Sports	161.57	143.00	89.93	111.29	72.93	54.43	0.0			
8. Le Cinéma	95.79	118.71	94.43	49.42	72.64	42.07	99.50	0.0		
9. L'Information	65.93	51.36	20.21	98.00	30.50	26.00	83.43	60.00	0.0	
10. Entertainment	31.43	48.00	53.62	18.14	36.00	40.64	33.57	19.07	67.36	0.0

N = 15

Table 3. Spatial Coordinates for Bilinguals in a Mixed Language Condition.

	1	2	3	4	5	6	7	8	9	10
1. Books	-73.85	17.12	19.40	15.00	9.66	-1.93	-.06	-12.33	2.19	-25.10
2. Magazine	-60.12	-24.18	-23.52	-1.56	-11.74	-3.25	-.05	14.40	-3.08	-19.33
3. Des Journaux	-16.97	-41.68	-2.81	2.70	-3.24	10.46	-.01	-6.59	-6.32	8.99
4. La Musique	6.59	50.47	-31.52	-7.61	-4.28	2.43	.01	-4.57	27.95	3.53
5. Radio	20.72	2.47	-23.15	-22.10	20.35	-.84	.02	.49	-23.54	-4.43
6. La Télévision	30.48	.06	9.02	-15.16	-18.01	-4.59	.02	-14.22	-16.53	4.13
7. Sports	80.19	-29.87	-.58	23.12	2.87	-1.47	.06	.60	13.76	-31.50
8. Le Cinéma	19.42	42.55	33.62	-4.92	-3.73	4.19	.02	14.15	-9.62	-13.07
9. L'Information	-8.56	-30.24	24.76	-23.38	6.48	-2.63	-.01	4.05	25.46	28.39
10. Entertainment	2.11	13.29	-5.22	33.92	1.67	-2.38	.00	4.01	-10.28	48.40
Eigenvalues (roots) of eigenvector matrix--										
	17642.34	8962.95	4320.12	3266.46	1066.40	183.64	.01	-859.44	-2698.65	-5445.09
Percentage of distance accounted for by individual vector--										
	49.78	25.29	12.19	9.22	3.01	.52	.00	-2.43	-7.61	-15.36
Cumulative percentages of real distance accounted for--										
	49.78	75.07	87.26	96.47	99.48	100.00	100.00	97.58	89.96	74.59
Cumulative percentages of total (real and imaginary) distance accounted for--										
	66.73	100.63	116.97	129.33	133.36	134.05	134.05	130.80	120.60	100.00
Trace 26438.63										

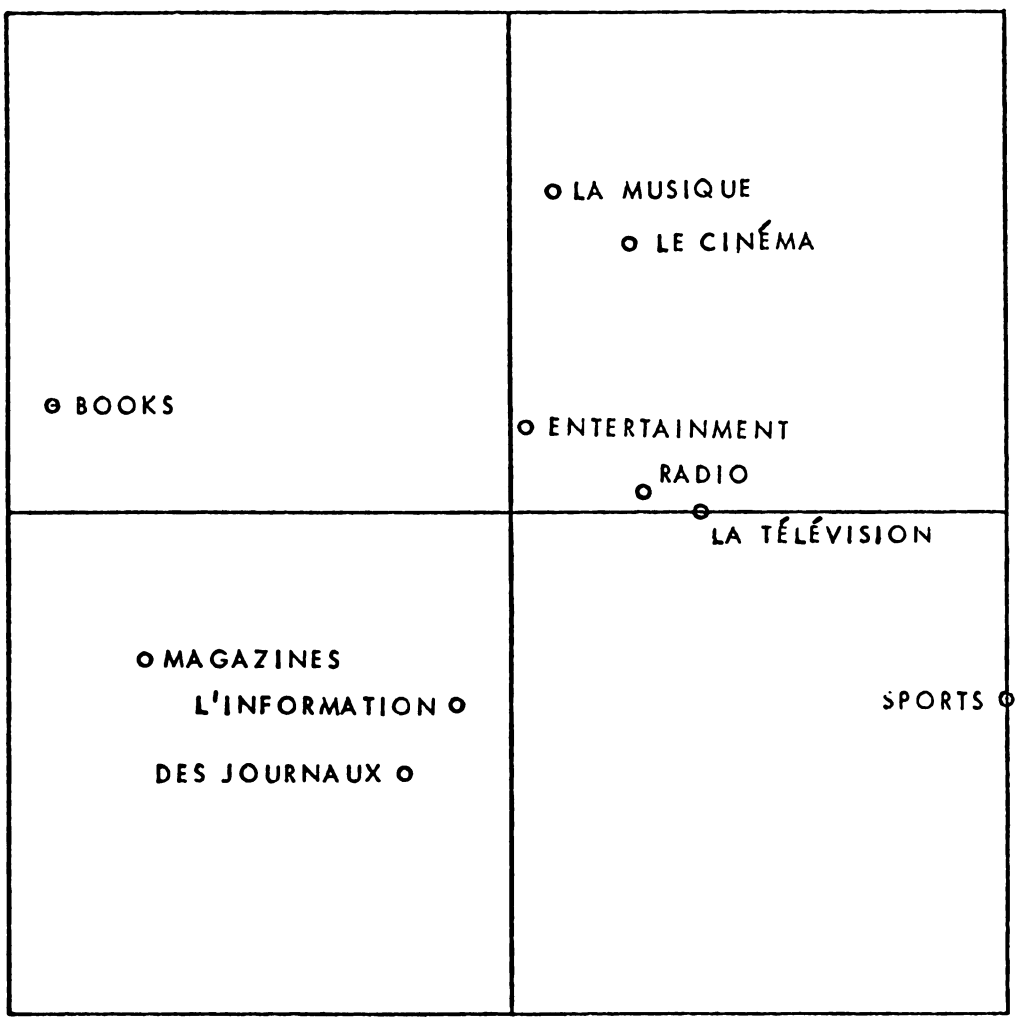


Figure 3. Bilingual Mixed-Language Space. N=15.

their contribution questionable from the start.[4] Together, they produced a multiple correlation of .83, which when squared created an R^2 equal to .69. It is significant at the .056 level. This probability is not low enough by traditional standards to reject the null hypothesis. However, the multiple correlation squared corrected for shrinkage was .447.[5] Thus, in the population of potential concepts, one would estimate that 44.7 percent of the variance on these three dimensions would be explained by language.

Table Four About Here

It should be noted that the inclusion of the language variable did not alter the dimensionality of the space. According to the scree test two underlying dimensions were present. As will be pointed out later, this result also occurred in the unilingual conditions. Thus, in the mixed-language condition the language attribute did not become manifest as a separate underlying dimension.

In summary, hypothesis one cannot be supported. Neither of the two dimensions which would be retained after the scree test could be considered a language dimension. From the regression analysis on all nine dimensions, it was determined that 44.7 percent of the variance of the language dimension is accounted for by these three dimensions. However, this was not significant at the .05

Table 4. Correlations of Individual Dimensions from Bilinguals Mixed Language Space with Language Vector.

Dimension	r	r^2
1	.147	.027
2	.141	.020
3	.318	.101
4	-.535	.287
5	-.441	.194
6	.460	.212
8	-.155	.024
9	.255	.065
10	.274	.075

* Dimension 7 was eliminated from this analysis because its variance equalled zero.

level. Clearly, the language attribute is present in the space. However, it only accounts for a small part of the total variance of the space.

Hypothesis Two

> H_2: A space generated by symbols from one language (English) will be significantly different from a space generated from its translated equivalents (in French), for monolingual subjects.

During the February data collection 150 anglophones at Carleton and 15 francophones at Ottawa and St. Paul's completed the questionnaires in their respective languages. The results of these sets of data are presented as the mean distance matrices (tables five and six) and the spatial coordinate matrices (tables seven and eight). A scree test on both sets of data determined that a two-dimensional solution made up of the two largest positive roots was appropriate for the English and French language spaces. In the case of the English space, these two dimensions explained 71.24 percent of the variance. The first two dimensions accounted for 63.69 percent of the variance for the francophones. The graphic representation of the English spatial manifold is presented in figure four and the French space in figure five. As in the case of the mixed-language space, the first dimension may be labelled evaluative and the second, entertainment-information. It also separated print media from electronic media.

Tables Five to Eight About Here

Figures Four and Five About Here

The French space was then rotated to a least-square congruence upon the English space using all ten factors. The distances between the two samples for each concept are given in table nine. The mean difference was 35.59 units. Under the assumption that if these two spaces were the same (the null hypothesis) the distances between the concepts would be zero, a t-test was performed to determine if these distances differed significantly from zero; t equalled 10.41. This is significant beyond the .001 level with df equal to 18. Thus, the null hypothesis of no difference between the two spaces can be rejected.

Table Nine About Here

Hypothesis Three

H_3: The space generated by symbols from one language (English) will be described by the same number of underlying dimensions as a space generated by its translated equivalents (French).

Based on the scree tests from the English language sample, the French speaking subjects and all sets of bilinguals in either of their two languages or when both languages were used to construct the spatial manifold, it was determined that there were two underlying dimensions

Table 5. Mean Distance Matrix for Monolingual English.

	1	2	3	4	5	6	7	8	9	10
1. Books	0.0									
2. Magazines	63.02	0.0								
3. Newspapers	96.09	55.97	0.0							
4. Music	123.82	120.81	161.97	0.0						
5. Radio	122.12	102.97	83.36	36.96	0.0					
6. Television	134.68	107.15	95.73	82.34	66.39	0.0				
7. Sports	155.69	136.38	97.82	154.23	110.06	67.73	0.0			
8. Movies	75.46	124.51	131.88	67.38	107.48	56.44	123.64	0.0		
9. Information	37.89	43.24	31.32	111.55	39.39	51.27	109.57	75.42	0.0	
10. Entertainment	33.10	43.93	95.23	15.94	37.52	38.68	57.10	16.76	77.18	0.0

N = 150

Table 6. Mean Distance Matrix for Monolingual French.

	1	2	3	4	5	6	7	8	9	10
1. Des Livres	0.0									
2. Des Revues	48.29	0.0								
3. Des Journaux	60.07	42.86	0.0							
4. La Musique	87.50	71.29	97.43	0.0						
5. La Radio	95.14	73.07	67.29	51.29	0.0					
6. La Télévision	94.50	76.93	65.57	74.21	43.00	0.0				
7. Le Sport	114.86	83.21	80.36	98.07	85.14	69.86	0.0			
8. La Cinéma	70.14	63.21	89.00	62.21	96.57	54.07	90.07	0.0		
9. L'information	83.79	48.36	28.00	103.21	32.21	36.64	81.07	84.57	0.0	
10. Le Divertissement	59.43	53.29	89.14	28.29	53.00	34.79	25.43	35.57	86.36	0.0

N = 15

Table 7. Spatial Coordinates for Monolingual English.

	1	2	3	4	5	6	7	8	9	10
1. Books	-78.65	3.15	-30.65	-10.62	-10.37	.01	-9.42	3.39	-17.91	-37.49
2. Magazines	-32.88	-23.24	.83	-23.74	26.17	-.08	1.17	-16.57	-4.45	1.47
3. Newspapers	-15.65	-66.82	2.89	-11.41	-2.77	-.22	13.91	22.42	-.42	9.21
4. Music	-10.32	84.65	23.71	-6.95	4.86	.27	5.66	10.26	29.36	-23.30
5. Radio	2.41	10.83	53.55	-5.63	-12.65	.01	.34	-9.87	-36.60	10.87
6. Television	39.57	.26	2.88	37.46	14.69	.00	-9.78	15.44	-23.34	-1.45
7. Sports	111.01	-28.36	-9.67	-13.58	-5.80	-.09	-.85	-7.99	11.48	-35.71
8. Movies	4.86	36.31	-40.02	26.26	-3.57	.12	14.63	-11.72	-12.49	14.84
9. Information	-42.07	-40.91	15.61	33.46	-6.13	-.13	-5.06	-10.28	41.39	6.41
10. Entertainment	21.68	24.18	-19.12	-25.26	-4.43	.08	-10.59	4.85	13.00	55.17
Eigenvalues (roots) of eigenvector matrix--										
	23776.95	16680.98	6691.95	4921.40	1302.97	.17	-764.03	-1559.18	-5257.75	-6735.97
Percentage of distance accounted for by individual vector--										
	44.55	31.25	12.54	9.22	2.44	.00	-1.43	-2.92	-9.85	-12.62
Cumulative percentages of real distance accounted for--										
	44.55	75.80	88.34	97.56	100.00	100.00	98.57	95.65	85.80	73.18
Cumulative percentages of total (real and imaginary) distance accounted for--										
	60.88	103.59	120.72	133.32	136.66	136.66	134.70	130.71	117.25	100.00
Trace 39057.50										

Table 8. Spatial Coordinates for Monolingual French.

	1	2	3	4	5	6	7	8	9	10
1. Des Livres	3.09	59.65	3.88	-7.97	-19.61	-1.71	.01	-2.77	-8.49	-15.49
2. Des Revues	11.53	27.01	6.75	-12.69	19.99	-9.65	.02	12.16	6.00	-7.56
3. Des Journaux	46.65	12.21	6.51	-6.53	1.69	16.04	.01	3.06	9.23	15.13
4. La Musique	-45.95	1.63	-34.03	-12.26	10.37	7.41	-.07	-1.15	-19.54	1.25
5. La Radio	11.73	-27.77	-40.75	-11.35	-5.69	-3.35	-.09	-6.14	22.15	-13.32
6. La Télévision	1.35	-27.83	-5.51	31.32	-8.38	1.52	-.01	16.85	-6.44	-12.30
7. Le Sport	-5.94	-44.90	44.39	-19.37	.45	1.63	.10	-5.44	-6.04	-17.70
8. Le Cinéma	-33.24	19.86	14.51	34.36	8.53	1.87	.03	-11.11	14.16	-3.26
9. L'Information	49.16	-11.38	-6.42	13.73	3.54	-8.10	-.01	-10.16	-18.41	17.02
10. Le Divertissement	-38.39	-8.49	10.68	-9.25	-10.88	-5.65	.02	4.69	7.37	36.23
Eigenvalues (roots of eigenvector matrix--										
	9600.42	8596.51	5288.84	3357.30	1201.19	525.69	.03	-765.70	-1737.59	-2782.56
Percentage of distance accounted for by individual vector-										
	33.60	30.09	18.51	11.75	4.20	1.84	.00	-2.68	-6.08	-9.74
Cumulative percentages of real distance accounted for--										
	33.60	63.69	82.20	93.96	98.16	100.00	100.00	97.32	91.24	81.50
Cumulative percentages of total (real and imaginary) distance accounted for--										
	41.23	78.15	100.87	115.29	120.44	122.70	122.70	119.41	111.95	100.00
Trace 23284.12										

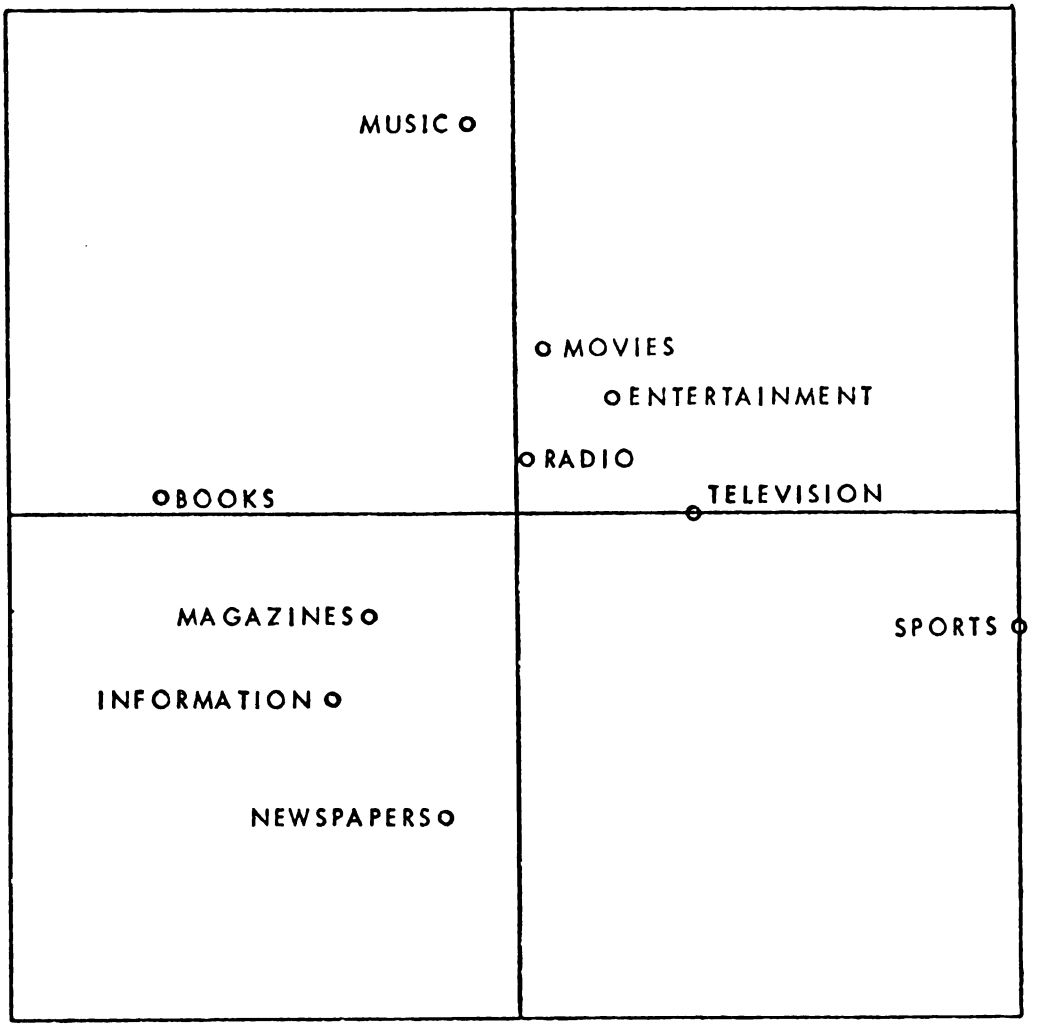


Figure 4. Graphic Representation of English Monolingual Space. N=150.

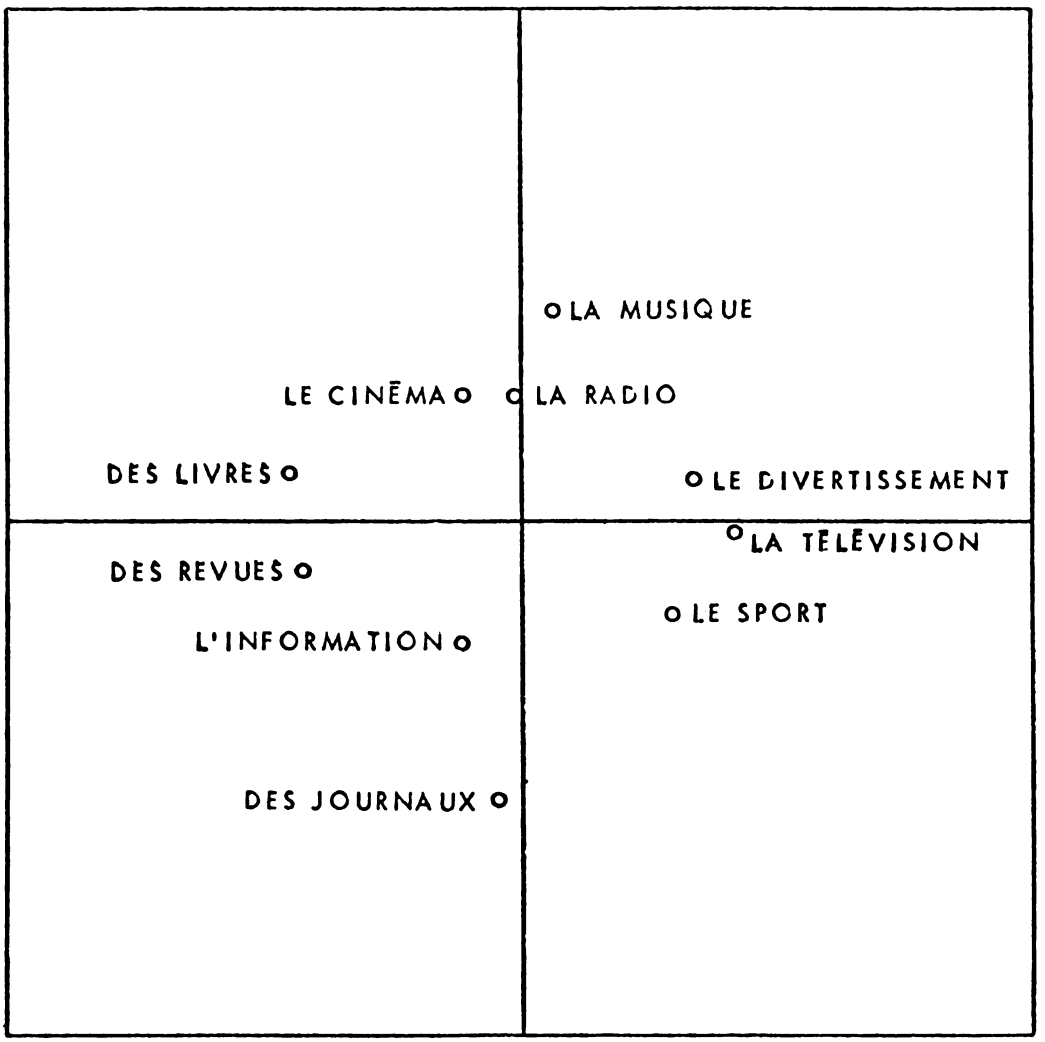


Figure 5. Graphic Representation of French Monolingual Space. N=15.

Table 9. Differences Between the French and English Monolinguals' Spaces after Least-Square Rotation on all Ten Dimensions

Concept	Differences in Spatial Position
Books	39.08 Units
Magazines	40.26 Units
Newspapers	37.43 Units
Music	41.67 Units
Radio	25.48 Units
Television	27.83 Units
Sports	59.28 Units
Movies	27.13 Units
Information	35.59 Units
Entertainment	22.12 Units
Mean Difference	35.59 Units

which were shared by all groups of subjects. In all cases, the dimensions selected were the two largest positive dimensions. They may be labelled evaluative (print media-electronic media) and entertainment-information. For the English monolinguals, these two dimensions accounted for 71.24 percent of the variance in the space. For the French monolinguals, it attributed 63.69 percent, for bilinguals in English, 75.80 percent, for the bilinguals in French, 72.50 percent and for the bilinguals with concepts in both languages, 75.07 percent. Thus, this hypothesis seems to be supported by the data.

Although no significance test was applied to these values, confidence may be placed in them due to the consistency of these scores. The range in the proportion of explained variance is only 12.11 percent and the greatest deviation from the mean percentage (71.66) of variance explained by these two factors is only 7.97 percent. Additionally, both dimensions can be easily identified and the same label can be applied equally well to the corresponding dimensions in each space. In summary, hypothesis three can be confirmed with a high degree of confidence.

Hypothesis Four

H_4: The space generated by symbols from one of a bilingual's languages (English) will be significantly different from the space generated by symbols from the other language (French).

During the February data collection, 82 bilinguals completed the English language version of the questionnaire at Carleton and 77 bilinguals completed the French version at Ottawa and St. Paul's. The results of these sets of data are presented as the mean distance matrices (tables ten and eleven) and the spatial coordinate matrices (tables twelve and thirteen). A scree test on both sets of data determined that a two dimensional solution made up of the two largest vectors was appropriate for both spaces. In the case of the English bilinguals, these two factors explained 75.80 percent of the variance. The first two dimensions accounted for 72.50 percent of the variance for the French bilinguals. The graphic representations of the English bilingual space is presented in figure six and the French bilingual in figure seven. As in all the other cases, the first dimension may be labelled evaluative (print media-electronic media) and the second, entertainment-information.

Tables Ten to Thirteen About Here

Figures Six and Seven About Here

The French bilingual space was then rotated to a least-square best-fit upon the English bilingual space. The mean discrepancy between the individual concepts was 21.84 units. The distance between the concepts is given

Table 10. Mean Distance Matrix for Bilinguals in English.

	1	2	3	4	5	6	7	8	9	10
1. Books	0.0									
2. Magazines	55.52	0.0								
3. Newspapers	81.59	37.78	0.0							
4. Music	108.64	104.51	146.03	0.0						
5. Radio	103.91	76.54	80.72	29.30	0.0					
6. Television	128.75	90.42	94.83	92.70	74.78	0.0				
7. Sports	190.70	142.31	119.96	167.08	113.78	78.04	0.0			
8. Movies	77.71	97.88	113.90	63.51	98.51	55.56	120.74	0.0		
9. Information	41.63	52.19	19.31	130.51	39.18	63.55	154.11	89.17	0.0	
10. Entertainment	36.69	52.73	84.57	14.74	39.03	32.21	49.47	18.32	97.54	0.0

N = 82

Table 11. Mean Distance Matrix for Bilinguals in French.

	1	2	3	4	5	6	7	8	9	10
1. Des Livres	0.0									
2. Des Revues	73.71	0.0								
3. Des Journaux	90.63	60.71	0.0							
4. La Musique	146.00	117.43	143.40	0.0						
5. La Radio	137.90	99.42	68.81	40.83	0.0					
6. La Télévision	140.29	103.90	93.60	74.85	53.88	0.0				
7. Le Sport	185.35	117.42	112.06	128.91	97.05	85.86	0.0			
8. Le Cinéma	103.59	113.01	122.06	63.51	92.00	55.47	123.36	0.0		
9. L'information	80.99	52.25	41.49	132.00	41.38	52.73	112.69	106.55	0.0	
10. Le Divertissement	89.03	74.18	98.09	29.30	59.49	48.55	36.39	36.39	117.02	0.0

N = 77

Table 12. Spatial Coordinates for Bilinguals in English.

	1	2	3	4	5	6	7	8	9	10
1. Books	-29.43	-70.94	-29.50	-2.68	-13.97	-.06	-4.56	23.13	6.66	-28.82
2. Magazines	-47.56	-32.73	16.40	-28.11	24.74	-.10	-2.69	-17.84	-10.33	-16.48
3. Newspapers	-74.93	18.94	14.03	10.19	-5.12	-.15	22.55	.64	17.69	13.70
4. Music	81.70	-25.26	28.15	-11.56	1.79	.17	1.61	-2.78	39.62	3.41
5. Radio	20.18	15.54	54.37	4.31	-19.03	.04	-.44	-2.82	-29.73	-22.36
6. Television	25.69	42.76	-2.19	21.93	22.82	.05	1.38	30.81	-6.91	-13.15
7. Sports	-11.06	87.32	-30.89	-20.54	-8.22	-.02	-10.14	-10.14	14.50	-15.61
8. Movies	45.03	-20.13	-45.42	25.32	.60	.09	10.23	-27.23	-13.77	-5.37
9. Information	-30.69	-12.08	11.02	33.80	.16	-.06	-20.76	-6.87	5.30	34.98
10. Entertainment	21.08	-3.42	-15.96	-32.65	-3.77	.04	2.84	13.11	-23.03	49.69
Eigenvalues (roots) of eigenvector matrix--										
	20020.10	17357.24	8483.35	4805.07	1801.89	-.09	-1187.78	-2882.07	-3924.08	-5939.70
Percentage of distance accounted for by individual vector--										
	38.16	33.08	16.17	9.16	3.43	-.00	-2.26	-5.49	-7.48	-11.32
Cumulative percentages of real distance accounted for--										
	38.16	71.24	87.41	96.57	100.00	100.00	97.74	92.24	84.76	73.44
Cumulative percentages of total (real and imaginary) distance accounted for--										
	51.95	97.00	119.01	131.48	136.16	136.16	133.08	125.60	115.41	100.00
Trace 38533.95										

Table 13. Spatial Coordinates for Bilinguals in French.

	1	2	3	4	5	6	7	8	9	10
1. Books	86.46	-50.05	16.98	2.29	-6.28	.27	-6.22	-7.79	6.55	-34.41
2. Magazines	41.85	9.63	21.80	-22.08	28.50	.13	6.66	5.95	-15.72	-3.33
3. Des Journaux	48.23	42.05	-1.42	-3.43	-24.16	.15	10.99	2.32	12.42	10.39
4. La Musique	-57.00	-48.70	-18.91	-30.40	4.74	-.18	2.08	-.78	33.44	1.95
5. Radio	-22.58	16.82	-39.04	-27.86	-12.40	-.07	-5.21	3.51	-30.58	-19.35
6. La Télévision	-34.00	10.47	-25.53	30.50	8.84	-.11	6.30	-18.27	-7.64	-17.87
7. Sports	-56.27	62.19	43.52	7.54	.26	-.18	-5.58	4.50	14.32	-26.23
8. Le Cinéma	-21.37	-54.07	-2.55	35.35	-3.14	-.07	2.08	19.10	-8.30	1.51
9. L'Information	44.15	34.57	-35.22	13.37	11.69	.14	-8.85	1.85	12.84	38.16
10. Entertainment	-29.45	-22.90	40.39	-5.28	-8.05	-.09	-2.24	-10.39	-17.32	49.18
Eigenvalues (roots) of eigenvector matrix--										
	22908.24	15638.88	8070.85	4648.21	1900.96	.23	-393.89	-944.48	-3294.59	-6564.87
Percentage of distance accounted for by individual factor--										
	43.09	29.41	15.18	8.74	3.57	.00	-.74	-1.78	-6.20	-12.35
Cumulative percentages of real distance accounted for--										
	43.09	72.50	87.68	96.42	100.00	100.00	99.26	97.48	91.29	78.94
Cumulative percentages of total (real and imaginary) distance accounted for--										
	54.58	91.85	111.09	122.15	126.68	126.68	125.74	123.49	115.64	100.00
Trace 41968.53										

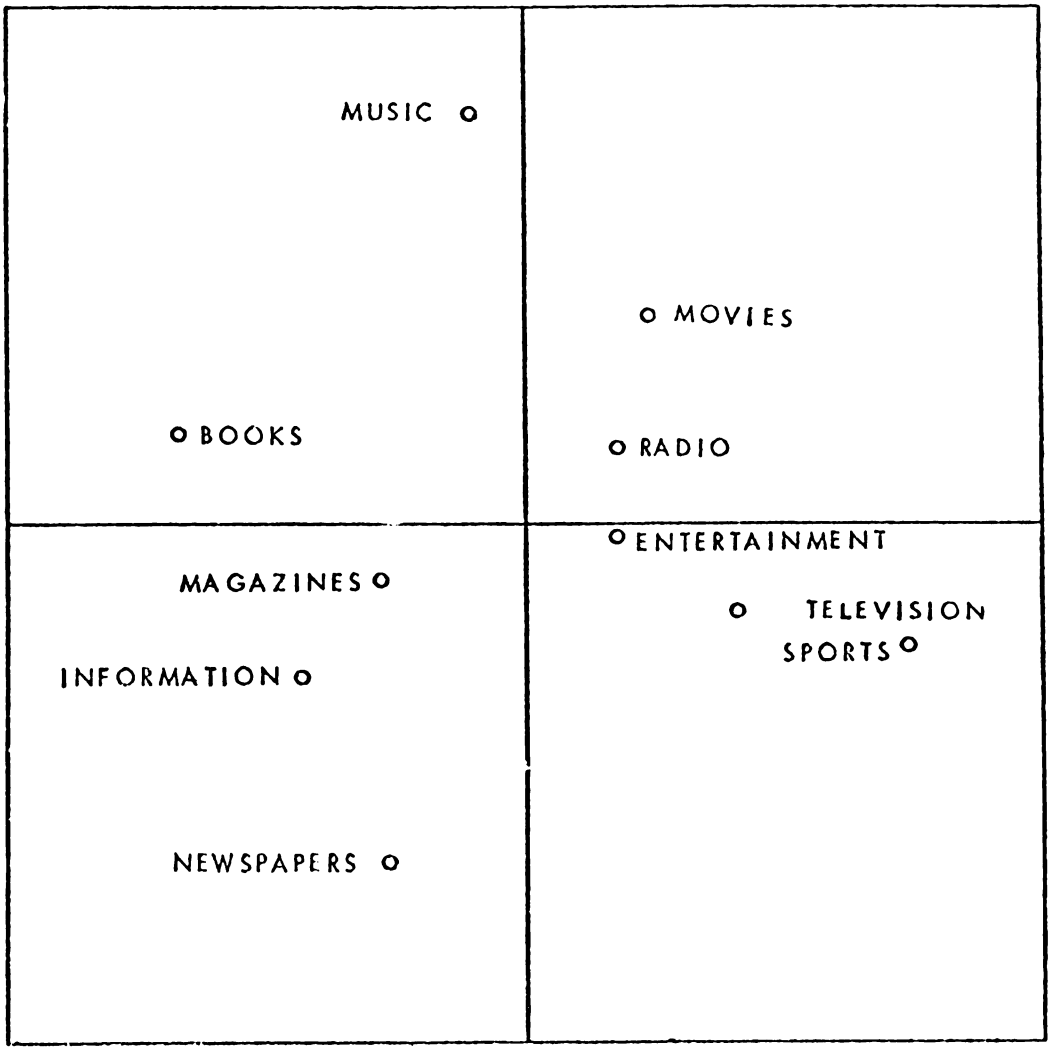


Figure 6. Graphic Representation of English Bilingual Space. N=82.

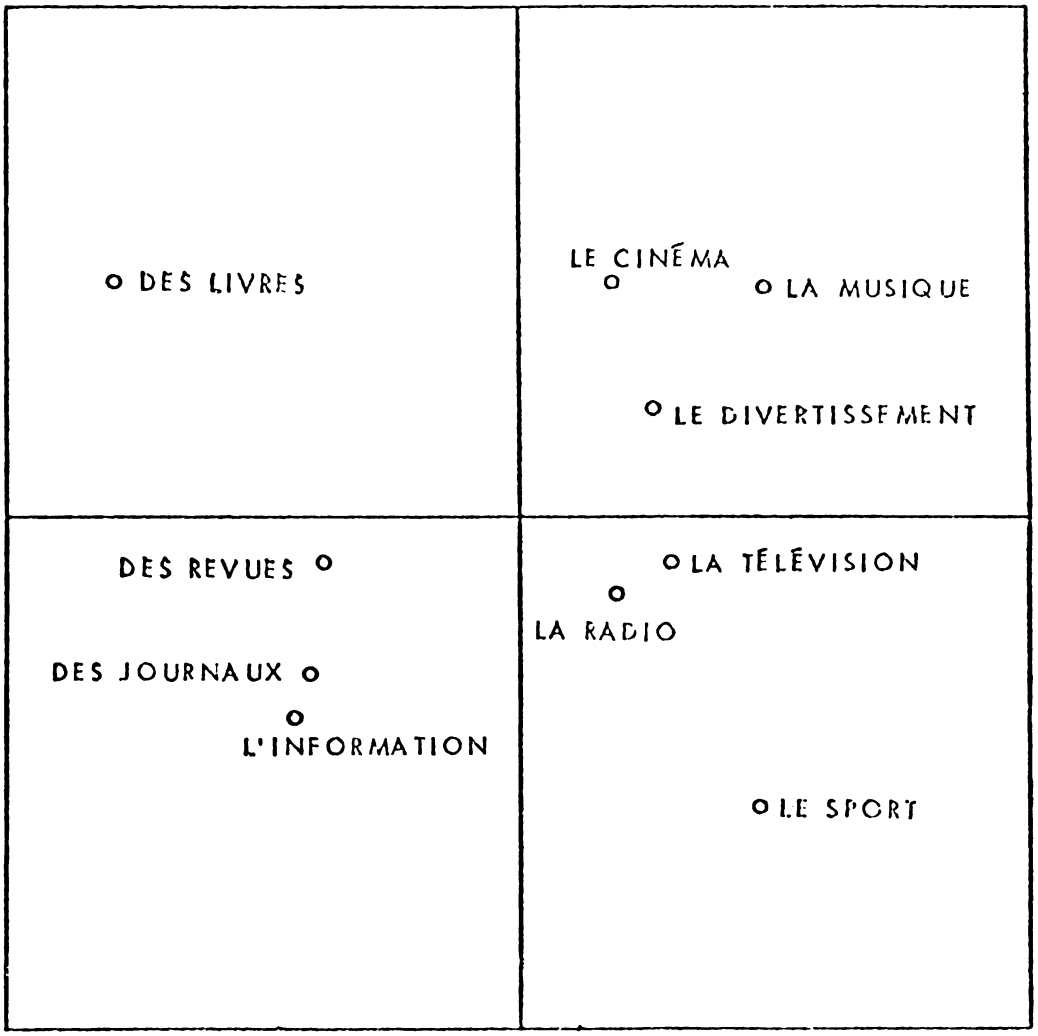


Figure 7. Graphic Representation of French Bilingual Space. N=77.

in table fourteen. A t-test was performed to see if these two spaces were significantly different. t equalled 7.96, which was significant beyond the .001 level with df equal to 18. Thus, the null hypothesis of no difference between the spaces can be rejected.

Table Fourteen About Here

Hypothesis Five

H_5: The degree of discrepancy between a space produced by a group of bilinguals (in either French or English) and a group of monolinguals in one of the bilingual's languages will be less than the discrepancy between the two monolingual groups.

The test of hypothesis five was performed in the following manner. The bilingual spaces both in English and French (tables twelve and thirteen) were rotated to a least-square best-fit upon the anglophone space (table seven) and the francophones' coordinate system (table eight). These operations produced a mean discrepancy of 19.28 units between the monolinguals and the bilinguals in English, a mean difference of 21.92 between the English monolingual and the bilinguals' French space, one of 29.10 units between the bilinguals' French space and its monolingual counterpart and a mean distance of 28.95 between the francophones' spatial manifold and the bilinguals in English. The vectors of discrepancy are given in tables fifteen to eighteen. These degrees of discrepancy are all smaller than the 35.59 units between the two

Table 14. Differences Between the Bilinguals' English and French Spaces After Least-Square Rotation on all Ten Dimensions.

Concept	Differences in Spatial Position
Books	31.99 Units
Magazines	18.07 Units
Newspapers	22.97 Units
Music	17.95 Units
Radio	8.96 Units
Television	14.97 Units
Sports	35.23 Units
Movies	19.69 Units
Information	32.51 Units
Entertainment	16.10 Units
Mean Difference	21.84 Units

monolingual spaces. Thus, all the relations were in the predicted direction.

Tables Fifteen to Eighteen About Here

Next, a series of t-tests (differences of means) were performed to see if the differences between the bilingual spaces and ones produced by monolinguals were significantly less than the degree of discrepancy between the two monolingual spaces. The t-test found that the degree of difference between the English monolingual and its bilingual space was significant at the .025 level. (t=2.48, df=18). The other differences were not significant. The English and the bilinguals in French difference was not significantly smaller than the discrepancy between the two monolingual spaces (t=1.62). This is significant between the .10 and .05 levels. While it is in the predicted direction it does not meet the probability level traditionally required to reject the null hypothesis. The differences between the French and bilingual in English and French and French bilingual were also not significant. t=.87 for the former groups and t=.91 for the later. These results are summarized in table nineteen.

Table Nineteen About Here

In summary, while all four comparisons are in the predicted direction, only one of the four is significant beyond the .05 level. One reached a probability level of

Table 15. Differences Between the English Monolingual and the Bilinguals' English Spaces after Least-Square Rotation on all Ten Dimensions.

Concept	Differences in Spatial Position
Books	19.44 Units
Magazines	20.02 Units
Newspapers	22.72 Units
Music	12.53 Units
Radio	10.34 Units
Television	16.07 Units
Sports	29.22 Units
Movies	20.92 Units
Information	23.38 Units
Entertainment	18.15 Units
Mean Difference	19.28 Units

Table 16. Differences Between the English Monolingual and the Bilinguals' French Spaces, after Least-Square Rotation on all Ten Dimensions.

Concept	Differences in Spatial Position
Books	30.13 Units
Magazines	18.33 Units
Newspapers	23.05 Units
Music	25.57 Units
Radio	13.75 Units
Television	21.68 Units
Sports	15.99 Units
Movies	22.20 Units
Information	30.85 Units
Entertainment	17.66 Units
Mean Difference	21.92 Units

Table 17. Differences Between the French Monolingual and the Bilinguals' English Space after Least-Square Rotation on all Ten Dimensions.

Concept	Differences in Spatial Position
Books	34.15 Units
Magazines	20.96 Units
Newspapers	23.35 Units
Music	36.05 Units
Radio	16.81 Units
Television	23.57 Units
Sports	54.29 Units
Movies	17.20 Units
Information	39.06 Units
Entertainment	24.02 Units
Mean Difference	28.95 Units

Table 18. Differences Between the French Monolingual and the Bilinguals' French Space after Least-Square Rotation on all Ten Dimensions.

Concept	Differences in Spatial Position
des livres	46.71 Units
des revues	29.83 Units
des journaux	21.65 Units
la musique	35.35 Units
la radio	21.04 Units
la télévision	17.38 Units
le sport	35.55 Units
le cinéma	26.90 Units
l'information	32.52 Units
le divertissement	24.09 Units
Mean Difference	29.10 Units

Table 19. t-tests Performed to Test Hypothesis Five.

Group	t	Significance (p)
English Monolingual-Bilingual in English	2.48	$\leq$.025
English Monolingual-Bilingual in French	1.62	$\leq$.10
French Monolingual-Bilingual in English	.91	>.10
French Monolingual-Bilingual in French	.87	>.10

.1 and the other two failed to reach even this degree of confidence. Thus, while the null hypothesis for hypothesis five cannot unequivocally be rejected, there seems to be a certain level of support for the notion that the degree of discrepancy between the bilingual and one monolingual will be less than the difference between the two monolingual spaces.

Hypothesis Six

> H_6: The degree of discrepancy between spaces of equivalent terms will increase in the following manner: monolingual language A (English), bilingual in language A, bilingual in B (French) and monolingual in language B.

In order to test hypothesis six all spaces were rotated upon all the others' coordinate systems. A graphic representation of all four spaces together is presented in figure eight for explanatory purposes. The discrepancies between them produced the matrix of mean differences presented in table twenty. With the exception of the difference between the francophones' space and the one produced by the French-bilinguals the results are in the predicted order. The means were then entered into a linear trend analysis. That is, the means were correlated with their predicted rank order of discrepancy from the monolingual spaces. In other words, the English monolingual system was assigned a position of zero. The discrepancy from the English monolingual space was one for the English bilingual space, two for the French

bilingual manifold, and three for the francophones. Likewise, the discrepancy between the English bilingual space and the francophone system was assigned a value of two and the French bilingual francophone discrepancy a one. These values produced a correlation of .6548.[6] A significance test was then performed on this coefficient which failed to reject the null hypothesis at the .05 level (F=6.00, df=1,5). Thus, although the means are in the predicted order, their placements are not significant and therefore, the null hypothesis of hypothesis six cannot be rejected.

Table Twenty About Here

Figure Eight About Here

Hypothesis Seven

H_7: The pattern of media usage will be significantly different for monolinguals in language A (English), monolinguals in B (French) and bilinguals living in the same geographical location.

Based on the data from questions 21 through 25 and 27 to 29, the null hypothesis of no difference between the pattern of media use for the two monolingual groups and bilinguals can be rejected. The English language sample on the average used the media a total of 51.4 hours per week, as compared to the French subjects who used the media an average of 39.1 hours per week. This difference

Table 20. Matrix of Discrepancies Between all Spaces.

	English Monolingual	Bilingual English	Bilingual French	French Monolingual
English	0.0			
Bilingual-English	19.28	0.0		
Bilingual-French	21.92	21.84	0.0	
French	35.59	28.95	29.10	0.0
N	150	82	77	15

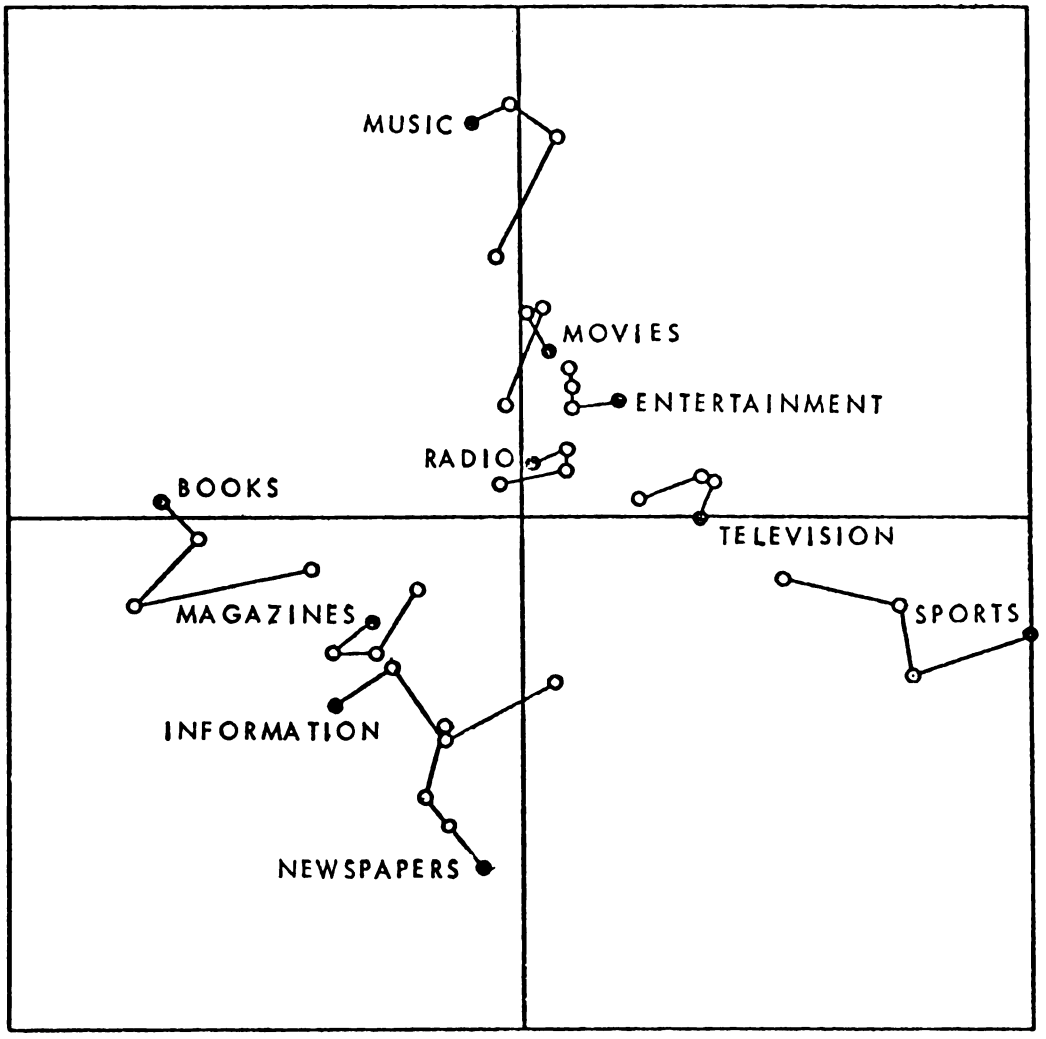


Figure 8. Graphic Representation of Combined Spaces of All Groups. The English monolingual space is closest to the label, followed by the English bilingual, French bilingual and finally, the French monolingual at the end of the connecting line.

is significant at the .05 level. This direction is maintained with all specific media except television. Television's use was significantly greater for the francophones ($p \leq .02$). They used TV on the average 10.9 hours per week as compared to 6.1 for the anglophones. This relationship was in reverse of the expected direction based upon the availability of the media. The other media (film, newspapers, magazines, radio, records/tapes and books) were all used to a greater degree by the English language group than the French language group. The differences were all significant at the .05 level, except records, which did not achieve significance at that level, and books, where a probability of .001 existed in the data.

While their total number of media hours per week (54.5) exceeded both the French (39.1) and the English (5.1) monolinguals, the rest of the figures place the bilinguals between the other two groups. Of the 54.5 hours, 40.7 (76 percent) are in English and 13.8 (24 percent) are in French. This compares to 47.7 hours (93 percent) in English and 3.6 (7 percent) in French for the anglophones, and 7.4 hours (19 percent) in English and 31.7 (81 percent) in French for the francophones. These relationships are significant beyond the .001 level in the predicted direction. With the exception of magazines, radio and records/tapes, these hours are moderate between the other two groups. For each individual medium the usage patterns in each language for bilinguals was moderate between the

francophones and anglophones. These results are summarized in table twenty-one.

Table Twenty-one About Here

It should be noted that the overall pattern of media use in the three groups is quite similar, indicating that the structure of media use is very homogeneous for the monolinguals and bilinguals. The rank order correlation of the hours used of the seven media between the anglophones and bilinguals is .96. It is .71 between the anglophones and francophones and .75 between the bilinguals and francophones. Again, although bilinguals' patterns are more similar to the anglophones, this finding indicates that the structure of media use for bilinguals is moderate between the two monolingual groups.

This analysis was extended to interpersonal communication (question 25), under the assumption that due to the bilinguals' embeddedness in the communication structure of society, they would tend to use interpersonal channels to a greater degree than monolinguals in order to transfer information across the language boundary. This notion was supported. Bilinguals used interpersonal communication more than monolinguals according to the data. On the average, they interacted a total of 30.7 hours per week with friends and family. Of these hours, 13.4 (43.7 percent) are in French and 17.3 (56.3 percent) are in English. This compared to 25.5 (24.4 or 95.7 percent

Table 21. Media Use Patterns of Bilinguals, English and French Monolinguals.

	English		Bilingual		French	
	Hrs.	%	Hrs.	%	Hrs.	%
Television						
English	5.4	(.89)	4.5	(.66)	1.9	(.17)
French	.7	(.11)	2.3	(.34)	9.0	(.83)
TOTAL	6.1		6.8		10.9	
Radio						
English	9.5	(.83)	11.0	(.74)	1.0	(.11)
French	1.9	(.17)	3.9	(.26)	8.3	(.89)
TOTAL	11.4		14.9		9.3	
Film						
English	2.5	(.93)	2.0	(.83)	.1	(.07)
French	.2	(.07)	.4	(.17)	1.4	(.93)
TOTAL	2.7		2.4		1.5	
Newspapers						
English	4.8	(.96)	3.2	(.78)	0.0	(.00)
French	.2	(.04)	.9	(.22)	4.1	(1.0)
TOTAL	5.0		4.1		4.1	
Books						
English	14.7	(.99)	8.6	(.74)	.8	(.17)
French	.2	(.01)	2.5	(.26)	5.9	(.83)
TOTAL	14.9		11.1		6.7	
Magazines						
English	2.7	(.96)	2.3	(.72)	0.0	(.00)
French	.1	(.04)	.9	(.28)	1.4	(1.0)
TOTAL	2.8		3.2		1.4	
Records/Tapes						
English	8.2	(.97)	8.5	(.77)	3.6	(.69)
French	.3	(.03)	2.6	(.23)	1.6	(.31)
TOTAL	8.5		11.1		5.2	
Total						
English	47.7	(.93)	40.7	(.76)	7.4	(.19)
French	3.6	(.07)	13.8	(.24)	31.7	(.81)
Grand Total	51.4	(1.0)	54.5	(1.0)	39.1	(1.0)
N =	150		159		15	

in English and 1.1 or 4.3 percent in French) for the anglophones and 24.2 (22.6 or 93.4 percent in French and 1.6 or 6.6 percent in English) for the francophones. These differences are significant at the .05 level and are summarized in table twenty-two.

Table Twenty-two About Here

In summary, hypothesis seven can be supported. While the overall structure of media usage is quite similar between the three groups, bilinguals use the total media and interpersonal communication more than either monolingual groups. Anglophones use the media significantly more than francophones with the exception of television, where the pattern is reversed. The pattern of use of the individual media for bilinguals is moderate between the two monolingual groups based upon hours and the language of use.

Hypothesis Eight

> H_8: The greater the proportion of mass media and interpersonal exposure in language A (English) (the less the proportion of exposure in language B - French), the greater the discrepancy of the space of the individual bilingual from the mean space of language B (French) monolinguals and the less the discrepancy from the average space of language A (English) monolinguals. This is for a space produced by translated equivalents.

In order to test this hypothesis 61 bilinguals in English and 60 bilinguals in French who completed all

Table 22. Comparison of Interpersonal Communication English, Monolinguals, Bilinguals and French Monolinguals.

	English Monolinguals		Bilingual		French Monolinguals	
	Hours	%	Hours	%	Hours	%
Total Interpersonal Hours*	25.5	(1.00)	30.7	(1.00)	24.2	(1.00)
English Interpersonal Hours**	24.4	(.96)	17.3	(.56)	1.6	(.07)
French Interpersonal Hours**	1.1	(.04)	13.4	(.44)	22.6	(.93)

* Significant in the predicted direction $p \leq .05$.

** Significant in the predicted direction beyond $p \leq .001$.

45 pair-comparisons were individually rotated to a least-square best-fit upon the aggregate space of both monolingual groups.[7] The degree of discrepancy for each individual was then calculated in the same manner as for the groups in the earlier hypotheses. These values were then entered into regression equations as the dependent variables with the proportion of mass media usage and interpersonal communication in each language as the independent variables. These results failed to reject the null hypothesis.

The zero-order correlations of the proportion of mass media and interpersonal communication in English with the degree of discrepancy from the French monolinguals' space were .20 and .07 respectively. The former coefficient is significant at the .04 level (F=4.35, df= 1,118) and the later did not achieve a .05 level (F=1.16, df=1,118). The zero-order correlations of the proportion of the mass media and interpersonal communication in French with the degree of discrepancy from the English monolingual space were .04 and .18. The later coefficient was significant at the .02 level (F=5.22, df=1,118) and the former did not achieve a .05 level (F=.17, df=1,118). Additionally, it was in the opposite of the predicted direction.

With these sets of zero-order correlations, multiple correlations were calculated. The attempt to predict the degree of discrepancy from the French space

from the two variables produced a multiple correlation of .20 which when squared was .04. This was not significant at the .05 level ($F=2.49$, $df=2,118$, $p \leq .088$). Likewise, the attempt to predict the degree of discrepancy from the English monolingual space with the language of mass and interpersonal communication was not significant at the .05 level. The multiple correlation was .21 and its square .04. ($F=2.70$, $df=2,118$, $p \leq .07$).

It is worth noting that in one case the language of mass communication was responsible for the size of the multiple correlation, while in the other the language of interpersonal communication explained most of the variance. In the attempt to predict the English discrepancy, the mass media variable had a beta weight of .13, while the interpersonal variable's beta was .22. In the French case, mass media had a beta of .45, while the interpersonal communication's beta was .03. These two tests may be taken as an attempt at cross validation of the predictive equation.[8] Because of the unstability of the beta weights this hypothesis may be rejected.

Summary

In summary, this chapter has reported the results of the test of eight hypotheses dealing with the organization of semantic information by bilingual individuals, how their system of organization relates to monolinguals and the causes for the arrangement of concepts

in their semantic system. Of these eight, four were confirmed, one was partially supported and the null hypothesis could not be rejected for three hypotheses. The implications of these results for the theory of bilingualism and the paradigm for the measurement of meaning presented in earlier chapters will be discussed in the following chapter.

FOOTNOTES FOR CHAPTER FIVE

[1]The use of M.D.S. requires that the dimensions be taken into account simultaneously (Torgerson, 1958). Thus, the notion of identifying individual dimensions may in fact be running against the spirit of the method. However, for ease of explanation and interpretation, this approach was adopted. In factor analysis because the data matrices are standardized, only the unique contributions of each factor can be considered, rather than the interrelations of the concept loadings on these factors.

By attaching an attribute label to one dimension of the space, it is implied that all the variance of the dimension could be explained by that attribute. This need not be the case and may only lead to confusion. A dimension should only be used to refer to the orthonormal reference vector and never to an attribute. Two variables may interact in such a way as to produce the variance on one dimension. Additionally, if an attribute is present in a space it may be congruent with the variance on two or more dimensions. Most likely, the attribute's variance can be explained by multiple vectors. Finally, the labelling of dimensions is a post hoc intuitive process which, although verifiable through regression procedures, should be avoided.

[2]The seventh or zero vector was removed from the analysis. The reason is that any N concepts may be plotted into a space of N-1 dimensions without any loss of information. For example, any two points may be connected by a line, yielding a single dimension upon which to differentiate the points. Three points may be connected by a plane. Likewise, four points may be connected in a cube and any N points in a hyperspace of N-1 dimensions. However, if any three or more points lie along a single continuum, fewer dimensions would be needed to precisely describe the system.

[3]As the number of variables (columns or dimensions) approaches the number of cases (concepts), the multiple correlation approaches 1.0. In this case, there were nine factors and only ten concepts. The R^2 was equal to 1.0.

[4]An argument against the use of the scree test and the notion of only using a limited subset of the dimensions in the space may be made from these results. Had only the first two dimensions been used to describe the space, almost no variance could be attributed to the language variable. This obviously would have been an erroneous conclusion. On the dimensions to the right of

the elbow language produced considerable variance, which, in the light of the total variance in the space is limited, but nonetheless present. Thus, all dimensions probably should be included in the analysis to avoid fallacious interpretations.

[5]The formula for the R^2 corrected for shrinkage is:

$$\bar{R}^2 = 1 - (1-R^2)N - 1/(N - k - 1)$$

where: N = number of concepts (subjects or cases)
k = number of factors (independent variables)

A complete discussion of the shrinkage of the multiple correlation is given in Kerlinger and Pedhazur (1973: 282-284).

[6]The zero value was not entered into the correlation. It was only presented here in order to facilitate the explanation of the method.

[7]Although 82 bilinguals completed the instrument in English and 77 in French, only 121 cases total were usable for this analysis. One reason was that 17 English bilingual and 14 French bilingual subjects did not complete all 45 pair-comparisons leaving empty cells which could not be used to generate a spatial coordinate system. Ordinarily, this is no problem and these subjects can be included in the analysis because the data is aggregated. That results in a variable sample size for each cell which does not affect the construction of the multidimensional space. The individual space could be generated if one was willing to estimate a value for the null cells. Presently, Galileo 3 does estimate empty cells, by taking a row or column average. The author feels this is an erroneous estimate because the empty cell may be a pair-comparison quite different from the other pairs in the row. A better estimate might be to use the group average. In this case, this would be the English or French bilingual average. However, even this estimate might not be appropriate if the individual is a deviant. Thus, rather than making uncertain estimates, the author decided to delete these cases.

Another reason that subjects were removed was their use of extreme values. Four English bilinguals and three French bilinguals had a cell average of greater than 1000. While these values do not affect the space in the aggregate because the other scores limit the effect of the extremes, in the case of individuals the extreme values may alter the dimensionality of the space and make comparisons impossible.

It should be noted that Galileo 3 does not allow the direct comparison of a mean space to individual spaces. Also, its input format requires integer data rather than real numbers. As a result, both the monolingual spaces were repunched into integer input format. This required that the values be rounded to the nearest whole number. Thus, there is a certain degree of rounding error in the discrepancy scores for each individual.

[8]Ordinarily, cross-validation is performed on two separate samples. The predictive equations resulting from the first sample are applied to the second to see the validity of the beta weights and multiple correlation. In this way the instability of the beta weights (the bouncing beta problem) are taken into account. Cross validation is discussed in depth by Kerlinger and Pedhazur (1973: 282-284). In this case, only one sample was available. However, two separate sets of variables which would identically test the theoretical hypothesis were used. Together, they can be compared to provide a better estimate of the significance of the predictive equation than only one estimate. In this way, there are two estimates for the relationship between the language of mass media and interpersonal communication and the discrepancy from the monolingual space.

CHAPTER SIX

DISCUSSION AND SUMMARY

Overview

The purpose of this chapter is to discuss the results of the investigations described in this study in terms of a theory of bilingual information processing and the paradigm for the measurement of meaning. It will also consider the social ramifications of the research in light of the problem of language shift. The final intent of this chapter will be to summarize the ideas in this thesis. The chapter will be divided into two portions. The first will consider the results of the tests of the eight hypotheses in light of a theory of bilingualism described in chapter three and the paradigm presented in chapter two. The latter will analyze the methods used in this study and how they might be altered in order to answer the questions this dissertation has raised but failed to resolve, and any new ideas which might be posed in this discussion.

The Theory

This section will proceed based upon the assumption that the findings reported here are generalizable to all bilingual individuals living in all bicultural environments. This, of course, is at best a tenuous presumption. First, the subjects were all college students.

A common criticism of social research is that we have learned a lot about the psychology and social behavior of college sophomores and white rats but little about people in general.

It is of concern to the author that two cells had only fifteen cases each. This has produced some reservations concerning the results. Do fifteen francophones adequately represent all users of that language? Perhaps not. This limited sample size may have resulted in the reversal of the predicted direction that was observed in hypothesis six.

Another possible criticism of the external validity of the study might be the sample of languages used. Only two languages were involved in the study. French and English are quite similar. Both are Indo-European languages and they share certain lexical items. In this sample of concepts the translated equivalents of radio, television, sports and information are identical except for phonological variation. Additionally, these two cultures have been interacting for centuries, adopting ideas, practices and technology from one another. Perhaps a better sample of languages might have been to use a native American language and English or some oriental language such as Chinese, Korean or Vietnamese with English. These languages are quite different, the world views of these cultures are very discrepant, and the interaction between the societies has been a relatively

recent phenomenon. However, subjects in these languages were not available and thus French and English speaking subjects were used.

The final problem of generalizability concerns the sample of concepts for this research. Only ten concepts dealing with a very limited substantive topic, the perception of the mass media, were scaled. This may be too few to produce meaningful results which would lend support for a theory of bilingual information processing.

All these considerations, along with the additional questions about significance testing in chapter four, must be taken as important restrictions on the generalizability of the results beyond the immediate data observed. Nonetheless, within this sample and under the conditions of this investigation, certain findings are clear-cut. From the data, it seems reasonable to conclude that language was not a major factor in the organization of semantic information by bilinguals. The semantic structure of multilingual individuals is organized in the same manner as those who only speak one language. This organizing principle seems to be the semantic similarity of the symbols. In all bilingual conditions (in either of their languages or when both are present) only two underlying dimensions were present. This is the same number of dimensions as were used by monolinguals. This may be taken as evidence in support of the paradigm for the measurement of meaning. All people process meaning in

the same manner regardless of the language in which the information is transferred.

The notion that semantic organization is independent of the specific language in which information is transferred would be in direct conflict of the Sapir-Whorf notion of linguistic relativity. They argue that language affects the way in which people process information. This is not to suggest that Sapir and Whorf's notions don't apply to syntactical variations between languages, but only to some limited aspects of the processing of semantic information. Also this does not imply that there are not cultural differences between linguistic groups, but only that all people process information in the same manner. Although the same number of dimensions and a similar arrangement of the symbols occurred in all spaces (see figure six), it should be pointed out that the results of hypothesis two and hypothesis four found significant differences in the arrangement of the concepts in the spaces of the monolinguals and bilinguals. Although, hypothesis eight was not supported, these may be the results of cultural differences produced by the communication patterns of each group. The communication distributions among them are restricted either by language or by social structural variables. Thus, the shared past experiences of the members of the groups with reference to the particular set of scaled concepts may be very limited. Clearly, it is impeded by the restricted interaction due to the lack of a common language.

The semantic structure of bilinguals may be considered to be moderate between the structures of the two monolingual groups from which their languages are taken. Hypothesis five was only partially supported. Although all the coefficients were in the predicted direction, only one of the four values was significant at the .05 level. While all the effects hypothesized were observed in this sample, in only one were the results strong enough to warrant generalization to a larger population with great confidence. Support for this conclusion may also be gained by an examination of figure six. This may be taken to indicate that the meaning system of bilinguals contains elements from both cultures. Bilinguals can share common experiences with either monolingual group due to their ability to communicate with both linguistic systems. However, rather than suggesting that the cause for this relation is inherent in the language, the author feels that the sociolinguistic notion of a speech community should be applied. Thus, the language groups should be described as separate cultural entities, with a different language. This would make more sense in terms of the paradigm, especially when considering that the semantic system may be independent of a specific language. The individuals' semantic systems are contingent upon their past experiences. A common language makes shared experiences possible to a far greater degree. As pointed out in chapter two, meaning must be defined in terms of

the language user's perception of the relationship between lexical items. The users of English are the anglophones and the bilinguals. The bilinguals also use French as do the francophones. This would seem to imply that the semantic system of bilinguals should be described by some balance between the consensual structure of each language. This seems to be the case, because the bilingual can integrate into either the French or the English speech community.

The bilingual's usage pattern of the mass media and interpersonal communication is also moderate between the two monolingual groups (hypothesis seven). While they used both types of channels to a greater extent than either the francophones or anglophones, the use of each specific language is less than the monolingual in that language but greater than the other set of monolinguals. The large total number of media hours is probably due to their embeddedness in two separate speech communities and the resultant abundance of media available to bilinguals. The degree of interpersonal communication may result from the fact that the media segregates the languages. All messages that are communicated across the linguistic boundary must pass through a bilingual, rather than directly through the mass media. Media messages are in either one language or the other. Simultaneous broadcasts in both French and English rarely occur, although it is conceivable that the video portion of a television program

could be held constant with the audio portion differing by language across two different television channels. This would be similar to dubbing, which is a common practice in foreign language films. Clearly, bilinguals are potentially important as an integrating mechanism for Canadian society. Thus, it may be necessary for bilinguals to interact interpersonally to a greater extent in order to perform their role as a cohesive mechanism in society.

However, while the use of the media and interpersonal communication of bilinguals is moderate between the monolingual groups, these variables do not seem to be good predictors of the individual bilingual's semantic structure (hypothesis eight). This would seem to run against the assumptions of the applied measurement system. If the spatial configuration is contingent upon an individual's past experiences, then media and interpersonal communication in each of their languages should predict the degree of discrepancy of the individual's structure from the monolinguals' spaces. This hypothesis was not supported. There are two possible reasons for this. Either the theory is fallacious or the methods employed were inadequate to describe the relationship. The author prefers the second explanation. The reasons for this conclusion and alternative procedures to test this hypothesis will be presented later in this chapter.

In summary, this portion of the discussion has

taken the empirical results of the test of the eight hypotheses as evidence for a theory of bilingual information processing. It is based on the assumption that the findings of this investigation are generalizable to all bilinguals in all bicultural settings. The organization of the semantic structure is independent of the particular language in which the message is communicated. All people, whether bilingual or monolingual, process meaning in the same manner. The author suggests that the organizing principle is the semantic similarity of the symbols involved. There are cultural differences in meaning. These probably result from the lack of communication between the societies rather than being inherent in language as Sapir and Whorf have suggested. Bilingual individuals' semantic structure may be considered to be moderate between the structures of the two monolingual groups from which their languages are taken. This results not from the structural properties of the language, but rather the bilinguals' ability to communicate effectively with either separate cultural group. The bilingual uses the mass media and interpersonal channels to a greater degree than the monolinguals, but their use of each language is moderate between the monolingual groups. This may result from the bilingual's embeddedness in two separate speech communities, their awareness of the opportunities in the media and the bilingual's role in the communication structure of society. Finally, mass media and interpersonal

usage does not seem to affect the way in which bilinguals process information.

Critique of Methods and Future Research

The investigation failed to find a significant and stable relationship between the bilinguals' mass media exposure and interpersonal communication with the degree of discrepancy from the monolingual spaces. The methodological reason for this may have been that the measure of discrepancy was inappropriate. There are two reasons for this statement. The first is the high degree of congruence between all the spaces in the analysis. There was a high correlation (.95) between an individual's discrepancy from the French space and his/her discrepancy from the English system. The reason was that rather than measuring some degree of difference what was measured was the magnitude of the individual's dissimilarity estimate. The larger the size of the average cell value, the larger was the discrepancy from the monolingual space. Thus, if an individual perceived the distance between red and white as very small he/she tended to use larger numbers for their estimates of the distances between the concepts. One possible solution to this problem might have been to expand or contract the individual spaces. This procedure has been used by psychometricians (Schönemann and Carroll, 1970) and essentially involves standardizing all the vectors of the spaces to the same

magnitude while preserving the relative relationship between each of the interpoint distances. However, the method may lead to erroneous conclusions, because as Lingoes and Schönemann (1974) point out such translations do not preserve the angles between the vectors. Additionally, this may have the effect of bounding the space and altering the true distances between the objects.

The second reason why this procedure may have been inappropriate is that the elements in the space did not reflect any difference between individuals which were measurable in terms of individual rates of behavior. A better approach might have been to scale three additional concepts (French, English and Me) into the space. The pair-wise distance between Me and the two languages could be used as the criterion variable which might be predicted from the proportion of the media and interpersonal communication in each of the bilinguals' two languages. In this way, it may become possible to demonstrate that the semantic structure is contingent upon the individuals' past linguistic experiences. These calculations could be performed in the same manner as outlined in Barnett, Serota and Taylor (forthcoming), for the prediction of an election. The criterion variable, proportion of distance from language A, would be derived from the equation,

$$X = 1 - S_m(A) / [S_m(A) + S_m(B)]$$

where, X = the criterion variable, $S_m(A)$ = the distance

between Me and language A (English) and $S_m(B)$, the distance between Me and language B (French). This would take into account the relative distance between the language and the self, and can be interpreted like a percentage. The spatial configuration would provide an accurage representation of the relationship between the media concepts, the languages and the self because all the pair-estimates are taken into account more or less simultaneously and error is better attributed to multiple influences upon judgment than a single estimation. Additionally, scaling in this manner accounts for all influences inherent and necessary in a specific set of judgments (Thurstone, 1927). In this case, the set of judgments refers to the mass media and its relation to language and self. Thus, by using the pair-wise estimate for a multidimensional space there is a greater degree of determinancy in the estimation of the relationship than by using a single measure. From the above discussion, the first suggestion of future research can be made. That would be to scale additional concepts in the spatial manifold. Besides French, English and Me, other concepts might be Family, Friends, Religion or Education. This would have a number of advantages. First, it would relate the semantic system of an individual to other institutions besides the mass media. This would make the data set more compatible with the data reported by Barnett and Wigand (1975). In this way, the social system in which any future data would

be collected could be compared more directly to the United States, Mexico, South Africa and the other countries not yet analyzed. This would also provide further evidence as to whether the differences in the spaces could be attributed to culture or language.

The second advantage of the increased number of concepts would be an increment in the degrees of freedom for the comparisons between the spaces. In this manner it might become easier to reject the null hypotheses on statistical grounds. Hypotheses five and six, while in the predicted direction, were not significant, and the author would prefer a similar but larger data set to settle this still unresolved issue.

The third advantage would be the increased generalizability. Based on only ten concepts, it seems rather tenuous to describe the entire semantic system of all bilinguals. The author would like to increase his confidence in the generalizability of the stated conclusions. This confidence could be provided with an additional data set with a larger sample of concepts.

The only disadvantage to an increased number of concepts would be the additional respondent burden. The number of pair-comparisons increases at a geometric rate with the arithmatic increase in concepts. As a result, what started out as 45 pair-comparisons with 10 concepts soon reaches 105 estimates with the addition of five terms. While college students willingly cooperate for

about 30 minutes of filling out a questionnaire, an hour's participation might introduce the problem of lack of attention by the respondents. This problem may become especially acute with a general population. It should be noted that there are alternative procedures which would allow this data to be collected. They would involve the use of splicing groups of pair-comparisons gathered on subsets of concepts, which when combined, form complete spaces. These procedures, however, require large numbers of subjects and make it impossible to use the individual as the unit of analysis as suggested above.

One of the basic tenets of the paradigm of the measurement of meaning is that the relationship between lexical items changes over time as a function of the information made available to the social system. This study included data from only a single point in time. Any future research on human information processing in general and specifically on bilingualism should deal with the change in definitions over time. One might take the variable, proportion of distance from language A, constructed above and observe how it changes as new communication media are made available in one of the bilingual's languages. One might predict that the distance between me and that language might become smaller as the proportion of the media in that language increases.

A good experiment might be to plot the changes in the meaning system of students at the United States

Army Language School or amongst the new Vietnamese refugees against a control group of native speakers in both languages. This research would attempt to answer the question of how an individual's semantic organization changes as he/she becomes bilingual. Another question might concern these structures at the various stages in the emergent bilingual compare to native speakers of the acquired language. One might predict that as the subjects learn the second language their semantic structure would become more congruent with the space from a group of native speakers of that language. The data reported here were based upon bilinguals living in a bicultural environment. From this the author concluded that language was of minor importance in the arrangement of the spatial configuration. This raises the related question. Does language become a less important attribute in an individual's semantic space as the second language is learned?

While this data provides only a static representation of the semantic system among three separate groups, it points toward future research in the area of language shift. This phenomenon may be described as the change in the pattern of spoken language among a given community, where the unit of analysis is some institution. This may range from a family to a political entity such as a metropolitan area or entire nation. This phenomenon has been described in great depth by Lieberson (1970). He points out that between 1951 and 1961, the retention

of French by bilinguals declined in all but one city (Quebec City) in Canada. The causes of this shift that he identifies are the residential patterns of urban areas, demographic factors such as variable fertility rates and immigration, the influences of occupational pressures, education and the mass media.

The data presented here also support these contentions. In the pattern of mass media exposure, bilinguals used approximately three times as much English programming and materials as French. Among the monolinguals, the francophones used twice as much English media as the anglophones used French media. This trend is also present in terms of interpersonal communication, where 56 percent of the bilinguals' interaction was in English. Additionally, the francophones used English more than the anglophones used French in interpersonal interaction. These findings are suggestive that the direction of language shift will be toward the dominant anglophone culture. Lieberson (1970) has documented this direction of change in all Canada's provinces except Quebec, where this relationship was not upheld.

Perhaps a more important finding is the one which shows that the bilinguals' semantic structure in French is more similar to the anglophones than to the francophones. The mean discrepancy between the French bilingual and the anglophone space is only 75 percent of the distance between the francophone and the French

bilingual space. Clearly, this should be taken to indicate that the semantic system is not language dependent but rather it results from the cultural differences between the groups and the individuals' past experiences. These experiences may result from both interpersonal interaction and the exposure to the mass media. Additional evidence for this conclusion comes from Lieberson (1970) who describes the residential patterns in Ottawa. French ethnic bilinguals are less closely linked to their French compatriots than anglophones in terms of geographical location of residence.

Over time one would expect that these differences would become more profound. The author feels that within two or three generations Canada may become a monolingual society. The one language would be English. It may take one generation for the francophones to become bilingual and another for the bilinguals to lose their mother tongue. Also, without the language difference from the United States, it seems reasonable to suggest that the two countries may unify at that time. These conclusions are based on the availability of the mass media, its use by bilinguals and monolingual French, the semantic systems of these three groups and the work of Lieberson. One factor previously unmentioned is the United States and its almost totally pervasive influence on Canadian culture. Future research in Canada should continue to observe the language behavior and semantic

systems of all groups. This would provide an excellent example of language shift and its relation to nation building and the more general sociological phenomenon of acculturation.

At the present time Canada is pursuing a national policy of developing a bilingual and bicultural society. Based on this research it seems unclear how that is going to be accomplished. If the entire society becomes bilingual it is doubtful that it will remain so for more than a generation or so due to the influence of the United States and the lack of francophone inputs into society to counterbalance the pressures from the south. Perhaps a better policy might be to segregate the language groups as has been the practice in the past. With the addition of increased French media content, the francophones' influences could continue to balance the powerful English influences. Under these conditions, bilinguals would still be present to link the two separate cultures; Canada could retain its rich francophone culture and perhaps minimize the influence of the United States.

A final piece of research that this dissertation suggests is a network analysis of a bilingual community. Schefferville, Quebec (population 3,000-plus) is a bilingual community that would provide a good example to describe the interaction patterns of people in a bicultural environment. Are these patterns based upon language, with francophones forming one or a series of

interconnected groups, linked together through bilinguals to a network of anglophone groups? Or, do other variables such as social class form the basis of communication structure in this setting? Do opinion leaders in these groups cross linguistic boundaries? Related questions concern how flow of news and other information would change in this community over time. Would a new environment stimulus such as a media in English channel alter these relations? Or would changes in the economic base of the town alter the networks to a significantly greater degree? With this data one might be able to make more reasonable estimates as to how the languages and interaction patterns of individuals affect the way in which they process information.

In summary, this section of the chapter has suggested future research in a number of critical areas. Among the suggestions have been a new operationalization of the notion of the relation between language and self. This would enable the researcher to better ascertain the relationship between past experiences and semantic structure. Other suggestions have been the inclusion of additional concepts to scale in order to increase the generalizability of the results, the study of semantic change over time and a network analysis of a bilingual community in order to determine how language affects individual interaction patterns.

Summary

In summary this dissertation began with a discussion of the measurement of meaning. It stated that meaning can only be measured in terms of the relations between symbols. The most important of these relations is similarity. Additionally, any system which measures meaning should be capable of taking into account the consensual nature of meaning and the dynamic nature of the relations. Finally, the system should be empirically fruitful. It next reviewed the literature on the measurement of meaning and chapter two concluded by suggesting that meaning be measured through a modified version of classical multidimensional scaling. Chapter three described the substantive problem of bilingual information processing. It reviewed the literature in psycholinguistics and sociolinguistics and concluded with eight theoretical hypotheses which combined both of those notions and which formed the basis of a theory of bilingual information processing. Chapter four applied the measurement system in chapter two with the theory in chapter four. It reformulated the theoretical statements into operational hypotheses and presented a design to test these statements. Chapter five reported on the results of these investigations. They were that the semantic system of bilinguals is moderate between the system of the monolingual groups from which it gets its languages. All groups used the same number of underlying dimensions

to differentiate the concepts and all groups perceived the mass media in a similar manner but statistically different. Finally, although the pattern of mass media and interpersonal communication were significantly different among the groups, these discrepancies could not be used to predict individual differences in the semantic structure. This chapter, six, discussed the results and implications of these findings in terms of the general paradigm for the measurement of meaning and made suggestions for future research on the topic of bilingual information processing.

APPENDIX A

1. English Language Questionnaire
2. French Language Questionnaire
3. Mixed Language Version of the Questionnaire

MASS COMMUNICATION RESEARCH PROJECT (CAR-MSU)

February, 1975

Dear Participant:

Communication scientists are interested in how an individual's communication environment affects the way in which he or she processes information. With the data from this survey questionnaire, we will be able to understand with greater clarity how communication media function.

The results are totally confidential and will in no way be connected with you as an individual. Please do not record your name.

Thank you for your cooperation.

PLEASE COMPLETE THE FOLLOWING AS ACCURATELY AS POSSIBLE.

Do not write in this space

ID 1 3

1. Sex: Male ___ Female ___ 2-4 ___
2. Age: ___ 5 -
3. Race: Caucasoid ___ Negroid ___ Native American ___ Mongoloid ___ 6 -
4. What is your principal occupation? _____ 7,8 --
5. How many years of formal education have you had? _____ 9 -
6. What is your yearly income? _____ 10,11 --
7. What is your father's occupation? _____ 12,13 --
8. How many years of formal education did your father have? _____ 14,15 --
9. What is your father's income? _____
10. What languages does your father speak? 16,17 --

    English ___ French ___ Both French and English ___ 18,19 --

    Other ___ please specify _____
11. What is your mother's occupation? _____ 20,21 --
12. How many years of formal education did your mother have? ___
13. What is your mother's income? _____ 22 -
14. What languages does your mother speak? 23,24 --

    English ___ French ___ Both English & French ___ 25,26 --

    Other ___ please specify _____ 27,28 --
15. What languages are spoken at

    a) Home? English ___ French ___ Both ___ Other ___

    b) School? English ___ French ___ Both ___ Other ___ please specify _____ 29 -

    please specify _____ 30 -

    c) Work? English ___ French ___ Both ___ Other ___

    please specify _____ 31 -
16. What is your family's ethnic background? _____ 32 -

Page 2

Do not write in this space.

17. Birthplace of parent or grandparent if different than Canada.

_____

18. Your religion: Catholic _____ Protestant _____ Jewish _____

Atheist _____ Other _____ please specify _____ 33 _

19. Where were you raised?

On a farm or in a rural area _____

In a town of less than 2,000 _____

In a town of 2,000 to 10,000 _____

In a city of 10,000 to 50,000 _____

In a city of 50,000 to 200,000 _____

In a city over 200,000 _____

In a suburb of a large city _____ 34 _

20. If you would rank-order your preference for the various media, how would you rank the following seven media? (One [1] is your favorite and seven [7] is your least favorite.)

Newspaper _____ 35 _

Television _____ 36 _

Film _____ 37 _

Radio _____ 38 _

Books _____ 39 _

Magazines _____ 40 _

Records/tapes _____ 41 _

21. On the average, how many hours per week total do you spend reading newspapers? _____ 42,43 __

a) Of those hours, how many are in French? _____ 44,45 __

b) Of these hours, how many are in English? _____ 46,47 __

22. On the average, how many hours per week do you spend reading books? _____ 48,49 __

a) Of these hours, how many are in English? _____ 50,51 __

b) Of thses hours, how many are in French? _____ 52,53 __

Page 3

Do not write in this space

23. On the average, how many hours per week total do you spend watching films (movies)? _____ 54 _

a) Of these hours, how many are in French? _____ 55 _

b) Of these hours, how many are in English? _____ 56 _

24. On the average, how many hours per week total do you spend reading magazines? _____ 57,58 __

a) Of these hours, how many are in French? _____ 59,60 __

b) Of these hours, how many are in English? _____ 61,62 __

25. On the average, how many hours per week total do you spend talking to your friends? _____ 63,64 __

a) Of these hours, how many are in French? _____ 65,66 __

b) Of these hours, how many are in English? _____ 67,68 __

26. On the average, how many hours per week do you spend with your family? ___ 69,70 __

27. On the average, how many hours per week total do you spend watching television? _____ 71,72 __

a) Of these hours, how many are in French? _____ 73,74 __

b) Of these hours, how many are in English? _____ 75,76 __

77,79 blank

80 1

DUPLICATE 1-5

28. On the average, how many hours per week total do you spend listening to the radio? _____ 6,7 --

a) Of these hours, how many are in French? _____ 8,9 --

b) Of these hours, how many are in English? _____ 10,11 --

29. On the average, how many hours per week total do you spend listening to records or tapes? _____ 12,13 --

a) Of these hours, how many are in French? _____ 14,15 --

b) Of these hours, how many are in English? _____ 16,17 --

Page 4

IF YOU SPEAK BOTH FRENCH AND ENGLISH PLEASE COMPLETE THIS PAGE; IF NOT, GO ON TO THE NEXT PAGE. THANK YOU.

Do not write in this space.

30. How old were you when you learned your second language? _____ 18,19 __

31. Where (in what context) did you learn your second language?

At home _____

At school _____

On the street or playground (from your friends) _____ 20 -

Other; please specify _____

32. What percentage of the time do you use English and French to speak to your three best friends?

Friend A	French ___%	English ___%	21,22 __ 23,24 __
Friend B	French ___%	English ___%	25,26 __ 27,28 __
Friend C	French ___%	English ___%	29,30 __ 31,32 __

33. If it takes ten units of energy (effort) to communicate (read, write, listen or speak) in English, how many units does it take to use French? 33,34 __

_____

34. If you derive ten units of enjoyment from communicating (read, write, listen or speak) in English, how much do you enjoy French? 35,36 __

_____

BLANK 37-39

35. Which language do you consider as your second language? English _____

French _____

80 2

Page 5

This next page of the questionnaire asks you to tell us how different (or, in other words, "how far apart") certain concepts are from each other. Differences between concepts can be measured in GALILEOS. The Galileo scale measures conceptual distance in the same way as inches, feet or meters measure physical distance. It is a relatively new concept or tool in the behavioural sciences.

To help you know how big a Galileo is think of the colors Red and White as being 100 Galileos apart.

We would like you to tell us how many Galileos apart the concepts listed on the following pages are from each other. Remember, the more different they are from each other, the bigger the number of Galiloes apart they are. On the following pages you will find pairs of words. If you think any of the pairs are more different than Red and White, write a number bigger than 100. If you think they are not as different, use a smaller number. Remember, the more different the words are from each other, the higher the number you should write. You are not limited to the numbers between 0 and 100.

On the following pages you will find lists of pairs such as those shown below. Please write a number in the blank after each pair which represents how different you feel the two items are.

IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE:

Newspapers
and magazines _____

Newspapers
and television _____

If you are not familiar with a particular item, skip that one and move on to the next. Keep in mind that there is no one correct answer; all that we ask is that you give us an honest and careful response about how you feel.

Please begin.

Page 6

IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE: ID

(01-06)-----
(07-08) 0 1

Books and Magazines	_____	(09-17) 0102 -----
Books and Newspapers	_____	(18-26) 0103 -----
Books and Music	_____	(27-35) 0104 -----
Books and Radio	_____	(36-44) 0105 -----
Books and Television	_____	(45-53) 0106 -----
Books and Sports	_____	(54-62) 0107 -----
Books and Movies	_____	(63-71) 0108 -----
Books and Information	_____	(72-80) 0109 -----

(01-06) DUP
(07-08) 0 2

Books and Entertainment	_____	(09-17) 0110 -----
Magazines and Newspapers	_____	(18-26) 0203 -----
Magazines and Music	_____	(27-35) 0204 -----
Magazines and Radio	_____	(36-44) 0205 -----
Magazines and Television	_____	(45-53) 0206 -----
Magazines and Sports	_____	(54-62) 0207 -----
Magazines and Movies	_____	(63-71) 0208 -----
Magazines and Information	_____	(72-80) 0209 -----

Page 7

ID (01-06) (07-08) DUP 0 3

IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE:

Magazines and Entertainment	_____	(09-17) 0201 -----
Newspapers and Music	_____	(18-26) 0304 -----
Newspapers and Radio	_____	(27-35) 0305 -----
Newspapers and Television	_____	(36-44) 0306 -----
Newspapers and Sports	_____	(45-53) 0307 -----
Newspapers and Movies	_____	(54-62) 0308 -----
Newspapers and Information	_____	(63-71) 0309 -----
Newspapers and Entertainment	_____	(72-80) 0310 -----

(01-06) (07-08) DUP 0 4

Music and Radio	_____	(09-17) 0405 -----
Music and Television	_____	(18-26) 0406 -----
Music and Sports	_____	(27-35) 0407 -----
Music and Movies	_____	(36-44) 0408 -----
Music and Information	_____	(45-53) 0409 -----
Music and Entertainment	_____	(54-62) 0410 -----
Radio and Television	_____	(63-71) 0506 -----
Radio and Sports	_____	(72-80) 0507 -----

Page 8

ID

IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE:

Radio and Movies	_____	(09-17) 0508 -----
Radio and Information	_____	(18-26) 0509 -----
Radio and Entertainment	_____	(27-35) 0510 -----
Television and Sports	_____	(36-44) 0607 -----
Television amd Movies	_____	(45-53) 0608 -----
Television and Information	_____	(54-62) 0609 -----
Television and Entertainment	_____	(63-71) 0610 -----
Sports and Movies	_____	(72-80) 0708 -----

(01-06) DUP
(07-08) 0 5

(01-06) DUP
(07-08) 0 6

Sports and Information	_____	(09-17) 0709 -----
Sports and Entertainment	_____	(18-26) 0710 -----
Movies and Information	_____	(27-35) 0809 -----
Movies and Entertainment	_____	(36-44) 0810 -----
Information and Entertainment	_____	(45-53) 0910 -----

Blank through 80

THANK YOU VERY MUCH FOR YOUR COOPERATION.

février 1975

Au participant:

Des scientistes en communications s'intéressent à l'entourage communicatif de l'individu et son effet sur l'utilisation de l'information. A partir de ces données, nous pourrons modifier l'environment afin que l'individu puisse profité d'avantage des moyens de communications qui lui sont disponibles.

Les résultats individuels sont complètement confidentiels. Donc, s.v.p. ne pas écrire votre nom.

Merci de votre coopération.

1. Sexe: masculin _____ féminin _____
2. Age: _____
3. Race: blanche _____ noire _____ jaune _____
4. Quel est votre métier? _____
5. Combien d'années d'éducation formelle avez-vous? _____
6. Quel est votre revenu annuel? _____
7. Quel est le métier de votre père? _____
8. Combien d'années d'éducation formelle a votre père? _____
9. Quel est le revenu annuel de votre père? _____
10. Quelles langues parle votre père? anglais _____ français _____
    les deux, français et anglais _____
    d'autres langues _____ lesquelles? _____
11. Quel est le métier de votre mère? _____
12. Combien d'années d'éducation formelle a votre mère? _____
13. Quel est le revenu annuel de votre mère? _____
14. Quelles langues parle votre mère? anglais _____ français _____
    les deux, français et anglais _____
    d'autres langues _____ lesquelles? _____
15. Quelles langues parle-t-on
    a) chez-vous? anglais _____ français _____ les deux _____
       d'autres langues _____ lesquelles? _____
    b) à l'université? anglais _____ français _____ les deux _____
       d'autres langues _____ lesquelles? _____
    c) à votre lieu de travail? anglais _____ français _____
       les deux _____ d'autres langues? _____ lesquelles? _____
16. De quel(s) groupe(s) ethnique est votre famille? _____
    _____

17. Quel est le lieu de naissance de vos parents ou de vos grand-parents si autre que le Canada? _____

18. Votre religion: Catholique _____ protestante _____
juive _____ athée _____ une autre religion _____
laquelle _____

19. Où avez-vous vécu pendant votre enfance?
Sur une ferme ou dans une région rurale _____
Dans un village de moins de 2,000 _____
Dans un village de 2,000 à 10,000 _____
Dans une ville de 10,000 à 50,000 _____
Dans une ville de plus de 200,000 _____
Dans une banlieue d'une grande ville _____

20. S.V.P., rangez en ordre de préference les sept moyens de communication suivants. Inscrivez le numéro (1) pour celui que vous aimez le mieux, et le numéro (7) pour celui dont vous aimez le moins.
le journal _____
la télévision _____
le cinéma _____
la radio _____
les livres _____
les revues _____
les disques ou bandes enregistrées _____

21. En moyenne, combien d'heures par semaine passez-vous à lire des journaux? _____
a) de ces heures-là, combien sont en français? _____
b) de ces heures-là, combien sont en anglais? _____

22. En moyenne, combien d'heures par semaine passez-vous à lire des livres? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

23. En moyenne, combien d'heures par semaine passez-vous au cinéma? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

24. En moyenne, combien d'heures par semaine passez-vous à lire des journaux? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

25. En moyenne, combien d'heures par semaine passez-vous à parler à vos amis? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

26. En moyenne, combien d'heures par semaine passez-vous avec votre famille? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

27. En moyenne, combien d'heures par semaine passez-vous à regarder la télévision? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

28. En moyenne, combien d'heures par semaine passez-vous à écouter la radio? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

29. En moyenne, combien d'heures par semaine passez-vous à écouter des disques ou des bandes enregistrées? _____

a) de ces heures-là, combien sont en français? _____

b) de ces heures-là, combien sont en anglais? _____

SI VOUS PARLEZ LE FRANCAIS ET L'ANGLAIS, S.V.P. COMPLETER CETTE PAGE. SINON, CONTINUEZ A LA PAGE SUIVANTE. MERCI.

30. A quel age avex-vous appris votre deuxième langue? _____

31. Où (dans quel contexte) avez-vous appris votre deuxième langue?

à la maison _____

à l'école _____

dans la rue ou sur le terrain de jeux (de vos amis)?_____

dans une autre situation _____ laquelle? _____

32. Quel pourcentage du temps parlez-vous en français et en anglais à vos trois meilleur(e)s ami(e)s?

Ami(e) A français _____% anglais _____%

Ami(e) B français _____% anglais _____%

Ami(e) C français _____% anglais _____%

33. S'il vous faut dépenser 10 unités d'énergie (ou d'effort) pour communiquer (lire, écrire, écouter, ou parler) en anglais, combien d'unités vous faudra-t'il dépenser en français? _____

34. Si vous ressentez 10 unités de plaisir quand vous communiquez (lire, écrire, écouter, ou parler) en anglais, combien d'unités de plaisir ressentez-vous quand vous communiquez en français? _____

35. Quelle langue considérez-vous comme étant votre deuxième langue? _____

Cette prochaine partie du questionnaire vous demande de nous indiquer le degré de différence (autrement dit, la distance) entre certains concepts. Les différences entre des concepts peuvent être indiquées en Galiléos. L'échelle Galiléo mesure la distance conceptuelle de la même façon que des pouces, des pieds ou des mètres mesurent la distance physique.

Pour vous aider à connaître la largeur d'un Galiléo, pensez aux couleurs rouge et blanc. La séparation entre ces couleurs est de 100 Galiléos.

Nous vous désirons d'indiquer la séparation entre les paires de concepts inscrits ci-dessous. Souvenez-vous que la plus grande la différence entre deux concepts, le plus de Galiléos les séparent. Si vous pensez que la différence entre une paire de mots donnés dans les pages suivantes est plus grande que la différence entre rouge et blanc, écrivez un chiffre qui est plus grand que 100. Si vous pensez que les concepts sont moins différents, écrivez un nombre plus petit. Vous n'êtes nullement limités aux numéros entre 0 et 100.

Dans les pages suivantes vous trouverez des listes de paires comme celles ci-dessous. S.V.P., écrivez un numéro dans l'espace qui accompagne chaque paire. Ce numéro doit représenter la grandeur de la différence dont vous pensez existe entre les deux choses.

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS,
QUELLE EST LA SEPARATION ENTRE:

des journaux et des revues _____

des journaux et la télévision _____

Si un item ne vous est familier, omettez celui-ci et continuez avec la prochaine paire. Il n'y a pas une seule réponse correcte; tout en que nous vous demandons, c'est d'indiquer honnêtement et avec soin une réponse qui représente votre avis.

S.V.P. commencer.

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS, QUELLE EST LA SEPARATION ENTRE:

Des livres et des revues _____

Des livres et des journaux _____

Des livres et la musique _____

Des livres et la radio _____

Des livres et le la télévision _____

Des livres et le sport _____

Des livres et le cinéma _____

Des livres et l'information _____

Des livres et le divertissement _____

Des revues et des journaux _____

Des revues et la musique _____

Des revues et la radio _____

Des revues et la télévision _____

Des revues et le sport _____

Des revues et le cinéma _____

Des revues et l'information _____

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS, QUELLE EST LA SEPARATION ENTRE:

Des revues et le divertissement _____

Des journaux et la musique _____

Des journaux et la radio _____

Des journaux et la télévision _____

Des journaux et le sport _____

Des journaux et le cinéma _____

Des journaux et l'information _____

Des journaux et le divertissement _____

La musique et la radio _____

La musique et la télévision _____

La musique et le sport _____

La musique et le cinéma _____

La musique et l'information _____

La musique et le divertissement _____

La radio et la télévision _____

La radio et le sport _____

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS, QUELLE EST LA SEPARATION ENTRE:

La radio et le cinéma _____

La radio et l'information _____

La radio et le divertissement _____

La télévision et le sport _____

La télévision et le cinéma _____

La télévision et l'information _____

La télévision et le divertissement _____

Le sport et le cinéma _____

Le sport et l'information _____

Le sport et le divertissement _____

Le cinéma et l'information _____

Le cinéma et le divertissement _____

L'information et le divertissement _____

MERCI POUR VOTRE COOPÉRATION

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS, QUELLE EST LA SEPARATION ENTRE: IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE:

Books and magazines _____

Books and des journaux _____

Books and la musique _____

Books and radio _____

Books and la television _____

Books and sports _____

Books and le cinema _____

Books and l'information _____

Books and entertainment _____

Magazines and des journaux _____

Magazines and la musique _____

Magazines and radio _____

Magazines and la television _____

Magazines and sports _____

Magazines and le cinema _____

Magazines and l'information _____

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS, QUELLE EST LA SEPARATION ENTRE: IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE:

Magazines and entertainment _____

Des journaux et la musique _____

Des journaux et radio _____

Des journaux et la television _____

Des journaux et sports _____

Des journaux et le cinema _____

Des journaux et l'information _____

Des journaux et entertainment _____

La musique et radio _____

La musique et la television _____

La musique et sports _____

La musique le cinema _____

La musique et l'information _____

La musique et entertainment _____

Radio and la television _____

Radio and sports _____

SI ROUGE ET BLANC SONT DISTANTS DE 100 GALILEOS, QUELLE EST LA SEPARATION ENTRE: IF RED AND WHITE ARE 100 GALILEOS APART, HOW FAR APART ARE:

Radio and le cinema _____

Radio and l'information _____

Radio and entertainment _____

La television et sports _____

La television et le cinema _____

La television et l'information _____

La television et entertainment _____

Sports and le cinema _____

Sports and l'information _____

Sports and entertainment _____

Le cinema et l'information _____

Le cinema et entertainment _____

L'information et entertainment _____

MERCI POUR VOTRE COOPERATION

THANK-YOU FOR YOUR COOPERATION

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