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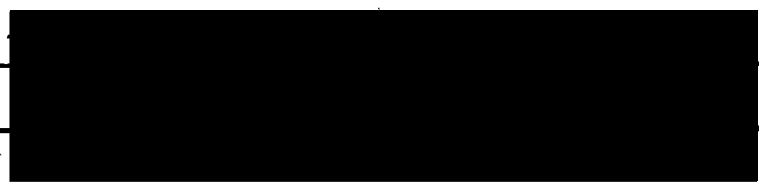

THE DEVELOPMENT OF MULTIDIMENSIONAL SCALING AS A STANDARDIZED PSYCHOLOGICAL TEST

by

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ABSTRACT

The purpose of this study was to assess the reliability and validity of multidimensional scaling (MDS) as a standardized psychological test. The test was conceptualized as a method for activating social self and social trait schemas. The central reference point of the test was a group of four stimuli representing aspects of the self. An additional eight stimuli were derived from the interpersonal dimensions of Dominance and Nurturance.

Seventy-six university undergraduates undertook a test-retest task with a two-week interval, in which they completed the MDS test and two criterion measures, the Interpersonal Adjective Scale (IAS) and a self-esteem scale.

The test-retest reliabilities of the MDS variables were generally high. Convergent validity was demonstrated by a good concordance between scores derived from the MDS test and the IAS scores. In addition, a combination of MDS variables was found to be as predictive of the self-esteem scores as the IAS variables, thus providing evidence for the convergent validity of the MDS test.

Results from the MDS test were compared to those for two other stimulus sets that differed from the first by the increased requirement for purely semantic rather than self-referent processing. There were clear, observable differences between the purely semantic and the self-referent processing that were attributed to the increased complexity and

affective value of stimuli in the self-referent context.

It was concluded that the MDS test showed great potential as a standardized assessment instrument, and that the technique was particularly suited to the study of social schemas. Suggestions were made for future research and applications of the MDS test.

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I. General Introduction

The purpose of this research is to assess the feasibility of using multidimensional scaling (MDS) as a standardized measurement instrument. In the past MDS has been used primarily as an exploratory instrument. However, it has certain features that give the technique the potential to be used as a standardized psychological test. To date, these features have not been systematically investigated.

In discussing the development of MDS as a standardized test, three major topic areas are introduced. The first is the technique and potential of MDS per se. The second is the requirements and psychometric criteria for a standardized measurement instrument. The third is the construct domain that provides a conceptual focus for the development of the MDS test. The general construct domain which is examined is that of cognitive social psychology, with particular reference to the literatures of the social schema and the dimensions of social perception.

Multidimensional Scaling

Multidimensional scaling is a data-analytic technique designed to reveal the pattern or structure contained in a matrix of empirical ratings of similarity between pairs of stimuli. The perceived relations among a set of stimuli are modelled by the geometric relations among points that represent the stimuli in a spatial model. Typically, a basic structure of two or three dimensions provides an easily visualizable and interpretable model that is consistent with the data and does justice to their complexity. (For a detailed description of MDS, see Appendix 1.)

MDS was originally developed as a means of exploring the dimensions underlying the perception of psychophysical stimuli (Kruskal, 1964; Ramsay, 1977; Shepherd, 1962; Torgerson, 1958). MDS has also enjoyed considerable use as a research instrument in cognitive-social psychology to investigate the dimensions underlying interpersonal perceptions (e.g., Bush, 1973; Rosenberg, Nelson & Vivekananthan, 1968; Wish, Deutsch & Kaplan, 1976). For example, Rosenberg et al. (1968) used a form of MDS to study the structure of personality impressions as reflected by trait adjectives. Wish et al. (1976) employed MDS to study the perceived dimensions of interpersonal relations.

MDS clearly has value as an exploratory technique, but it also has several quantitative features that make it potentially useful as a standardized psychological test in applied and

clinical situations. These will be discussed in Chapter II.

Requirements for a Psychological Test

Anastasi (1976) defines a psychological test as "an objective and standardized measure of a sample of behaviour" (p.23). To be of practical value, the test should be a reliable and valid predictor of a relatively broad and significant area of behaviour.

Thus, a test based on MDS (hereafter known as the MDS test), if it is to be taken seriously as a psychological test rather than simply an exploratory technique, must demonstrate the following: a) that the test can predict behaviour in a relatively broad and significant area, b) that it involves an adequate sample of behaviour, c) that this sample of behaviour can be objectively measured, that is, measured in a way that is "independent of the subjective judgement of the individual examiner" (Anastasi, 1976, p.27), d) that the sample of behaviour is obtained in a standardized way, that is, with "uniformity of procedure in administering and scoring the test", so that the scores obtained are comparable across test subjects (Anastasi, 1976, p.27), e) that the test scores are reliable, that is, they are "stable over a variety of conditions in which essentially the same results should be obtained" (Nunally, 1978, p.191), and f) that the test is valid, that is, that it "actually measures what it purports to measure" (Anastasi, 1976,

p. 28).

In subsequent chapters, each of these requirements is discussed in more detail. In particular, the reliability and validity of the MDS test are discussed in Chapter III.

The Construct Domain

One of the criteria for a psychological test is that it should predict behaviour in a relatively broad and significant area. Since MDS is a data-analytic technique, it can be applied to any content area. Thus, one of the first decisions to be made in developing MDS as a psychological test is the choice of content, which includes both an area in which behaviour is to be predicted and an associated construct domain.

The behavioural area that has been chosen is the social and interpersonal one. The associated construct domain is that of social cognition, with a focus on the concept of the social schema. The area of social and interpersonal cognition was selected because of an increasing recognition in personality psychology of the importance of cognition in the manifestation of individual differences, especially social cognition.

> Much of what we normally regard as personality-contingent behaviour is based on the differing and distinctive ways in which persons construct reality from the sensory information available to them, particularly that emanating from their relationships with other people (Carson, 1979, pp.250-251).

Thus, one of the major assumptions made in the social cognition

literature is that social behaviour is to a large extent the result of how the person has perceived the situation.

This social perception has been conceptualized in different ways. One approach has been to investigate the dimensions underlying social perception, and this approach developed out of earlier work on the dimensions of meaning (Osgood, Suci & Tannenbaum, 1957). The three dimensions of meaning are referred to hereafter as the E-P-A system: Evaluation, Potency and Activation. The two dimensions underlying social perception are related, but are more denotative and specific, Nurturance and Dominance (Wiggins, 1979). Nurturance is an aspect of Evaluation, while Dominance can be thought of as a combination of Potency and Activation.

Another more recent approach to the problem has been to transplant a construct from cognitive psychology, known as the schema, into the domain of social cognition.

> The schema provides hypotheses about incoming stimuli, which include plans for interpreting and gathering schema-related information. It may also provide a basis for activitating actual behaviour sequences or expectations of specific behaviour sequences (Taylor & Crocker, 1981, p.91, emphasis added).

The social schema is a schema representing constructions of how the social world works. The self schema is a type of social schema that represents the abstracted essence of a person's perception of him or herself.

The E-P-A dimensions of meaning, and the Nurturance and Dominance dimensions of social perception can be thought of as social schemas in the sense that they are cognitive structures

that enable us to recognize and process social information.

Implications for the MDS Test

MDS may be used as a technique for revealing the dimensions of perception in a given stimulus domain. When the MDS stimuli are interpersonal in nature, the test reveals the manner in which the subject perceives aspects of the social world.

The specific question asked in the present research was whether a standardized MDS test could reveal something about how a person perceives him or herself in an interpersonal context. It is assumed that a person's social behaviour (and thus his or her "personality") results in part from the subject's self perception. However, the present study does not attempt to demonstrate that a subject's actual social behaviour can be predicted from his or her responses to the MDS test. Nevertheless, it does lay the groundwork for such an attempt by assessing whether the MDS test meets certain basic psychometric criteria that would indicate some promise in pursuing further research in this area.

Summary

MDS is a data-analytic technique that provides a spatial model for representing similarity relations among a set of stimuli. Its value as an exploratory tool has been demonstrated,

but it may also have potential as a standardized assessment instrument.

In order for MDS to be useful in this way, it must meet several criteria. It must be an objective, standardized, valid and reliable measure of a sample of behaviour, and it must predict behaviour in a relatively broad and significant area.

Choosing the behaviour to be sampled and predicted is the first step in the development of the MDS test. The area of individual differences in social cognition was selected because of its importance in the cycle of social perception and social behaviour.

Two different lines of thought about social cognition are brought together here. The first is the notion of dimensions underlying perception that are common to all people in a culture. The most fundamental and general dimensions of perception and meaning are Evaluation, Potency and Activation. The dimensions underlying social perception are Nurturance and Dominance.

A more recent approach to social cognition involves the construct of the social schema. Social schemas are cognitive structures that enable us to recognize and process social information. The self schema is an example of a social schema. The E-P-A dimensions of meaning, and the Nurturance and Dominance dimensions of interpersonal perception can also be seen as examples of social schemas.

MDS is a technique well suited for investigating the dimensions of perception in a particular domain. The content of the stimuli used in the MDS test which is reported here was based on the dimensions of interpersonal perception and the self schema construct. The aim of the study was to assess the value of the MDS test as a measure of a person's self perception in an interpersonal context.

In Chapter II, several aspects of MDS are discussed, including MDS as a sample of behaviour, the objectivity of the MDS test and the standardization of the MDS test. In Chapter III, a discussion of test validity and reliability is presented. In Chapter IV, the general construct domain of the MDS test is discussed fully. In Chapter V, the discussion focusses on the ways in which the development of the MDS test is influenced by the foregoing theoretical considerations.

Chapter VI and VII describe pilot work and the methodolody of the present study. The results of the present study are presented in Chapter VIII. The discussion follows in Chapter IX, with a summary and conclusions presented in Chapter X.

II. Multidimensional Scaling

A complete description of MDS can be found in Appendix 1. However, in this chapter, the following aspects of MDS are discussed: MDS as a sample of behaviour, the objectivity of the MDS test and the standardization of the MDS test.

MDS as a Sample of Behaviour

A good psychological test should involve an adequate sample of behaviour. The MDS task involves behaviour that is somewhat different from the behaviour sampled in a typical self-rating assessment instrument.

> Performance in a[n MDS] scaling experiment must call upon an indefinite number of poorly understood mental processes. Further, these processes that mediate between the content of the mind and the to-be-scaled behaviour may be sufficiently representative of thinking processes of a general sort to warrant consideration of the scaling experiment as a paradigm for the study of thinking.
> ...More particularly, the scaling experiment requires of the subject that he select and combine attributes [of the stimuli] in a way that allows consistent discrimination among members of a set of concepts.
> ...close examination of the scaling experiment may provide some insights into thinking (Arnold, 1971, p.349, emphasis added).

The MDS task requires that the subject make a number of judgements of similarity between pairs of stimuli from a set of, say, n stimuli. This number of stimuli results in $n(n-1)/2$

similarity judgements being made.

In judging the similarity or dissimilarity between two stimuli, the subject becomes involved in an act of information processing in which the stimuli are recognized, categorized in some way and then compared to each other in terms of these categories. Since each stimulus is processed for its information repeatedly as it is paired with every other stimulus in turn, the MDS task provides a very reliable sample of information processing within the domain defined by the stimulus set.

The purpose of MDS is to represent the similarity judgements between pairs of stimuli as distances in Euclidean space.

In a review of multidimensional scaling, Cliff (1973) outlines the evidence for the idea that MDS structures do not merely summarize data, but also validly reflect behavioural realities. In view of the consensus between MDS and other multivariate treatments of similar data, Cliff concludes that there is no doubt that the MDS task does tap a type of stable "cognitive map" or cognitive structure within which the concepts of the stimuli can be located.

The Objectivity of MDS

A good psychological test allows behaviour to be measured in a way that is independent of the individual examiner. MDS possesses several objective and quantitative features that

fulfill this requirement. These features are described below. They include the stimulus configuration, the overall stimulus error, the individual stimulus errors and the exponent.

MDS has typically been used as an exploratory device, with the stimulus set containing stimuli of unknown value to the subject and the investigator. Since the properties of the stimuli to be used in making similarity judgements are not specified by the investigator, the subject draws on his or her own set of perceptual values in what may be construed as a projective test.

The interpretation of the MDS dimensions emerging from such an exploratory procedure is ultimately a subjective act: the investigator examines the MDS configuration to determine the content of the dimensions. (Various statistical procedures have been used to assist in this task, such as multiple regression of unidimensional scales used to rate the stimuli onto the dimensions of the MDS configuration.)

However, even when MDS is used in this exploratory way, there are a number of quantitative and objective features that may prove to be reliable and exploitable indicators of cognitive functioning. It is these quantitative and objective MDS features that are the focus of the present study. They are the potential test "scores" whose reliability and validity are to be assessed. Most of these are derived from a particular MDS computer program, MULTISCALE II (Ramsay, 1977).

Relations among stimuli: stimulus configuration. Given a standard set of stimuli, a variable of major importance in assessing individual differences would be the pattern of relations among the stimuli particularly with reference to a normative sample. This pattern of relations among stimuli is referred to as the stimulus configuration.

In addition, the geometric relations among particular stimuli may be of interest. For example, self esteem may be measurable in terms of the distance between a "self" and an "ideal self" stimulus.

Another objective measure, which is related to the stimulus configuration, is the number of dimensions used by a subject in judging a set of stimuli. However, this index will not be considered here. For the purposes of the present study, a two-dimensional space will be assumed for all subjects, since preliminary research showed little variation in dimensionality for the subject population under study.

Overall stimulus error. The degree of consistency with which a subject has made his or her MDS judgements is referred to as the overall error. The model underlying MDS assumes that dissimilarity judgements are transitive. That is, if stimuli A and B are seen as similar, and stimuli B and C are seen as different, then stimuli A and C are expected to be seen as different. Thus, the spatial model used to represent the similarity relations will predict that A and C will be distant. If the subject has been inconsistent and judges A and C to be

similar, then the fit between the observed data and the model will decrease and this will be reflected in the error term. MULTISCALE II provides an overall estimate of error that is unbiased by, or independent of, the number of dimensions in the model. This, therefore, may be used as an objective indicator of subject consistency.

A high overall estimate of error produced by MULTISCALE II would reflect inconsistency or lack of certainty in the subject's cognitive structure, suggesting an underlying unstable construct system in the stimulus domain in question.

Individual stimulus errors. Unlike earlier MDS programs, MULTISCALE II is also able to provide an error term for each stimulus separately. This reflects the degree of consistency with which the subject has judged each stimulus. It seems likely, for example, that an unusual degree of such objectively defined error in a subject's judgements about a "self" stimulus would indicate an unusually vague self definition or self concept. This is an individual difference that would be expected to have significant consequences for social behaviour.

Exponent. The MULTISCALE II program provides a measure, called the exponent, of how polarized a subject's similarity ratings are. This measure may be of psychological interest, since it might be used to determine how "black and white" a subject's perceptions are relative to a subject with a more differentiated and less extreme mode of categorization.

Thus, there are four objective MDS measures that will be studied here. They are the stimulus configuration, the overall error, the individual stimulus errors, and the exponent. Each of these variables has the potential for measuring an aspect of cognitive behaviour or schematic structure in a way that is independent of any subjective bias from the examiner, since each is a quantitative value produced by a set of rules in the MDS computer program.

The Standardization of MDS

A good psychological test allows for uniformity of procedure in administering and scoring the test, so that scores are comparable across subjects. Thus, the MDS test must be standardizable in terms of both adminstration and scoring.

Administration of the MDS test is easily standardized. The major problems arise in the development of a standardized stimulus set, and in obtaining standardized values for the stimulus configuration variable of the MDS test.

Administration and scoring of the MDS test. The MDS task itself is, in fact, easily standardizable. For example, subjects may be presented with a set of all possible pairs of stimuli, and be asked to rate each pair for similarity on a 9-point scale (1=very similar, 9=very different). Subjects are asked to try to use the full range of numbers available, and not to worry about being consistent from one judgement to the next. They are also

advised not to spend much time on each judgement.

The MULTISCALE II program will produce "scores" for each subject on the overall error, the individual stimulus errors and the exponent. These scores are comparable across subjects. "Scores" representing the stimulus configuration are not comparable but can be made to be by a normalization process described in Chapter VII.

The problem of the stimulus set. A major methodological problem is encountered in trying to establish a standard set of stimuli, so that results will be comparable across all subjects. While the test content may be based on the social/interpersonal domain, this contains a vast repertoire of possible test stimuli and some rational basis is needed for selecting a standard set of stimluli.

For example, the MDS test could be developed in a purely empirical way, like the MMPI. Any set of stimuli from the interpersonal domain could be scaled by different personality types or clinical groups and a "fishing expedition" launched to determine if each group treats the standard stimulus set in different and discriminating ways. Such an approach would be time consuming and unnecessary. The social cognition literature contains several clues which suggest an appropriate point of departure for the development of a stimulus set. Before these clues are discussed it is necessary to elaborate on certain characteristics of the MDS technique itself.

A major consideration in the choice of the stimulus set is the fact that for MDS, as for factor analysis, "what you get out is what you put in". In other words, the content of the dimensions and, to a certain extent, the dimensionality or number of dimensions, are determined by the content and dimensionality inherent in the stimulus set (whether or not these are known in advance by the investigator) in interaction with the subject who is doing the MDS task. Consider a simplified example in which a stimulus set consists of colours varying only in hue and saturation. It is unlikely that these stimuli will be perceived by a subject along dimensions of brightness, or for example, size, since neither of these dimensions is inherently present in the stimulus set. On the other hand, a stimulus set of colours varying along all three dimensions of hue, saturation and brightness might be perceived along only two of these dimensions by a subject with damage to a certain aspect of his visual system.

When MDS is used as an exploratory instrument with stimuli whose salient properties are unknown, its unique value derives from the fact that the investigator does not specify which properties or attributes of the stimuli the subject is to use in making the similarity judgements. The exploratory MDS task is, in effect, a projective test with the subject imposing his own cognitive structure onto the stimulus domain.

The typical projective test provides an unstructured or amorphous situation (or here, a set of stimuli of unknown value)

that allows the subject to produce his own subjective biases of interpretation, presumably based on his own set of schemas. However, as a result of research in information processing, Broadbent (1977) has observed, with respect to projective tests of individual differences, that

> ...there is more bias in the selection for attention of an appropriate stimulus that genuinely points toward the direction favoured by the bias. Thus, a truly unstructured and amorphous projective test is likely to be less satisfactory as a way of revealing indiviual biases than a test that contains stimulus features appropriate for the particular bias that is suspected (p.113, emphasis added).

As we have seen, the MDS stimulus set is always biased towards the structure inherent in the stimuli themselves, whether or not the investigator is aware of what the bias is. One of the major strategies used in the development of the stimulus set in the present study was to attempt to exploit the perceptual biases that were already known to exist in the interpersonal domain, rather than exploring them. The stimulus set that emerged contained a majority of stimuli representing these biases which served as "anchors" for interpreting the MDS solution and provided a normative structure for the standardized stimulus set. The remaining stimuli in the set consisted of stimuli of more subjective and unknown value, which were anchored within the interpersonal structure but free to vary according to individual differences.

One possible strategy in this type of research would be to use a set of purely "subjective" stimuli, that is, stimuli whose value for an individual subject cannot be predicted by the

investigator (e.g., "your mother", "your boss"). The clinical usefulness of such a stimulus set is undeniable if one sits down with the subject, or client, and discusses in detail the stimulus configuration arising from the MDS task. However, even though the stimulus set per se is standardized, there is no reason to expect that the resulting stimulus configurations would be similar enough across a range of clients to allow for the development of any kind of norms for the stimulus configuration variable (although norms for the exponent and the overall error would be possible).

On the other hand, it is important to note that if all the stimuli have a known and constant value for all subjects, stimulus configuration norms would be very easy to establish but it is unlikely that any useful individual differences would be revealed, and it is individual differences that are the focus of assessment. Such an "objective" stimulus set might consist of a set of interpersonal trait words with known semantic relationships to each other.

Clearly, the stimulus set should contain an optimal balance between subjective stimuli, to reveal individual differences, and objective stimuli, to anchor the stimulus set in an objectively interpretable and normative structure.

Summary

The MDS task provides a sample of information processing behaviour and can reveal the cognitive structure underlying the stimulus concepts.

The MULTISCALE II program for MDS provides four objective and quantitative measures whose value as valid and reliable indicators of psychological function can be assessed. These measures are the stimulus configuration, the overall stimulus error, the individual stimulus errors and the exponent.

The administration and most of the scoring of the MDS test are easily standardized. The greatest challenge in the present study is the development of a standardized stimulus set. The first principle applied here is that the biases known to be shared by all people in interpersonal perception may be exploited to improve the effectiveness of the MDS test as a measure of interpersonal perception.

A related principle is that these common biases will serve as objectively interpretable anchors in a normative structure. They are represented by "objective" stimuli whose value is known and constant for all subjects. "Subjective" stimuli, whose value varies in unknown ways across subjects, provide the vehicle for revealing individual differences within the normative structure.

III. Validity and Reliability of the MDS Test

All but two of the requirements for a psychological test have been discussed above. These are that the test can predict behaviour in a relatively broad and significant area (i.e., the area of social cognition), that the test involves an adequate sample of behaviour (i.e., a sample of information processing and categorization), and that the sample of behaviour can be measured objectively and in a standardized way. In this chapter, the final essential criteria the the MDS test must meet are discussed, namely, the criteria of validity and reliability.

Validity and reliability are frequently (although not always: see Cronbach & Meehl,1955) treated as separate and unrelated psychometric issues, except insofar as a reliable test is not necessarily valid, while a valid test is always reliable (assuming the trait measured is stable over time). Both validity and reliability are divided into subtypes that are considered to be more or less interchangeable equivalents of each other (Messick, 1980).

In an excellent article on test validity and the ethics of assessment, Messick (1980) argues convincingly that all forms of validity are founded on the concept of construct validity. What follows is a summary of his arguments.

The construct. The construct or theory provides "spectacles" or ways of categorizing or construing reality, and

is the starting point.

Content valididy. Test items must adequately sample the domain specified by the construct.

Convergent and discriminant validity. Construct validity emphasizes two intertwined sets of relationships for the test. One is between the test and different methods for measuring the same construct or trait. This is concerned with the meaning of the measure as a reflection of the construct, and is known as convergent validity. The other is between measures of the focal construct and exemplars of different constructs predicted to be variously related to it on theoretical grounds. This is concerned with the meaning of the construct as reflected in the measure's relational properties and is known as discriminant validity.

Criterion validity. Predictive and concurrent criterion validity are both forms of construct validity because reference to the construct is necessary in order to make rational decisions about appropriate criteria. The questions usually asked are: a) is the test effective in detecting current behavioural patterns (as identified by a previously established test), and b) can the test be substituted for a longer, more cumbersome or more expensive criterion measure?

Construct validity. The construct's nomological network will produce hypotheses and predictions about how subjects' test scores should behave under different experimental manipulations.

Reliability

The various forms of reliability are popularly thought of as completely separate from issues of validity. However, most of the major forms of reliability (except perhaps inter-rater reliability) can be looked at from the perspective outlined above, and can be seen as aspects of construct validity. An outline of the major ways in which reliability is measured follows.

Coefficients of internal consistency. These measure the representativeness of a given set of items selected from a domain, and can be seen as an aspect of content relevance and content selection (content validity), which are directly related to construct validity.

Coefficients of stability - test-retest reliability. These measure how stable test scores are in the face of variability in subjects and test conditions. The degree of temporal stability expected in the test is a function of the temporal stability implied in the underlying construct.

Coefficients of equivalence - split-half and parallel-forms reliability. These estimate error from item selection (content relevance and content selection), and from temporal stability when parallel forms are administered at different times.

In general, Messick argues that a better name for construct validity is "interpretive meaningfulness".

> Construct validity is the unifying concept... that integrates criterion and content considerations into a

> common framework for testing rational hypotheses about theoretically relevant relationships.... The bridge or unifying theme that permits this integration is the meaningfulness or interpretability of test scores, which is the goal of the construct validation process (p.1015).

(Messick also argues that construct validity is not complete without an evaluation of the value implications and social consequences of test interpretation and test use.)

The central importance of the construct is reinforced by the fact that many personality tests are developed by presuming the existence of a set of traits or personality constructs for which a measurement technique must be found. The initial impetus for the present research reversed this process: MDS, an interesting technique with attractive quantitative and other features, existed, for which a construct to measure must be found. The construct domain for the MDS test is discussed in the following chapter.

IV. The Construct Domain

The general construct domain of the MDS test is elaborated more fully in this chapter. The primary construct is the social schema. The dimensions of meaning (the E-P-A system) and the dimensions of interpersonal perception (Nurturance and Dominance) are discussed and are viewed as trait schemas, a subset of person schemas. The construct of the self schema, another type of person schema, is then introduced. These concepts are linked by a discussion of the difference between semantic and self-referent information processing.

The Schema

When a subject is engaged in the similarity ratings of an MDS test, one may ask what behaviour is actually being sampled. A conceptual model for this is provided by the construct of the schema and the category structures underlying schemas.

In recent years, social psychology has undergone the cognitive revolution that has characterized psychology in general. There has been extensive borrowing from cognitive psychology of theoretical concepts and experimental paradigms that have facilitated the investigation of cognitive processes and structures that underlie social judgements and memory for persons (Higgins et al., 1981).

One of the major conceptual borrowings from cognitive psychology is the schema (Bartlett, 1932; Posner & Keele, 1968). The idea of the schema per se was developed to explain how we structure our perceptions of the environment by selecting certain aspects to attend to and ignoring the remaining mass of detail. Neisser (1976) makes the analogy between the schema and the format statement in a computer program: we are not able to recognize a stimulus unless we already have a schema about its meaning.

> A schema is a cognitive structure that consists in part of the representation of some defined stimulus domain. The schema contains general knowledge about that domain, including a specification of the relationships among its attributes, as well as specific examples or instances of the stimulus domain (Taylor & Crocker, 1981, p.91).

Social Schemas

Social schemas are those schemas that represent constructions of how the world works. Taylor and Crocker make the assumption that social schemas are related to specific content domains. They are content-specific rather than content-free processing structures.

There are three general classes of social schemas: a) person schemas, including trait conceptions like extravert and introvert (Cantor & Mischel, 1979), person impressions or representations of specific individuals (e.g., Hamilton, Katz & Leirer, 1980), and self schemas (Markus, 1977; Markus, Crane, Bernstein & Siladi, 1982), b) role schemas, for occupations,

social roles and social stereotypes, and c) "event" schemas and scripts (e.g. Shank & Abelson, 1977) which are schemas for social events or situations. Although not strictly in the domain of social schemas, mention should be made here of "emotion" schemas (Russell, 1980), the cognitive structures capable of representing affect.

In summary,

> Social perceivers...have schemas about types of personalities, social events, and social roles. When they encounter a new stimulus person or event, they draw upon their representation of that kind of person or event (i.e. their schema) and use it to fill out attributes of the stimulus configuration before them and generate predictions about other attributes and subsequent events (Taylor & Crocker, 1981, p.91).

The focus of the present study is on person schemas, with reference to the way in which the self schema interacts with trait schemas by way of their shared semantic structures.

The Structure of Social Schemas

The cognitive categories of person perception appear to be similar in nature to the natural categories of human thought as described by Rosch (1973). A major feature of Rosch's work is the organization of categories in a "vertical" dimension of levels of abstraction or inclusiveness. For any concept domain, there is a superordinate level of highest abstraction, a "basic level" of abstraction that is optimally useful, and a subordinate level which is the most concrete and rich in detail.

Taylor and Crocker (1981) describe the structure of social schemas in a similar way:

> A schema can be thought of as a pyramidal structure, hierarchically organized, with more abstract or general information at the top, and categories of more specific information nested within the general categories. The lowest level in the hierarchy consists of specific examples or instances of the schema (e.g., specific people or events) (p.92).

Cantor and Mischel (1979) have demonstrated a superordinate level of categories in person prototypes (e.g., the extraverted person), where categories are highly differentiated from each other, but less rich in detail. The "basic level" has categories that are both rich in information and maximally differentiated from each other (e.g., "public relations" type). The subordinate level is very rich in detail, but contains categories that are poorly differentiated from each other (e.g., door-to-door salesman).

At each level of abstraction, Rosch proposes that there are categories of different content at the same level of inclusiveness. These categories are not mutually exclusive with clearly defined boundaries, as in the tradional view of cognitive categories. Instead, they have "fuzzy boundaries" with elements within the categories being clustered around a prototype. The less prototypic elements merge continuously rather than discretely into the fuzzy boundaries of related categories (Rosch & Mervis, 1975).

The Circumplex Model

Rosch does not specify the nature of the relationships among categories at a given level of abstraction, beyond the notion of prototypes and fuzzy boundaries. However, in the specific domain of the categories of the interpersonal domain, Wiggins (1979, 1980) argues that a circumplex model satisfies the requirements of prototypes and fuzzy boundaries as well as explicitly specifying the nature of the relationships among categories.

The basic structure of the circumplex is that of two bipolar axes that are orthogonal to each other, thus defining a two-dimensional space. The elements of the domain are distributed continuously around the perimeter of a circle in this space, with each fuzzy category merging into its neighbouring categories. Categories that are adjacent in the circumplex are less distinct than categories that are opposite to each other.

Wiggins (1980) argues that this circumplex structure ties together in a coherent and potentially testable model a wide range of personological constructs that have been studied in the past as separate entities. He implies that the circumplex model also represents the semantic structure underlying the use of these constructs in person perception at the basic level of categorization.

MDS and Schemas

Thus, the structure of a category system is hierarchical. There is a vertical dimension of inclusiveness or abstractness, ranging from the most abstract, through a basic level, to the most concrete subordinate level. There is also a horizontal level, containing categories of different content at the same level of inclusiveness.

Wiggins (1980) maintains that social categories, at least at the basic level of categorization, are modelled best by a circumplex structure, with a set of bipolar prototypes merging into each other at fuzzy boundaries.

The structure of the social schema is manifested whenever a social perceiver shows evidence of "grouping or categorization, balance, and the imputation of relations of similarity, proximity, reciprocity, and dominance in [his or her] construction of a stimulus configuration" (Taylor & Crocker, 1981, p.95).

In MDS, the subject's task is to rate the similarity between pairs of stimuli. In order to do so, the subject must be able to recognize categories and to impute relations of similarity between them. Thus, the act of rating the similarity between a pair of stimuli can be conceptualized as the activation of a schematic structure or structures. MDS would therefore seem to be well suited as a vehicle with which to explore schemas and their structures.

Similarly, a two-dimensional MDS configuration consisting of two orthogonal dimensions merging into each other at fuzzy boundaries can be interpreted as a circumplex, the structure thought to be the best model of social categories at the basic level of categorization.

This, along with the objective and quantitative features of MDS discussed in Chapter II, further enhances the potential of the MDS technique as a useful tool for research and application in the area of social cognition.

The MDS task appears to have the potential to provide a sample of cognitive behaviour that involves the activation of social schemas. The stimulus set for the MDS test is designed to activate two different types of person schemas. The first type is the trait schema, represented by Wiggins' (1979) interpersonal circumplex and the dimensions of Nurturance and Dominance. These stimuli provide the objective, normative anchors for the test. The second type of person schema in the stimulus set is the self schema. Stimuli based on the self schema provide the subjective, individual aspect of the test.

The Objective Stimuli

The "objective" stimuli are those stimuli that have a shared common value across a subject population. They do not only provide a normative structure for the comparison of scores. Because they are based on the common biases known to underlie

interpersonal perception, they also serve to enhance the effectiveness of the MDS test as a measure of social cognition.

The objective stimuli chosen are derived from the E-P-A dimensions of meaning first studied by Osgood, Suci and Tannenbaum (1957). These dimensions are further refined in the specific interpersonal domain into two dimensions, Nurturance and Dominance (Wiggins, 1979), and it is to these that the objective MDS stimluli are directly related.

The core of social perception. Kelly's (1955) construct theory and the Repertory Grid Test resulting from it represented one of the first attempts to assess personality by way of individual differences in the cognitive construction of reality. This approach made the assumption that each person bases his constructions of reality on his own individual and unique experiences. The focus was on the differences in the way people perceive social reality.

On the other hand, several decades of research have shown that there is, beneath the level of unique individual experience, a common core or common language of perception that is fundamental for all people within, and to a certain extent, across cultures. This core is grounded in the defining limits of the language used to frame perceptions. In turn, the semantic structure may be grounded in a biological structure that is common to all people.

The first evidence of a common core in social perception comes from the work of Osgood et al. (1957) on the theory and

measurement of meaning, using the Semantic Differential Technique. This research "offered evidence for a reasonably stable and reproducible set of dimensions within which meaningful judgements are made" (Osgood, 1962, p.10). The content of these dimensions of meaning have, as a result of their apparent generality, become almost archetypal representations of the content of the cognitive dimensions that have been found in later studies. They have also emerged in cross-cultural studies (e.g. Jakobovits, 1966; Osgood, 1962, 1964; Tzeng, 1975; Tzeng & May, 1975). The names of the factors or dimensions have been derived intuitively by examining the common characteristics of the descriptors grouped in each factor.

The three dimensions, Evaluation (good/bad), Potency (strong/weak) and Activation (fast/slow), have been found not only with different statistical techniques, but also with a wide range of different stimuli. These include trait words (Rosenberg, Nelson & Vivekananthan, 1968), emotional response adjectives (Bush, 1973), interpersonal relations (Wish, 1976), musical excerpts (Wedin, 1972), and paintings (Berlyne, 1974).

These three dimensions appear to represent the most superordinate level of categorization of meaning (Wiggins, 1980) They lack any sort of denotative significance, and may change their mode of combination in specific contexts. For example, the usual three-factor space coalesced into two (Benevolence and Dynamism) for political concepts (Osgood et al., 1957).

In a recent plea for the recognition of the importance of affect in so-called "cognitive" processes, Zajonc (1980) offers evidence for two independent systems of evaluation: "a fast, crude, and, perhaps, predominant affective system and a slower, more detailed cognitive one" (Abelson, Kinder & Peters, 1982). Recent work by Allen and Ebbesen (1981) also supports this notion.

Zajonc (1980) refers to the first E-P-A dimension, Evaluation or the attribution of preference, as the "fast, crude" affective system. He notes that the affective reactions that motivate our basic approach/avoidance behaviour are primary in ontogeny, and that the good-bad discrimination is one of the very first made by children. Affect was also primary in philogeny, and present long before the evolution of language. Zajonc suggests several physiological locations where the affective system might be based, including the right hemisphere.

Evaluation, as Zajonc suggests, may arise from a specific affective system. Potency, on the other hand, requires a quite different kind of processing. In order to make a judgement about whether a stimulus is more or less powerful than oneself, one must first be able to make the discrimination between oneself and another, an ability that arises developmentally much later than the simple judgement of whether something feels good or bad. In addition, in social information processing research, dominance schemas (i.e., Potency) have been found to be organized in a linear fashion (Taylor & Crocker, 1981; Wegner &

Vallacher, 1977). The ability to organize things serially is related more to the left than the right hemisphere, and in general, dominance discriminations would seem to be much more purely cognitive in nature and to arise in a "higher" level of the nervous system than evaluation judgements.

Finally, the Activation dimension (fast-slow, exciting-calm) appears to be related to the emotional intensity of the person's reaction to the stimulus. Information of this sort might arise from the arousal system and/or the autonomic nervous system.

There is an analogy to the idea that the dimensions of meaning might be grounded in physiological systems. One of the first uses for which MDS was developed was psychophysiological research into the dimensions of colour vision. Three dimensions have been found in the perception of colour: hue, saturation and brightness. Each of these dimensions depends upon activity in different levels of the visual system, and is drawn from a different source of information. Given the fundamental survival aspects of the E-P-A dimensions, it is reasonable to expect that these dimensions would also be drawn from different physiological sources.

In the abstract-concrete dimension of category structures, the E-P-A dimensions seem to represent the most abstract, superordinate and general level (Wiggins, 1980). While they are highly differentiable, they provide no specific denotative details. This is not surprising since these dimensions are the

common denominator underlying the meaning of language and categorization across all domains. They represent the physiological bases for more specific schemas arising out of them.

E-P-A and the emotional and interpersonal domains. In any given domain, what is considered good or bad, strong or weak, or fast or slow, is given a more specific denotation relevant to the domain in question. The domains of emotional experience and interpersonal interaction are perhaps the most fundamental to human beings, and as such, the dimensions of these domains are closely linked with the superordinate E-P-A dimensions.

Russell (1980, 1983) reports that there are two basic (and cross-cultural) dimensions in the perception of emotions: Pleasure-Displeasure (an aspect of the Evaluation dimension of the E-P-A system) and Arousal-Sleep. This second dimension appears to reflect the Activation dimension of the E-P-A system, rather than the Potency dimension. Russell notes that other dimensions have been found in the perception of emotion, but they account for very little variance, and, if interpretable at all, they tend to be cognitive or social correlates of emotion, such as Dominance-Submission. They can be interpreted as referring to "perceived aspects of the antecedents or consequences of the emotion rather than to the emotion per se" (Russell, 1980, p.1171)

Wiggins' circumplex model. Interpersonal or social perception also appears to consist of two major dimensions.

Wiggins (1979, 1980) reports on an exhaustive research effort in this area, and finds that these dimensions are Nurturance (friendly-hostile), an Evaluative dimension, and Dominance (dominant-submissive), clearly a Potency dimension.

It has been argued here that the language used to conceptualize social experience arises out of a biologically "pre-wired" perceptual system that allows for primary categorizations in terms of how good or bad a stimulus feels, and how powerful it is in relation to the perceiver. There are many other ways to classify stimuli that are not so directly tied to the E-P-A system, but in the interpersonal domain, the superordinate dimensions of Nurturance(friendly/feels good vs. hostile/feels bad) and Dominance (dominant/strong vs. submissive/weak) do seem to be primary (Wiggins, 1979, 1980), and are what Asch (1946) would consider to be central rather than peripheral traits.

This superordinate level can be expanded into a more basic information-rich level at which categories are maximally differentiated from each other(Rosch, 1973). For example, Wiggins(1979) developed a scale of 128 interpersonal adjectives consisting of 16 subordinate level words nested in 8 basic level categories (see Appendix 2), through an exhaustive and iterative procedure that began with a pool of 800 interpersonal adjectives. These categories fall in a circumplex (two-dimensional, circular) structure (see Figure 1) that is consistent with a wide range of research and theory in this area

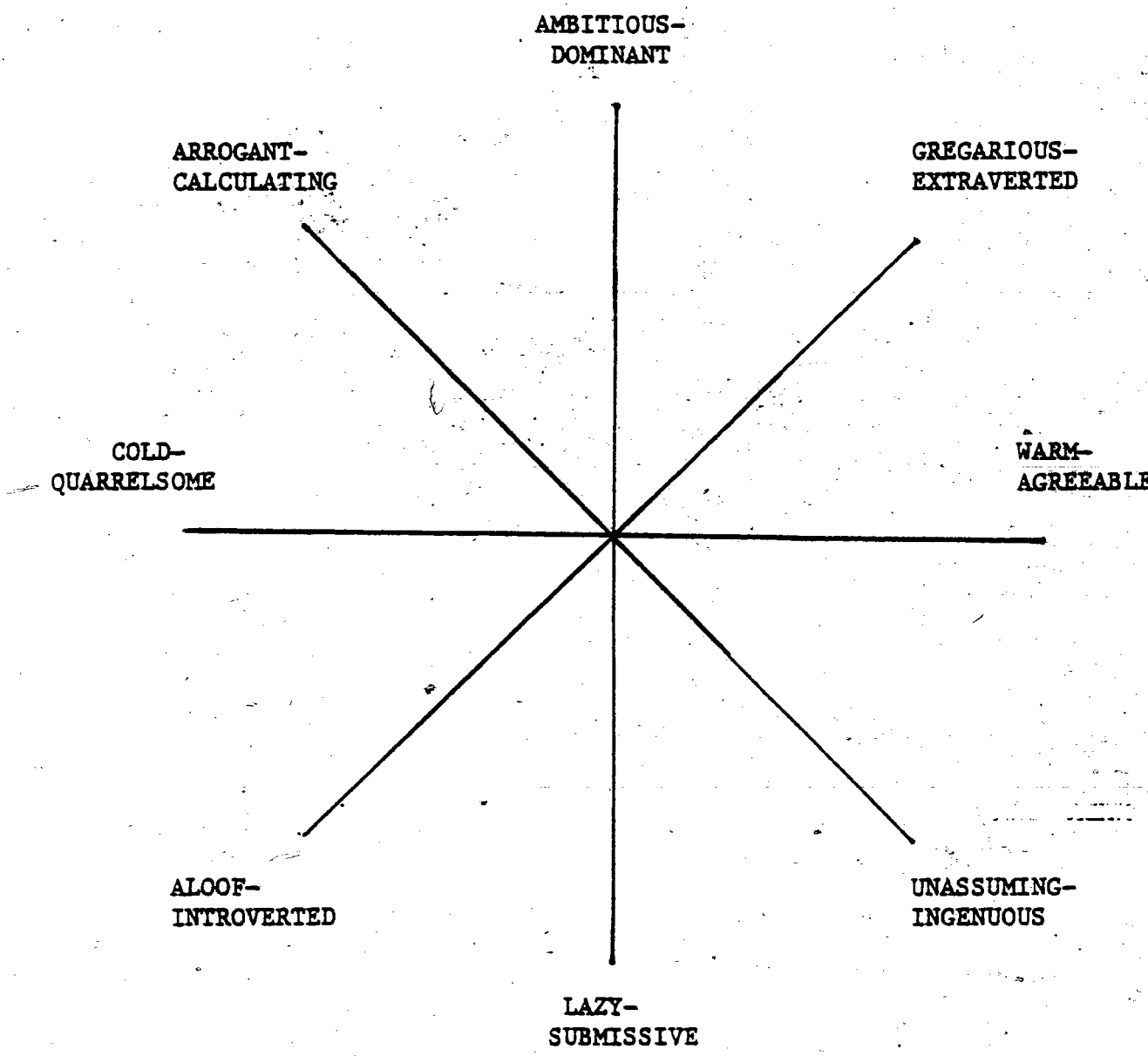


Figure 1. Wiggins Interpersonal Circumplex

(e.g., Foa, 1961, 1965; Foa & Foa, 1974; Leary, 1957).

The basic two dimensions are labelled Nurturance and Dominance. These two dimensions are further subdivided into eight categories. The labels attached to each category "are meant to capture the flavor of terms that share the same profile of semantic features and may serve more as tags than as definitions" (Wiggins, 1979, p.398). These eight categories can be further subdivided into 16 categories, but it appears that for most lay people, this system is too detailed and represents a suboptimal level of categorization (Wiggins, 1979).

The Subjective Stimuli

The "subjective" stimuli are those stimuli whose value is unique for each individual subject, and unknown in advance to the investigator. They provide a vehicle for the expression of individual differences, and are free to vary within the normative structure provided by the objective stimuli.

The subjective stimuli chosen are aspects of the self concept or self schema. The complete MDS test as developed in this study is therefore essentially a self-rating task that may provide a useful way to measure a person's perception of him or herself in an interpersonal context. In other words, the test is designed to measure aspects of a subject's social self schema.

The self concept. The self concept is a construct that has been studied, and, more often, thought about, by a number of

psychologists, beginning in the modern era with William James (1910). Others include Cooley (1902), Mead (1934), Lecky (1945), Snygg & Combs(1949), Hilgard (1949), Rogers (1951), Sarbin (1952), Sullivan (1953), Allport (1955), (all cited in Epstein, 1973), and Rosenberg (1979).

A brief definition of self concept, as generally used, is "the totality of the individual's thoughts and feelings having reference to himself as an object" (Rosenberg, 1979, p.7).

The following points are included by Epstein (1973) in a summary of the characteristics that have been attributed to the self concept (p.407). a) The self concept is a subsystem of internally consistent, hierarchically organized concepts contained within a broader conceptual system. b) It contains different empirical selves, such as a body self, a spiritual self, and a social self. c) It develops out of experience, particularly out of social interaction with significant others. d) It is essential for the functioning of the individual that the organization of the self concept be maintained. Rosenberg (1979) makes a similar point: that there is a need to preserve a stable self concept and "to maintain it intact in the face of potentially challenging evidence" (p.57). e) There is a basic need for self esteem which relates to all aspects of the self system, and, in comparison to which, almost all other needs are subordinate.

The self schema. More recently, the subject of the self concept has emerged as a topic of research in the guise of an

information processing construct called the "self schema" (Kuiper & Rogers, 1979; Markus, 1977; Markus et al. 1982; Rogers et al., 1977).

The self schema literature tends not to refer to the self concept literature, but it is clear from definitions of the self schema that they are related. For example, the self schema represents the abstracted essence of a person's perception of him or herself which evolves to "help the person keep track of the vast amounts of self-relevant information encountered..." (Rogers et al., 1977, p.677). Markus (1977) describes the self schema as a cognitive structure that results from attempts to organize, summarize or explain one's own behaviour in a particular domain. The self schema functions as a selective mechanism that organizes and guides the processing of self-related information. The self concept, as defined by Markus et al. (1982), is the union of the various domains of the self schemas.

Markus (Markus, 1977; Markus et al., 1982) and Rogers (Kuiper & Rogers, 1979; Rogers, Kuiper & Kirker, 1977) have produced some impressive empirical research that demonstrates the construct validity of the "self schema" idea. For example, Markus (1977) identified subjects with self schemas relating to independence and dependence by their responses on several self-rating scales. Subjects who rated themselves as "independent" or "dependent" were considered to be "schematic" for the independence-dependence dimension. Subjects who rated

themselves in the middle range of this dimension were considered "aschematic", that is, to lack schemas on this particular dimension.

Schematic subjects were found to be able to process information faster in the schematized domain, to possess more easily retrievable behavioural evidence in the domain, and to be resistant to counterschematic information, in contrast to aschematic subjects. This was taken as evidence for the existence of well-established schemas in schematic subjects, and the absence of such schemas in aschematics.

Similar findings occurred for the dimensions of masculinity and femininity, and androgyny (Markus et al., 1982). Androgynous subjects were classified into two groups. High androgynous subjects (rated themselves highly for both masculinity and femininity) showed evidence of schemas for both masculinity and feminity, while low androgynous subjects appeared to lack schemas for both of these dimensions.

Markus has thus provided evidence that the endorsement of specific categories of trait adjectives as self-descriptive reflects, at least in part, an underlying, well-articulated self schema. Evidence for the existence of the self schema derives from such measures as response latency, availability of behavioural evidence, confidence of self predictions of behaviour on schema-related dimensions, and resistance to counterschematic information. Rogers et al. (1977) have shown that schemas will also facilitate memory recall of

schema-related material.

In summary, self schemas a) facilitate the processing of information about the self (judgements and decisions about the self, such as rating whether adjectives are self-descriptive or not), b) contain easily retrievable behavioural evidence, c) provide a basis for confident self-predictions of behaviour on schema-related dimensions, and d) make individuals resistant to counterschematic information.

Self concept and self schema. It is important to clarify what the self concept and the self schema are not. Rosenberg (1979) distinguishes the self concept a) from Freud's ego, which "consists of a set of intellectual processes enabling the individual to deal with reality" (p.7), b) from the humanistic "real self" (e.g., Horney, 1950; Maslow, 1954; cited in Rosenberg, 1979), and c) from Eriksen's (1959) concept of "ego-identity" which has definitions that include "a conscious sense of individual identity" and "a unconscious striving for continuity of personal character" (Rosenberg, 1979, p.7).

Rosenberg stresses the cognitive character of the self concept: it is a picture of the self, not the self per se. The definition of the self schema is very similar to this in essence, and is perhaps even more rigorously cognitive. Neither of these constructs can explain the underlying source of the organizing power and function of the self concept or the self schema. This takes the discussion into another realm of discourse, that of the ego and ego identity.

Both the self-concept and the self-schema constructs contain the idea that the individual, as well as being an active agent, views himself as an object and has organized concepts, cognitive structures or schemas that represent this view. There are different concepts or schemas about the self in different domains, and within the same domain, representing different "empirical selves". Both views ascribe great importance to the organizing function of the self concept or self schema in the functioning of the individual. Both views recognize a consistency in the self concept or self schema, referred to either as "the need for self consistency" or "resistance to counterschematic information".

Self esteem. A major difference between the two approaches is the absence of an affective/evaluative component in the self schema construct (reflecting a problem in much of the social information processing literature; see Higgins et. al, 1981), compared to a very explicit self esteem component in the self concept approach.

According to Rosenberg (1979),

> The general human tendency to assess and evaluate the objects which enter the phenomenal field (Osgood et al., 1957) applies fully, perhaps even particularly, to the self. Almost invariably, to see ourselves in whole or in part is to assess, evaluate, and pass judgement on what we see (p.25).

Consistent with the recommendations of Higgins et al. (1981), it is suggested here that the construct of the self schema would be considerably enriched if it were expanded to include the basic structural principle of a good-bad

classification of self-referent information. In the domain of social self schemas, there would be a further classification of the self into the categories derived from the Nurturance and Dominance dimensions.

Self esteem has often been operationally defined as the disparity between the scores for oneself and one's ideal self on personality ratings of both (Gough, Fioravanti & Lazzari, 1983). This definition can easily be applied in the context of the MDS test.

Certainty in the self schema. Vallacher (1976) presents evidence that high self esteem persons are more likely to be certain of their self theories, while low self esteem persons are more likely to hold their self theories in doubt.

In the present context, "self theory" will be translated as "self schema(s)". Thus, we might expect that persons with highly developed and articulated schemas about themselves would have higher self esteem than those who are relatively undifferentiated, or aschematic with reference to who they are. (However, a highly articulated but "bad" self schema is also a possiblity.)

If a person does possess a well-established self schema along a particular dimension, we can expect that there would be consistency in the way the person uses the schema to make similarity judgements and categorizations. Subjects who lack such a schema could not be expected to make consistent similarity judgements about schema-related stimuli.

Thus, in an MDS task, we could expect that subjects with schemas along particular dimensions will show consistency in how they make decisions about these dimensions. Such consistency would be represented by a low stimulus error for the stimuli in question. On the other hand, subjects who are aschematic for the dimension would be expected to show high stimulus error for stimuli in the dimension.

The self schema and semantic structures. Most personality tests involve communication based on written language, as in personality tests where the subject is asked to rate adjectives being self-descriptive or not. As mentioned above, high endorsement on a trait is taken to indicate the existence of a well-established schema for that trait. Thus, the content of the self schema is accessed by language on most personality tests, and the MDS test will be no exception to this.

Ebbesen (1981) argues that when people are engaged in self-rating tasks, the relationships among the trait constructs they use reflect the semantic relationships among the trait terms rather than the actual internal personality structure. If Ebbesen is correct, then when a subject is engaged in a self-rating task, the self schema that is activated must be structured, in large part, according to the semantic relationships among the trait terms in his or her repertoire. Thus, the activation of the self schema in a self-rating task provides an example of a situation in which semantic processing and self-referent processing are interacting.

Semantic processing per se has been shown to be rather different than when information is processed in a self-referencing context, where the self schema has been activated. Rogers et al. (1977) had subjects rate adjectives on four tasks designed to force various kinds of encoding: structural, phonemic, semantic, and self reference. Incidental recall of rated words was found to be best under the self-reference condition. These results were taken as evidence that:

> self-reference represents a powerful and rich encoding device...In order for self-reference to be such a useful encoding process, the self must be a uniform, well-structured concept...As an aspect of the human information-processing system, the self appears to function as a superordinate schema that is deeply involved in the processing, interpretation, and memory of personal information (Rogers et al., 1977, p.685, 686,677).

The MDS task can be thought of, therefore, as having two components: the recognition and categorization of trait terms in the context of their semantic relationships to each other, and their membership, or lack of it, in the subject's self schema.

Summary

In summary, the central construct underlying the MDS test is that of the social schema. Social schemas are cognitive structures that represent the knowledge, attributes and specific examples of aspects of the social world. One type of social schema is the person schema, of which the self schema and the

prototypic schema are aspects.

A schema can be thought of as a category system that is organized hierarchically into three levels of abstraction: the superordinate level, the basic level and the subordinate level. At any level of abstraction, categories of different content are clustered around prototypes that merge into each other at fuzzy boundaries.

At the basic level of abstraction, categories are rich in information yet maximally differentiated from each other. Social categories at the basic level appear to be modelled best by a circumplex structure, with a set of bipolar prototypes merging into each other at fuzzy boundaries.

The structure of a schema is manifested whenever categorization or similarity judgements (among other things) occur. Thus, the MDS task, which directly involves both categorization and similarity judgements, would seem to be an ideal vehicle with which to study schematic structure. In addition, two-dimensional MDS configurations can be interpreted as a circumplex structure, which is thought to be the best model for social categories at the basic level of categorization.

The prototypic schema and the self schema are the constructs underlying the two types of stimuli, objective and subjective, respectively, that are used in the stimulus set for the MDS test.

The particular prototypic schemas conceptualized here are probably biologically prewired perceptual biases that predispose

people to interpret human experience, in general, in terms of its affective value, its power relationship to the self and its degree of intensity, and to interpret social experience in particular in terms of its nurturing, affiliative value and its power relationship to the self. In other words, people take with them into their social worlds built-in tendencies to categorize their experience on a fundamental level in terms of Nurturance and Dominance. These two dimensions of social perception are shared among people within our culture, and they are expressed in a common language with a specific semantic structure.

The semantic structure underlying the prototypic schemas of Nurturance and Dominance is best modelled as a circumplex, a set of bipolar axes that merge into each other at fuzzy boundaries in a two-dimensional space. The stimulus set for the MDS test was derived from a subset of these bipolar axes.

These stimuli serve two related functions. First, they are meant to improve the effectiveness of the projective aspect of the MDS test by reinforcing or exploiting the perceptual biases known to exist in social cognition. At the same time, because they <u>are</u> so fundamental to social cognition, they are expressed in a common language with a known semantic structure. Thus, they have a shared common meaning that will provide a normative anchor for the MDS test.

The self schemas underlying the subjective stimuli in the MDS test represent the abstracted essence of a person's knowledge about the self. The self schema functions as a

powerful organizing influence in the encoding of social information.

Access to the self concept, and the various self schemas that comprise it, is gained in part by the use of language and the words we use to describe ourselves. The social self schemas in the self concept must therefore be grounded in the semantic structure associated with the dimensions underlying social perception. In other words, the social self concept must include, among others, self schemas relating to the degree of nurturance and dominance the subject perceives him or herself to possess. On a deeper level, the social self concept must also include self schemas relating to the subject's evaluation of him or herself, in other words, self schemas that represent the subject's level of self esteem.

The stimuli in the MDS test that are designed to activate self schemas are also meant to provide a vehicle for the expression of individual differences, because the subjective value of these stimuli cannot be predicted.

As mentioned above, both prototypic and self schemas have representations in the form of words with specific semantic relationships to each other. When a subject is engaged in a self-rating task on a personality test, both prototypic and self schemas are being activated through the medium of language. The question arises as to whether such a task taps the subject's actual self schema, whether it merely taps the semantic structure underlying the self-descriptive words in the test, or

whether there is any difference between prototypic social schemas as applied to the self, and the semantic relationships underlying the meanings of the words representing these prototypes. Certainly there is evidence to suggest that there are differences between semantic processing per se and self-referencing processing that activates the self schema.

V. Implications for the MDS Test

The core construct that was chosen to form the focus of the MDS test is that of the social schema, as represented by the self schema and the prototypic bipolar dimensions of Nurturance and Dominance.

In the MDS test, the self schema is represented by four "empirical selves" or aspects of the self concept that were selected as the subjective stimuli. They were a) Your Usual Social Self, b) Your Ideal Self, c) Your Sexual Self, and d) Your Problem Self.

"Your Usual Social Self" refers to a person's "everyday" self concept or self schema, the kind of person one thinks oneself to be in a social context.

"Your Ideal Self" refers to the kind of person one aspires to be, one's ideal self (Rogers, 1959, cited in Gough et al., 1983). The measurement of the discrepancy between the real and ideal selves has been studied as a reflection of self esteem (Butler, 1968; Butler & Haigh, 1954; Pervin & Lilly, 1967; Shlien, 1962; cited in Gough et al., 1983). The distance between the "Usual Social Self" and the "Ideal Self" stimuli on the MDS test may prove to be a valid measure of self esteem. The "Ideal Self" stimulus was included as an anchor to identify positive aspects of the self schema.

"Your Sexual Self" refers to a person's sense of identity as a sexual being (and is not equivalent to gender). No previous literature on this aspect of the self schema was found. The "Sexual Self" was included among the self stimuli because it seemed to be an extremely important, and unstudied, aspect of a person's identity, and also because it seemed likely, for many people, to be a stimulus that would be charged with affect, and therefore a powerful element in the stimulus set.

"Your Problem Self" refers to the aspect(s) of oneself that one dislikes and worries about. Again, no previous literature was available, but this stimulus was included to serve as an anchor for identifying the negative aspects of the self schema. The interstimulus distance between the "Ideal Self" and the "Problem Self" may turn out to be a variable of interest.

Because of the inclusion of the "ideal" and "problem" self stimuli, the subjective stimulus set contains only two truly subjective stimuli, "Your Usual Social Self" and "Your Sexual Self". However, variations were expected across subjects in the way that the "ideal" and "problem" self stimuli relate to the configuration of the objective stimuli.

There were eight objective stimuli selected for inclusion in the MDS test, based on Wiggins' (1979) circumplex of social categories. The categories chosen were Warm, Cold, Agreeable, Quarrelsome, Dominant, Submissive, Ambitious, Lazy.

The development of the stimulus set and its final version are discussed in the following chapter. Because this study

represents the initial exploration into this research problem, the stimulus set was purposely kept as simple as possible. It is hoped that the data from this simple stimulus set will serve as groundwork from which more complex stimulus sets can be developed in the future.

The validity and reliability of the MDS test are the major criteria for determining the value of the test.

Content validity. The content validity of the test is represented by the content selection and coverage of test items (or test stimuli, in the case of the MDS test), and is directly related to the construct(s) underlying the test. Great care was taken to select stimuli for the MDS test that are thought to be at the core of social schemas, in general, and self schemas, in particular. The content validity of the stimulus set cannot be measured in any direct way, and can only be inferred from the general success or failure of the test itself.

Convergent validity. Convergent validity represents the meaning of the test as a reflection of the construct, and can be measured by comparing the MDS test with a different method for measuring the same construct.

Markus (1979, 1982) has demonstrated that subjects who strongly endorse a particular trait on a self-rating task will have a well-established schema (i.e., are "schematic" for this trait) as reflected in behavioural evidence of various sorts. By reverse analogy, then, subjects who are schematic for a particular trait will strongly endorse that trait in a

self-rating task. Thus, scores obtained from a self-rating task, as in the common type of personality test, can be used as one measure of the construct of the self schema for a particular trait or set of traits.

An attempt to demonstrate convergent validity for the MDS test could be made by correlating aspects of the MDS test with scores on a self-rating personality test, such as Wiggins' (1979) Interpersonal Adjective Scale (IAS).

Discriminant validity. Discriminant validity is demonstrated when measures of the focal construct are related in the predicted ways (typically uncorrelated) to exemplars of different constructs. This form of validity will not be evaluated in the present study.

Criterion validity. Predictive criterion validity is demonstrated when the test being developed is effective in detecting current behavioural patterns as identified by a previously established test. In the case of the MDS test, predictive validity could be investigated by comparing the effectiveness of the MDS test and a personality test (like the IAS) in predicting scores on a self-esteem test, like the Tennessee Self Concept Scale.

Concurrent criterion validity exists when the test being developed is shown to be substitutable for a longer, more cumbersome or more expensive criterion measure. This form of validity will not be evaluated in the present study.

Construct validity. Construct validity is demonstrated when, under different experimental manipulations, the subjects' test scores behave according to the hypotheses and predictions derived from the construct's theoretical network.

In this study, three predictions are made that can be considered as aspects of construct validity because they involve the confirmation of relationships derived from theory about the self schema construct, although they do not involve experimental manipulation per se.

The first prediction is that, since semantic processing and self-referent processing are different (Rogers et al., 1977), then if the MDS test does activate the self schema, there should be observable differences when the results of the MDS test are compared with the results of a related but purely semantic MDS task.

The second prediction is that subjects who are schematic for a particular trait, as identified by their high scores on the related trait scale, should show high consistency, or low error, for the stimuli in the MDS test that are designed to activate the trait schema. Conversely, aschematic subjects should show low consistency, or high error, for these stimuli.

The third prediction is derived from Vallacher's (1976) finding that people with high self esteem were more likely to be certain of their self theories. Certainty in a self theory would involve being schematic for a trait of set of traits. If the MDS test is tapping the self schema, then certainty in the self

schema, reflected by low overall stimulus error or low error for individual self stimuli, should be associated with high self esteem. Conversely, high error should be associated with low self esteem.

Reliability. A test-retest format should be employed to assess the reliability of the MDS test since the self schema construct implies stability over time.

Internal consistency is not relevant to the MDS test, and parallel-forms reliability will not be dealt with in the present study.

VI. Development of the Stimulus Set

Several pilot studies preceded the main study. These represented five stages in the development of the stimulus set for the MDS test.

Stage 1: The Unanchored Stimulus Set

The first pilot study consisted of an assessment of the test-retest reliability of a set of 14 entirely "subjective" stimuli. In other words, the subjective value of each of the stimuli, for a given subject, could not be predicted in advance.

A total of 51 subjects were tested twice, with a two week interval between the testing sessions. The subjects were university students who volunteered and who were each given feedback about their MDS results.

The stimulus set used in this first pilot study is shown in Table 1.

The test-retest reliability of this stimulus set was assessed using a feature of the MULTISCALE II program which produces a coefficient that is analogous to the usual correlation coefficient. This statistic is more fully described in Chapter VII. The average correlation between the subjects' stimulus configurations for the two testing sessions was r=0.65, with 84% of the correlations falling between r=.50 and r=.89.

Table 1

Unanchored Stimulus Set

1. Yourself
2. Your ideal self
3. Your sexual self
4. Your problem
5. Your mother
6. Your father
7. Your partner
8. Your closest friend
9. Someone to whom you are sexually attracted
10. One other person from your social scene
11. Someone with authority over you
12. A peer with whom you feel competetive
13. One other person from school or work
14. One other important person from your current life

This type of stimulus set could have considerable clinical value, in that its interpretation can involve the client and therapist in a discussion about the meaning of the dimensions in the client's output configuration. Such a discussion is interesting and often helpful to both client and therapist (and there are few clinical tests that provide the opportunity for this sort of feedback to the client). Christian (1978) has used a similar stimulus set with schizophrenics, and has found the interpretive discussions to be clinically valuable. He also reported that for certain types of patients, the MDS task in itself was therapeutic, perhaps because it requires a conscious cognitive organization which may clarify the patient's thoughts and feelings about him or herself and others.

The problem with this type of stimulus set is that because all the stimuli are of subjective value, norms are difficult to derive. The second stage of development of the stimulus set therefore involved the introduction of "anchor" stimuli, that is, stimuli with a known and shared subjective value.

Stage 2: The Semi-Anchored Stimulus Set

In the second pilot study 48 subjects were tested. These were university students who volunteered and who were given feedback about their MDS results.

The stimulus set consisted of 15 stimuli, nine of which were "subjective", and six of which were "objective" anchors.

Table 2

Semi-Anchored Stimulus Set

1. Yourself
2. Your ideal self
3. Your sexual self
4. Your problem self
5. Your mother
6. Your father
7. Your mate
8. Your supervisor
9. Your friend
10. Good
11. Bad
12. Friendly/Warm
13. Unfriendly/Cold
14. Powerful/Active
15. Weak/Passive

(See Table 2.) These anchors were based on Wiggins' (1979) Nurturance and Dominance dimensions, and have known semantic relations to each other. (See Chapter IV.)

Although the introduction of the anchors helped to make the stimulus configurations interpretable, two problems were encountered. First, the double word stimuli (e.g., "friendly/warm") were confusing for subjects. Single concepts seemed to be better as stimuli. Secondly, the proportion of subjective to objective stimuli was too high. More objective than subjective stimuli seemed to be necessary at this point.

The next stimulus set was based therefore on single concepts and a reversed proportion of subjective and objective stimuli.

Stage 3: The Anchored Stimulus Set (Version 1)

In the third pilot study, there were 17 subjects, university student volunteers who were given feedback on their MDS results.

The stimulus set consisted of 16 stimuli: the four subjective "self" stimuli, and 12 interpersonal trait adjectives derived from the expanded categories of the Nurturance and Dominance dimensions (Wiggins, 1979). (See Table 3.) These words have a known semantic relationship to each other, described as a circumplex. (See Chapter IV).

The problem with this stimulus set was its heterogeneity. When making the similarity judgements, subjects found it was

Table 3

Anchored Stimulus Set (Version 1)

1. Your usual social self
2. Your ideal social self
3. Your sexual self
4. Your problem social self
5. Warm
6. Cold
7. Agreeable
8. Quarrelsome
9. Dominant
10. Submissive
11. Ambitious
12. Lazy
13. Arrogant
14. Unassuming
15. Extraverted
16. Introverted

difficult and confusing to have to shift between self stimuli and trait-word stimuli. Hence, the subsequent stimulus set was designed to be more homogeneous.

Stage 4: The Anchored Stimulus Set (Version 2)

The fourth pilot study employed 56 subjects, university students who were each paid five dollars for their participation. This study involved a test-retest task, and subjects also completed the Wiggins Interpersonal Adjective Scale (IAS) and a version of the Tennessee Self Concept Scale. The main results of these aspects of this pilot study are reported later in Chapter VIII.

The stimulus set consisted of 16 stimuli all framed as aspects of the self. Four were the subjective "self" stimuli and the other 12 were objective "self" stimuli, in that they were based on Wiggins' interpersonal categories with known circumplex structure. This stimuli are given in Table 4.

Subjects found this stimulus set easier than the previous one, once they adjusted to thinking about so many different aspects of themselves. However, this stimulus set presented too long a task. The dropout rate was very high: only 28 out 56 subjects (50%) returned for the second testing session. Clearly, the excessive dropout rate indicated that the use of 16 stimuli made the test too long and difficult for subjects, from whom cooperation is essential if their judgements are to be reliable.

Table 4

Anchored Stimulus Set (Version 2)

1. Your usual social self
2. Your ideal social self
3. Your sexual self
4. Your problem social self
5. Your warm self
6. Your cold self
7. Your agreeable self
8. Your quarrelsome self
9. Your dominant self
10. Your submissive self
11. Your ambitious self
12. Your lazy self
13. Your arrogant self
14. Your unassuming self
15. Your extraverted self
16. Your introverted self

Thus, a shortened version of this stimulus set was employed in the next stage of development.

Stage 5: The Final Version

The Stage 4 stimulus set was reduced to 12 stimuli, the four subjective "self" stimuli, and eight objective self stimuli derived from the eight basic categories of Wiggins' (1979) circumplex (see Table 5). Ninety-seven subjects, who were paid five dollars for their participation, were solicited for a test-retest task.

The return rate for the second test session, two weeks later, was high (76 out of 97 subjects, or 78%), much higher than with the longer stimulus set. This seemed to indicate that the shortened version of the test would enlist better cooperation and more reliable responses from subjects.

In addition, the test-retest reliability of the shortened test was found to be slightly higher than that of the longer version. This also seemed to provide an indication that the shortened test was preferable, since on theoretical grounds one would expect higher reliability with the longer test.

This final version of 12 stimuli formed the basic stimulus set which was used in main study described in the following chapter.

Table 5

Anchored Stimulus Set (Final Version)

1. Your usual social self
2. Your ideal self
3. Your sexual self
4. Your problem self
5. Your warm self
6. Your cold self
7. Your agreeable self
8. Your quarrelsome self
9. Your dominant self
10. Your submissive self
11. Your ambitious self
12. Your lazy self

VII. Method

The purpose of the study which is reported below was to assess the reliability and certain aspects of the validity of the standardized MDS test, using the final version of the stimulus set described in the previous chapter.

Subjects

The subjects solicited were university students. They were paid five dollars each for their participation, in addition to receiving feedback on the results of their testing.

Two groups totalling 76 students were tested and retested using the final 12-stimulus version of the MDS test. In addition, 28 subjects were tested and retested using the longer 16-stimulus version of the test. While the focus was on the 12-stimulus version, references to the data from the longer version will made in certain analyses which are reported in the next chapter.

Of the total 104 subjects, 74 were female and 30 were male. The average age of the females was 23.5 years. The average age of the males was 24.9 years.

Test Materials

Subjects were administered three tests, in counterbalanced order. Two weeks later, the subjects were retested using the same tests, again in counterbalanced order. Each testing session took about one hour.

The MDS test. The development of the final 12-stimulus version of the MDS test has been described previously. Table 5 gives a list of the stimuli in this set. The full test is given in Appendix 4. The test "items" consisted of all the possible pairs of stimuli listed on a printed form. Each pair was listed only once, for a total of 66 pairs of stimuli. Beside each pair of stimulus names a nine-point rating scale was printed, ranging from one (Very Similar) to nine (Very Different). Subjects were asked to rate each pair of stimuli according to how similar they were, and to use the full range of numbers on the rating scale if possible.

Interpersonal Adjective Scale. In order to reduce the testing time for subjects, a shortened version of Wiggins (1979) Interpersonal Adjective Scales (IAS) was used. Appendix 2 contains the items on this test. Twelve out of the sixteen eight-item scales were used, the scales omitted being Calculating, Aloof, Ingenuous and Gregarious. These particular scales were selected for omission because they were on the diagonals rather than the main axes of the circumplex (see Figure 1). The remaining scales were those corresponding to the

Table 6

Interpersonal Adjective Scales

1. Arrogant
2. Unassuming
3. Extravert
4. Introvert
5. Warm
6. Cold
7. Agreeable
8. Quarrelsome
9. Dominant
10. Submissive
11. Ambitious
12. Lazy

stimulus items in the 16-stimulus version of the MDS test, and are presented in Table 6. The scales were administered using an eight-point scale ranging from "Extremely Inaccurate" to "Extremely Accurate" as a description of the subject.

Self-esteem test. A shortened version of the Tennessee Self Concept Scale (Fitts, 1965) was used, in order to reduce testing time for subjects. Appendix 3 contains a list of the items on this version of the test. Two out of the eight 18-item subscales were used. These were the Personal Self scale, reflecting the individual's sense of personal worth and his or her feeling of adequacy as a person, and the Social Self scale, reflecting the person's sense of adequacy and worth in his or her social interactions with other people in general. The other six self-concept scales, including scales for the Physical Self, the Moral-Ethical Self and the Family Self, were omitted because they were not directly a part of the interpersonal domain reflected in the MDS test.

Additional Subjects and Procedure

One aspect of the construct validation of the MDS test called for the comparison of three stimulus sets differing in the proportions of semantic versus self-referent processing that were required in making the similarity judgements.

The first of these stimulus sets (Stimulus Set 1) is presented in Table 7. It consisted entirely of interpersonal

Table 7

Stimulus Set 1 (Words Only)

1. Arrogant
2. Unassuming
3. Extravert
4. Introvert
5. Warm
6. Cold
7. Agreeable
8. Quarrelsome
9. Dominant
10. Submissive
11. Ambitious
12. Lazy

adjectives based on the Interpersonal Adjective Scale. Subjects rating this stimulus set would be judging the stimuli in terms of semantic similarity only. A group of 54 subjects judged this stimulus set at one time only. The subjects were university student volunteers who were paid three dollars each for their participation.

The second stimulus set (Stimulus Set 2) is listed in Table 8. This stimulus set was identical to the first except that each stimulus is presented as an aspect of the self. Thus, in rating this stimulus set, the subjects would be making judgements based on both semantic similarity and self reference. A group of 47 subjects completed this task. The subjects were university student volunteers who were each paid three dollars for their participation.

The third stimulus set selected was the one used in the main part of this study. Because of the inclusion of four "self" stimuli (Your Usual Self, Your Ideal Self, Your Sexual Self and Your Problem Self), this stimulus set required a substantial amount of self-referent processing, more than either of the first two stimulus sets. The data for this stimulus set were taken from the first testing session of the test-retest task, using the 76 subjects employed in the main reliability and validity components of this research.

Table 8

Stimulus Set 2 (Self Words)

1. Your Arrogant Self
2. Your Unassuming Self
3. Your Extravert Self
4. Your Introvert Self
5. Your Warm Self
6. Your Cold Self
7. Your Agreeable Self
8. Your Quarrelsome Self
9. Your Dominant Self
10. Your Submissive Self
11. Your Ambitious Self
12. Your Lazy Self

VIII. Results

Descriptive Statistics

MDS variables. One of the purposes of the present study was to establish norms for the MDS variables investigated. Table 9 presents the means and standard deviations for the two testing sessions (denoted as Times 1 and 2) of the overall error, the exponent and the individual stimulus errors for each of the twelve stimuli.

Personality variables. The sample of 76 subjects who were tested using the final 12-stimuli version of the MDS test actually consisted of two separate groups of 34 and 42 subjects respectively. Recall that a third group of 28 subjects was tested using the 16-stimuli version of the MDS test. All three groups of subjects completed the Interpersonal Adjective and Self Esteem scales at both testing sessions. In order to determine whether these three groups could legitimately be pooled to provide a sample of n=104 for the purpose of analyzing the personality data, a discriminant analysis was performed. No significant differences between the three groups were found. Therefore, the descriptive statistics presented below for the personality data are based on a sample of n=104. (All statistics in which both the personality data and the MDS data are involved

Table 9

Means and Standard Deviations

of the MDS Variables

Variable	Time 1		Time 2	
	Mean	S.D.	Mean	S.D.
Overall Error	0.400	0.077	0.366	0.081
Exponent	1.234	0.357	1.297	0.362
Individual Stimulus Error				
Usual Self	1.043	1.112	0.854	0.857
Ideal Self	1.006	0.911	0.950	0.992
Sexual Self	1.220	1.107	1.219	1.159
Problem Self	1.040	1.076	1.038	1.046
Warm Self	1.176	1.118	0.995	0.822
Cold Self	0.752	0.816	0.703	0.917
Agreeable Self	0.950	0.939	1.100	1.161
Quarrelsome Self	0.978	1.021	0.681	0.839
Dominant Self	1.147	0.980	1.288	1.208
Submissive Self	0.918	0.856	1.297	1.110
Ambitious Self	1.381	1.162	1.194	1.033
Lazy Self	1.201	1.323	1.415	1.363

jointly are based on a sample of n=76.)

Table 10 presents the means and standard deviations for the two testing sessions of the 12 Interpersonal Adjective scales, the four combined Interpersonal Adjective scales, the two Self Esteem subscales and the overall Esteem scale. It should be noted that the two Self Esteem subscales were not analyzed separately, but were instead combined to form a longer and more reliable overall Esteem scale. The summary data for the Interpersonal Adjective scales are very similar to those reported by Wiggins (1979) from a much larger but comparable sample of university students.

Circumplexity of the Interpersonal Adjective Scales. One of the major characteristics of Wiggins' Interpersonal Adjective Scales was their deliberately-structured two-dimensional circumplex pattern. Table 11 presents the hypothetical intercorrelations expected among the Interpersonal Adjective Scales (Wiggins, 1979) assuming a circumplex structure is present, with those found in the present study at both testing sessions, based on the data from the sample of n=104. The greatest deviations from the expected correlations occured with the variables Arrogant and Unassuming, both of which are half scales and thus based on fewer items.

The agreement between the expected correlations of the circumplex model and those obtained from the data, as measured by the usual correlation coefficient, was r=0.91 for Time 1 and r=0.90 for Time 2. Thus, even with this relatively modest

Table 10

Means and Standard Deviations

of the IAS and Self Esteem Scores

Scale	Time 1 Mean	Time 1 S.D.	Time 2 Mean	Time 2 S.D.
Ambitious	3.660	0.528	3.755	0.502
Dominant	3.097	0.614	3.200	0.593
Arrogant	2.145	0.598	2.113	0.525
Cold	1.682	0.525	1.659	0.505
Quarrelsome	1.688	0.444	1.704	0.408
Introverted	2.729	0.625	2.692	0.609
Lazy	2.287	0.579	2.221	0.548
Submissive	2.597	0.668	2.554	0.638
Unassuming	3.066	0.543	3.081	0.049
Warm	4.035	0.522	4.039	0.532
Agreeable	3.997	0.444	4.021	0.388
Extraverted	3.457	0.607	3.478	0.510
Ambitious-Dominant	6.757	0.989	6.955	0.976
Cold-Quarrelsome	3.369	0.839	3.362	0.789
Lazy-Submissive	4.884	1.043	4.775	1.023
Warm-Agreeable	8.031	0.859	8.060	0.819
Personal Esteem(PE)	3.889	6.571	5.083	7.272
Social Esteem(SE)	19.139	6.808	19.148	6.929
Global Esteem(PE+SE)	23.028	11.943	24.231	13.051

Table 11

IAS Intercorrelations in Comparison With

The Circumplex Model

	Amb-Dom						
	0.50	. . . .	correlation expected for Circumplex				
Arrogant	0.09	. . . .	correlation at Time 1				
	0.09	. . . .	correlation at Time 2				
		Arr					
	0.00	0.50					
Cold-	-0.11	0.39					
Quarrel.	-0.14	0.47					
			Col-Qrl				
	-0.50	0.00	0.50				
Introvert.	-0.42	-0.03	0.29				
	-0.51	-0.08	0.25				
				Intr			
	-1.00	-0.50	0.00	0.50			
Lazy-	-0.85	0.15	0.17	0.45			
Submissive	-0.86	0.03	0.24	0.50			
					Laz-Sub		
	-0.50	-1.00	-0.50	0.00	0.50		
Unassuming	-0.26	-0.52	-0.29	0.07	0.16		
	-0.40	-0.47	-0.15	0.25	0.27		
						Unass	
	0.00	-0.50	-1.00	-0.50	0.00	0.50	
Warm-	0.02	-0.11	-0.71	-0.25	0.00	0.30	
Agreeable	-0.00	-0.20	-0.72	-0.14	-0.01	0.24	
							War-Agr
	0.50	0.00	-0.50	-1.00	-0.50	0.00	0.50
Extravert.	0.53	0.22	-0.34	-0.74	-0.42	-0.15	0.37
	0.56	0.13	-0.32	-0.62	-0.48	-0.26	0.33

sample, there was evidence that the Interpersonal Adjective Scales do conform to a circumplex structure.

Reliability

MDS variables. A major purpose of this study was to assess the test-retest reliability of the MDS variables. In order to evaluate the stability of the stimulus configuration, a test-retest reliability coefficient was computed for each subject individually across the two testing sessions. This was accomplished by using a feature of the MULTISCALE.II program that allows for the input of a reference configuration (Time 1 configuration) to which a second configuration (Time 2) is then fitted. The match is measured by a coefficient that is essentially a generalization of the usual correlation coefficient.

These correlation coefficients are reported in a frequency distribution in Table 12. The average test-retest correlation for the MDS stimulus set was r=0.79, with a standard deviation of 0.388. All but one of these correlations were greater than r=0.50, and 72% of them were equal to or greater than r=0.70. Thus, the stimulus configuration variable of the MDS test is quite stable over a two-week interval.

The test-retest reliability coefficients of the other MDS variables (overall error, individual stimulus errors and exponent) are reported in Table 13. The exponent was the only

Table 12

MDS Stimulus Configuration

Test-Retest Reliability

Intra-Subject Correlations	Frequencies		
0.90 - 1.00	20	Mean	0.786
0.80 - 0.89	17	Mode	0.640
0.70 - 0.79	19	Median	0.798
0.60 - 0.69	15		
0.50 - 0.59	4	s.d.	0.388
0.40 - 0.49	1		
0.30 - 0.39	0		
0.20 - 0.29	0		
0.10 - 0.19	0		
0.00 - 0.09	0		

Table 13

MDS Variables

Test-Retest Reliability

	Correlation	p
Exponent	0.70	0.000
Overall Error	0.36	0.001
Individual Stimulus Error		
Usual Self	0.27	0.008
Ideal Self	0.02	0.423
Sexual Self	0.18	0.060
Problem Self	0.31	0.004
Warm Self	0.10	0.197
Cold Self	0.27	0.010
Agreeable Self	0.10	0.185
Quarrelsome Self	0.04	0.357
Dominant Self	0.23	0.023
Submissive Self	0.08	0.248
Ambitious Self	0.30	0.004
Lazy Self	0.06	0.300

one of these MDS varables to show a high test-retest correlation (r=0.70). The overall error had a correlation of r=0.36, and the correlations for the individual stimulus errors ranged from r=0.02 to r=0.31, with an average of r=0.16.

There was a decrease in the mean value across testing sessions for the overall error, and for eight out of 12 individual stimulus errors (see Table 9). This suggests a practice effect, whereby subjects approaching the MDS test for a second time tended to make their similarity judgements in a more consistent fashion. On the other hand, the exponent, which reflects the degree of polarization in similarity judgements, remained relatively stable across the two week interval, suggesting that the exponent reflects an ongoing response tendency.

Personality variables. The test-retest reliability coefficients for the Interpersonal Adjective and Esteem scales are presented in Table 14. They were generally high, ranging from r=0.85 (Lazy-Submissive) to r=0.65 (Unassuming). The alpha coefficients of internal consistency for the combined Interpersonal Adjective Scales (Ambitious-Dominant, etc.) were all greater than r=0.80, and are comparable to those reported by Wiggins (1979). Of the individual scales, Dominant was the most internally cohesive, and Unassuming was the least. The internal consistency of the overall Esteem scale was also high (alpha= 0.84 for Time 1 and alpha=0.89 for Time 2).

Table 14

IAS and Self Esteem Variables

Test-Retest and Internal Reliability

Variable	Test-Retest Correlation	Alpha Coefficient Time 1	Time 2
Ambitious	0.75	0.72	0.77
Dominant	0.81	0.82	0.84
Arrogant	0.75	0.81	0.80
Cold	0.74	0.76	0.83
Quarrelsome	0.68	0.74	0.75
Introverted	0.81	0.75	0.81
Lazy	0.84	0.76	0.78
Submissive	0.83	0.81	0.79
Unassuming	0.65	0.65	0.61
Warm	0.78	0.78	0.84
Agreeable	0.73	0.71	0.72
Extraverted	0.84	0.82	0.78
Ambitious-Dominant	0.84	0.84	0.87
Cold-Quarrelsome	0.76	0.82	0.85
Lazy-Submissive	0.85	0.82	0.84
Warm-Agreeable	0.78	0.83	0.86
Personal Self Esteem	0.62	0.71	0.80
Social Self Esteem	0.74	0.78	0.83
Global Self Esteem	0.71	0.84	0.89

Note: All correlations are significant at the 0.000 level.

Convergent Validity

Both the MDS test involving similarity judgements among aspects of the social self and the IAS self-rating task are conceptualized as involving the activation of self schemas in the interpersonal domain. A high rating on a particular trait scale is taken to indicate the presence of a schema for that trait in the subject's self concept (Markus, 1977, Markus et al., 1982). Conversely, if a subject is schematic for a particular trait, then a high score is expected on a scale such as those found in the IAS.

In the MDS test, a task analogous to a self-rating task is presented in the form of ratings of similarity between the Usual Social Self stimulus and the eight interpersonal stimuli (e.g., Your Warm Self, Your Lazy Self). Likewise, similarity judgements between these interpersonal stimuli and the other self stimuli (Ideal Self, Sexual Self, Problem Self) provide a type of self-rating task.

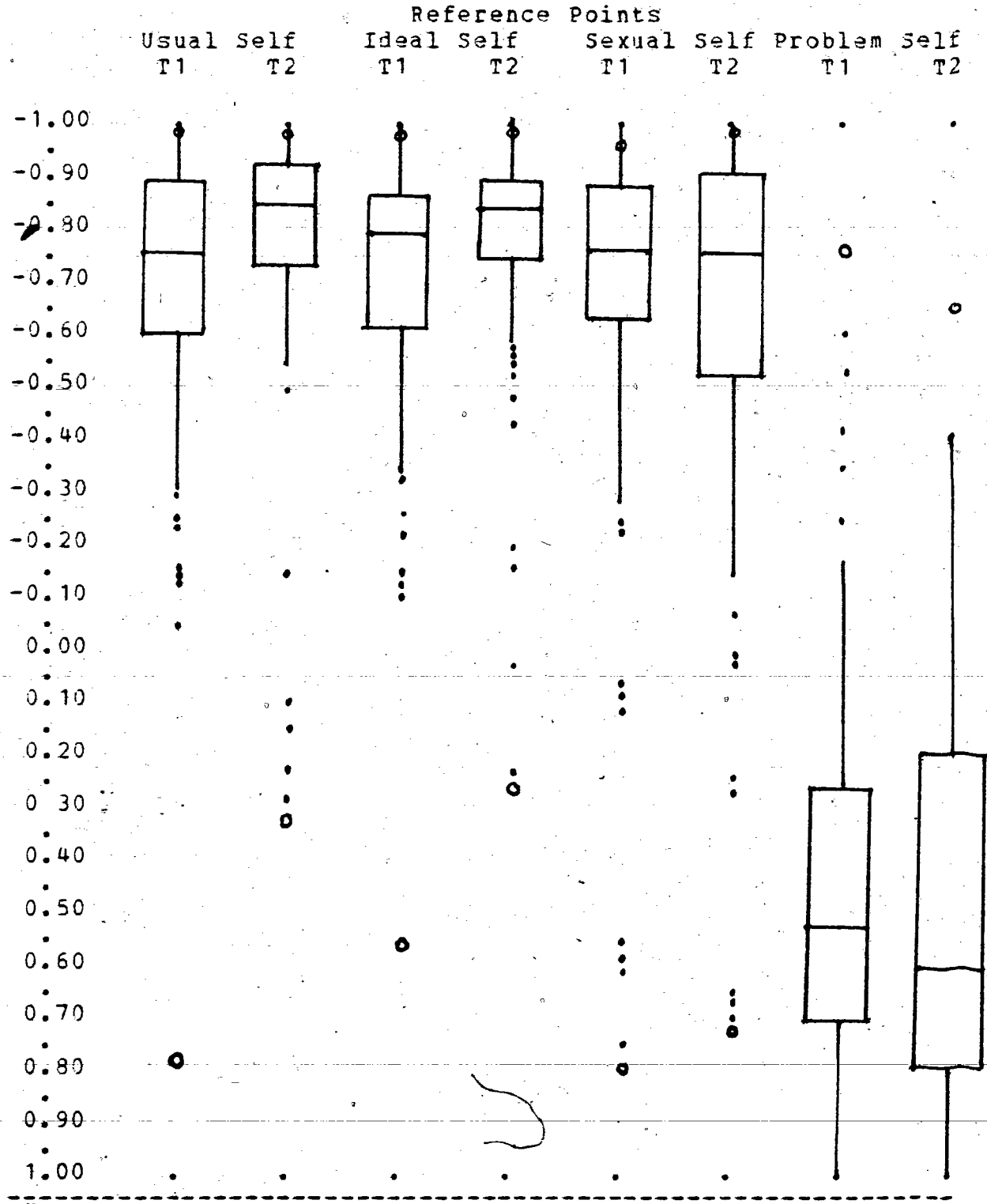
Scores analogous to those obtained on the IAS may be derived from the MDS test by using the stimulus configuration to compute the interstimulus distances between the particular self stimulus (which is the reference point) and the interpersonal stimulus in question (e.g., the distance between the Usual Social Self and the "Dominant self", or between the Ideal Self and the Submissive Self). Unfortunately, these interstimulus distances are not comparable across subjects since each subject

has a different stimulus configuration. While this presents no difficulty for performing intra-subject analyses, it is an issue for performing across-subject analyses. However, "normalized" distances, that are comparable across subjects, may be computed by taking the average of all the interstimulus distances for one subject and dividing each of the subject's original distances by this average. The result is that the average normalized distance is the same for every subject. In this way, a profile of MDS scores was constructed, consisting of a set of normalized distances from each of the eight interpersonal stimuli to the reference self stimulus. A profile consisting of the subject's eight IAS scale scores was the corresponding criterion measure for the eight normalized MDS distances. These two profiles were correlated with each other in order to obtain an index of intra-subject agreement. Convergent validity is demonstrated in such an analysis by a high correlation between these two sets of profiles.

The concordance between the IAS profile and the normalized MDS distances was evaluated for each subject individually using the usual correlation coefficient. This is an appropriate measure of agreement in the present context because profile elevation is irrelevant. These data are presented in Table 15 in the form of box plots (Tukey, 1977), two (Times 1 and 2) for each of the four possible self-reference points (Usual Social Self, Ideal Self, Sexual Self, Problem Self). The box plots represent the frequency distributions of the intra-subject

Table 15

Box Plots of Intra-Subject Correlations between MDS Normalized Distances and IAS Scores



correlations. The top and bottom of the boxes represent the upper and lower quartiles of the particular frequency distribution. The line dividing the box represents the median of the distribution. The two lines or "whiskers" extending from the ends of the box are each equal in length to the interquartile distance. Any values falling outside of the whisker ends of the box plot are considered outliers and are plotted individually. The open circles are the extreme values observed in the data.

As can be seen from Table 15, the Self, Ideal Self and Sexual Self reference points provided a substantial number of correlations less than r=-.50. Thus, there was a good match between the subjects' IAS profiles and the MDS profiles. The negative correlations were anticipated, since a high score on an IAS scale should be associated with a small distance between the self-reference point and the related interpersonal stimulus (e.g., a high score on the IAS scale Dominance should be associated with a small distance between the Dominant Self stimulus and the self-referent stimuli. Similarly, a low score on an IAS scale (e.g., Lazy) should be associated with a large distance between the related interpersonal stimulus (Lazy Self) and the self-referent stimulus. The Usual Social Self and the Ideal Self stimuli appeared to be the best self-reference points.

The Problem Self reference profiles had a quite different pattern of correlations, one that was more spread out and that clustered around r=0.40. This seems to indicate that most

subjects did not identify with the Problem Self as their central reference point, referring instead to the more positive self stimuli of the Usual Social Self, the Ideal Self and the Sexual Self. The preponderance of positive correlations with the Problem Self reference point indicated that high scores on the IAS variables (e.g., Dominance) tended to be associated with large MDS distances (e.g., between Problem Self and Dominant Self).

In addition to this intra-subject analysis of the data, across-subject analyses were also performed. One approach was to compute individually the correlation coefficients between each of the IAS variables and their associated MDS normalized distances (see Table 16). The best correlations consistently were between the IAS variables Dominant, Ambitious and Lazy, and the related MDS distances for the Usual Social Self, Ideal Self and Sexual Self reference points (e.g., Usual Social Self-Dominant Self distance, Ideal Self-Lazy Self distance).

A second across-subject approach to convergent validity was to compute the canonical correlations between the set of IAS variables and the set of MDS distances (see Table 17). For each of the Usual Social Self, Ideal Self and Sexual Self reference points, the largest canonical correlations range between r=0.60 and r=0.69 for Times 1 and 2, respectively. For the Problem Self reference point, the correlations were r=0.57 and r=0.56 respectively.

Table 16

Across-Subject Correlations

Between Individual IAS Scores and Individual MDS Distances

	Reference Points							
	Usual Self		Ideal Self		Sexual Self		Problem Self	
	T1	T2	T1	T2	T1	T2	T1	T2
Warm	-0.05	-0.14	-0.17	-0.11	-0.09	-0.03	-0.09	-0.06
Cold	-0.29	-0.37	-0.34	-0.19	-0.03	-0.14	-0.29	-0.16
Agre	-0.13	-0.14	-0.15	-0.06	0.11	0.04	-0.04	-0.05
Qurl	-0.25	0.06	0.02	0.07	0.01	-0.13	-0.17	-0.03
Dom	-0.48	-0.38	-0.51	-0.47	0.06	0.17	-0.52	-0.32
Sub	-0.23	-0.15	-0.25	-0.11	-0.31	-0.05	-0.26	-0.19
Amb	-0.39	-0.45	-0.29	-0.39	-0.14	0.08	-0.27	-0.28
Lazy	-0.41	-0.47	-0.39	-0.35	-0.14	0.08	-0.38	-0.32

Note: Correlations underlined are significant at the 0.01 level.

Table 17

Canonical Correlations Between Eight IAS Variables and Eight MDS Normalized Distances

	Largest Canonical Correlation			
Self Reference Point	Time 1	p	Time 2	p
Usual Self	0.68	0.00	0.64	0.01
Ideal Self	0.65	0.00	0.69	0.01
Sexual Self	0.68	0.01	0.60	0.04
Problem Self	0.57	0.66	0.56	0.53

Both the individual correlations and the canonical correlations demonstrated good concordance between the IAS variables and the related MDS distances.

Concurrent Validity

Self esteem is often measured by rating scales in which high self esteem is indicated by high scores on items of positive value and low scores on items of negative value (the Tennessee Self Concept Scale is of this general type). A similar pattern of relationships between the IAS and the self esteem scale used in this study was predicted and confirmed, as can be seen in Table 18. That is, positive Interpersonal Adjective scales showed moderate positive correlations with self esteem, and negative Interpersonal Adjective scales showed moderate negative correlations with self esteem.

Given these correlations between the individual IAS variables and self esteem, it seemed reasonable to expect that the combination of IAS variables would substantially predict self esteem in a multiple regression analysis. Concurrent validity was assessed by comparing the ability of the MDS test with that of the IAS in making this prediction.

A comparison (see Table 19) was made between the multiple correlation coefficient for the eight IAS variables predicting Self Esteem, and the multiple correlation coefficient for the eight corresponding MDS interstimulus normalized distances for

Table 18

Correlations Between IAS Variables and Self Esteem

	Time 1		Time 2	
	r	p	r	p
Warm	0.05	0.324	0.18	0.058
Cold	-0.31	0.003	-0.18	0.060
Agreeable	0.29	0.005	0.30	0.004
Quarrelsome	-0.33	0.002	-0.44	0.000
Dominant	0.37	0.000	0.25	0.000
Submissive	-0.41	0.000	-0.38	0.000
Ambitious	0.50	0.000	0.42	0.000
Lazy	-0.44	0.000	-0.50	0.000

each of the four self reference points (Usual Social Self, Ideal Self, Sexual Self and Problem Self). The multiple correlation coefficient for the eight IAS variables was R=0.67 for Time 1 and R=0.61 for Time 2. The multiple correlation coefficients for the four sets of eight MDS normalized distances were somewhat lower, especially at Time 2. Thus, the eight MDS distances were less predictive of Self Esteem than were the eight IAS variables.

However, a combination of seven MDS variables was found that reliably predicted Self Esteem at Times 1 and 2, with a multiple correlation coefficient of R=0.69 (p=0.000) both times, which is somewhat better than the IAS prediction. These variables were the overall error, the exponent, the individual stimulus error for the Warm Self stimulus, and four interstimulus distances, Self-Ideal Self, Ideal Self-Ambitious Self, Sexual Self-Warm Self and Sexual Self-Lazy Self. Thus, the MDS test was capable of predicting Self Esteem at least as efficiently as the IAS when a combination of MDS variables was used. It should be noted that the correlation coefficient between the Self Esteem score and the best individual MDS variable, the Self-Ideal Self distance, was r=-0.49 at Time 1 and r=-0.45 at Time 2, significant at the 0.01 level both times.

Table 19

Multiple Regression Analyses of Self Esteem on IAS and MDS Variables

	Time 1		Time 2	
	R	p	R	p
Eight IAS Variables	0.67	0.00	0.61	0.00
Eight Normalized Interstimulus Distances				
Reference Point:				
Usual Self	0.60	0.01	0.46	0.01
Ideal Self	0.56	0.00	0.42	0.02
Sexual Self	0.52	0.00	0.52	0.02
Problem Self	0.37	0.26	0.49	0.01

Construct Validity

Semantic vs. self referencing. It was hypothesized that there would be an qualitative difference between the results of an MDS task involving purely semantic processing of stimuli and the results of an MDS task involving self-referent processing. Table 20 presents the means and standard deviations of the overall errors, exponents and individual stimulus errors for each of the three stimulus sets used to examine this hypothesis.

Stimulus Set 1 consisted entirely of 12 interpersonal adjectives (e.g., Warm, Cold). Stimulus Set 2 consisted of these same interpersonal adjectives presented as aspects of the self (e.g., Warm Self, Cold Self). Stimulus Set 3 consisted of eight interpersonal Selves (Warm Self, Cold Self, Agreeable Self, Quarrelsome Self, Dominant Self, Submissive Self, Ambitious Self and Lazy Self), and four purely self stimuli (Self, Ideal Self, Sexual Self and Problem Self).

When the data for each stimulus set were analysed for each group as a whole, the overall error and the exponent showed differences that are in the expected direction. The overall error increased from Stimulus Set 1 to Stimulus Set 2 to Stimulus Set 3, indicating a greater degree of inconsistency as subjects dealt with increasingly self-referent stimuli. The mean of the exponent also increased across the three stimulus sets. The individual stimulus errors showed no systematic differences.

Table 20

Semantic vs. Self-Referent Processing

Comparison of Three Stimulus Sets

	Stimulus Set 1 (Semantic, Words Only)	Stimulus Set 2 (Self-Words)	Stimulus Set 3 (Self-Referent, Self Stimuli)		
			T1	T2	
Error	0.773	1.034	3.054	1.552	
Exponent					
Mean	1.62	2.15	4.91	2.48	
S.D.	0.63	0.90	3.61	2.41	
Individual Stimulus Error:					
Arrogant	0.91	0.66	1.39	1.14	Usual S.
Unassuming	1.03	0.73	0.61	0.66	Ideal S.
Extraverted	1.65	1.10	0.85	0.56	Sex. S.
Introverted	1.48	1.15	0.58	1.01	Prob. S.
Warm	0.78	1.05	0.96	1.02	
Cold	1.11	1.11	0.80	0.78	
Agreeable	1.08	1.25	1.19	1.03	
Quarrelsome	0.63	0.89	1.23	0.87	
Dominant	0.72	0.94	1.01	1.58	
Submissive	1.02	0.65	1.45	1.15	
Ambitious	0.83	1.20	1.21	1.27	
Lazy	0.76	1.27	0.72	0.94	

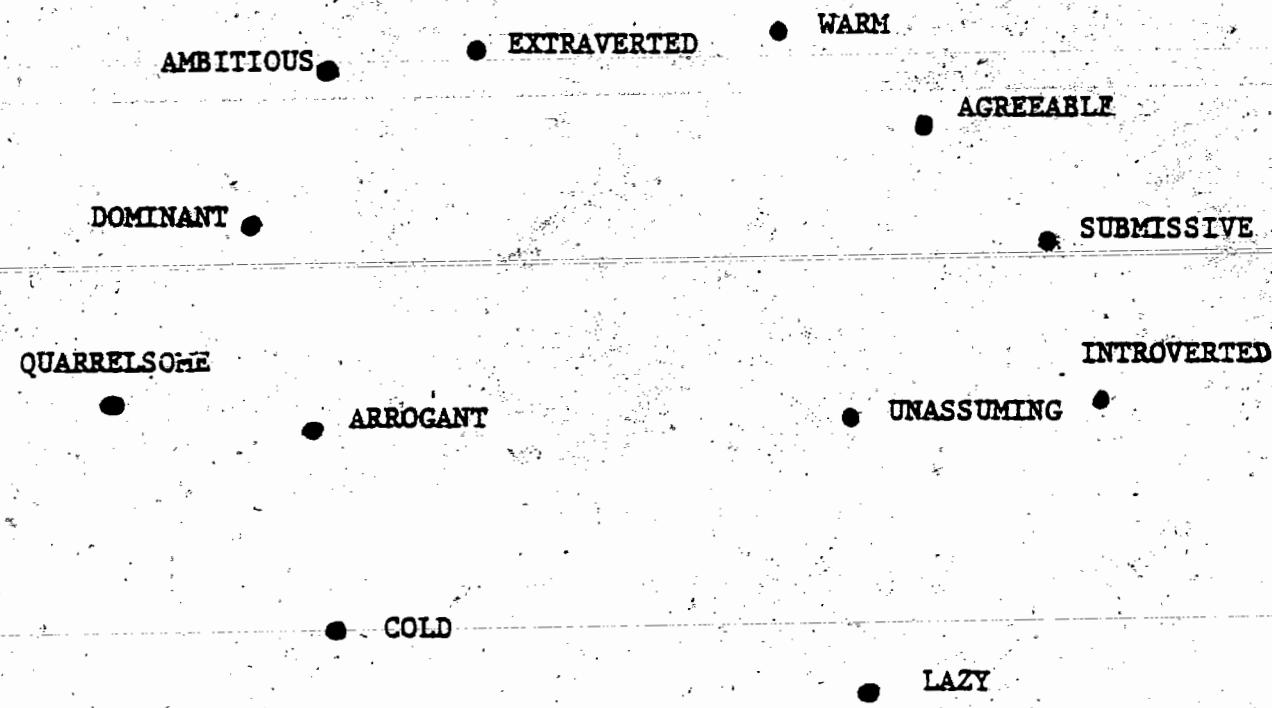


Figure 2a. Stimulus Configuration for Stimulus Set 1 (Words Only).

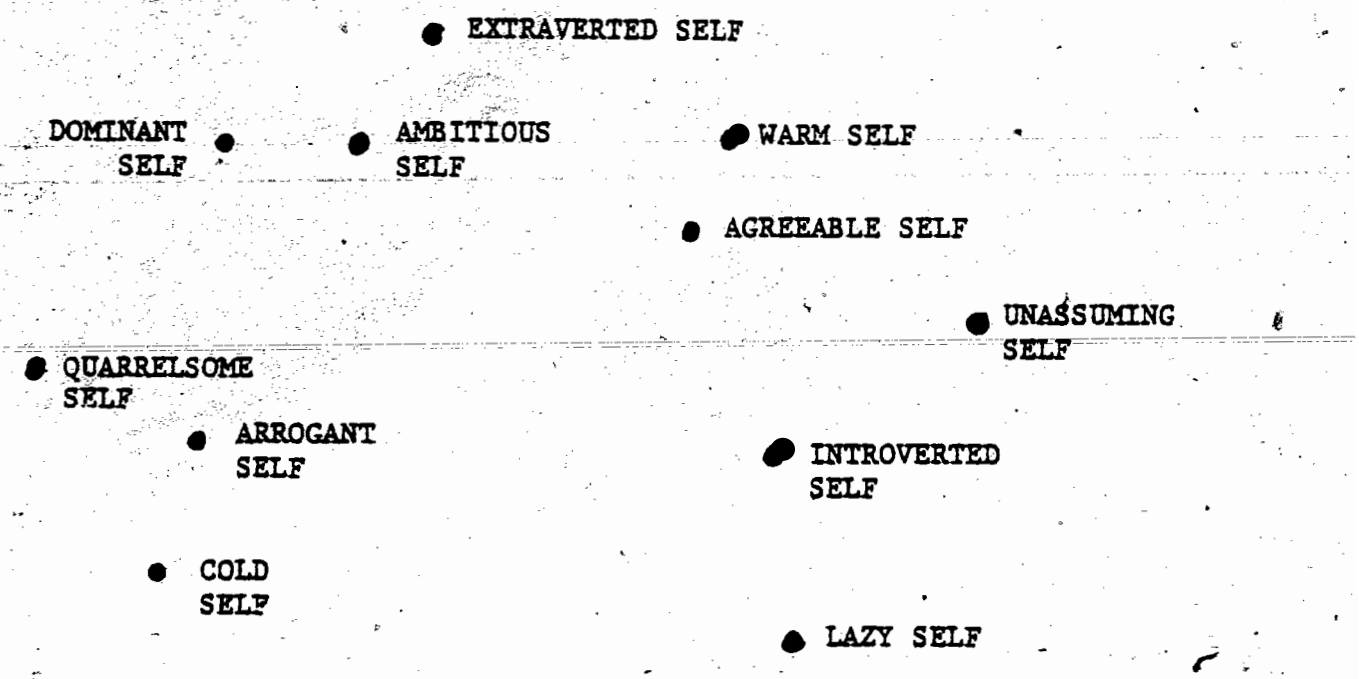


Figure 2b. Stimulus Configuration for Stimulus Set 2 (Self Words).

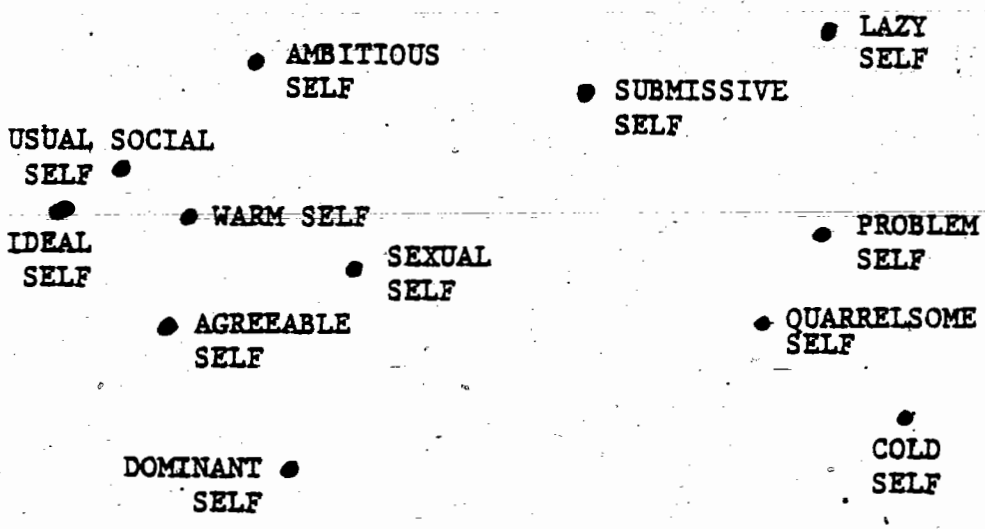


Figure 2c. Stimulus Configuration for Stimulus Set 3 (Self Stimuli).

The stimulus configurations for the three groups also demonstrated the expected differences. Figures 2a, 2b and 2c show the stimulus configurations for Stimulus Sets 1, 2 and 3 respectively. It can be seen that for the first group (semantic processing only), the stimulus configuration was in the general form of an ellipse, with the eight major interpersonal stimuli falling in the order in which they occur in the Wiggins circumplex (Wiggins, 1979). The interpersonal variables on the diagonals of the circumplex (Arrogant, Unassuming, Extravert and Introvert) were somewhat misplaced, though their locations were not inappropriate. Some distortion was expected here since it was discovered that at least one third of the subjects using Stimulus Sets 1 and 2 were interpreting the stimulus "Unassuming" or "Unassuming Self" to mean "not making assumptions" rather than its standard meaning as the opposite of arrogant.

The configuration for the second group (12 interpersonal aspects of the self) also generally followed the circular ordering of the circumplex, but formed a more distorted ellipse than the first configuration. There appeared to be a tendency for the clustering of stimuli of related meaning, rather than an even spread, as for the first group.

For the third group, which used the stimulus set containing the four self stimuli and the eight interpersonal stimuli, the circumplex ordering of the eight interpersonal stimuli disintegrated altogether. Here, the pattern seemed rather to be

based on two general clusters, one consisting of the four positive interpersonal stimuli and the Self, Ideal Self and Sexual Self, and the second cluster consisting of the four negative interpersonal stimuli and the Problem Self, with the closest associations being between the Problem Self and the Quarrelsome and Cold Selves. In contrast to Stimulus Sets 1 and 2, the first dimension here appeared to be an Evaluative one. The position of the Ambitious Self was unexpected at Time 1. (It was in a more logical position at Time 2, probably reflecting the practice effect and the increased consistency in subjects' judgements at Time 2.)

Configuration-matching correlations were calculated between each pair of groups, based on the configurations for the eight interpersonal stimuli. As expected, the best correlation was between the configurations for Stimulus Sets 1 and 2 ($r=0.97$). The lowest correlation was between Stimulus Sets 1 and 3 ($r=0.69$). The correlation between Stimulus Sets 2 and 3 was intermediate ($r=0.72$), as expected.

In general, therefore, it can be said that the influence of self referencing on semantic MDS processing was reflected in the overall error and exponent variables, and the stimulus configuration also showed significant differences when self referencing was introduced. When the MDS task involved purely semantic processing, the resulting stimulus configuration followed the circumplex-like pattern that was expected given the known semantic relationships among the stimuli. The Dominance

dimension accounted for the most variance, and this pattern remained more or less the same when the same stimuli were introduced as aspects of the self. However, when four interpersonal stimuli were replaced by four self stimuli, a dramatic restructuring of the configuration occurred which overwhelmed the semantic structure of the interpersonal stimuli. In this case the stimuli tended to form in clusters of similar meaning, with the Evaluative dimension accounting for the most variance.

Schematic vs. aschematic MDS processing. It was hypothesized that subjects who scored high or low on an interpersonal adjective scale, and who were thus considered to be schematic for that trait (Markus, 1979; Markus et al., 1982) would show lower individual stimulus error for the related MDS stimulus than subjects scoring in the intermediate range. That is, being schematic for a particular trait would allow the subject to be more sure and more consistent in his or her judgements of the stimuli associated with this trait in the MDS task. Given this hypothesis, an inverted U-shaped relationship was expected between the two variables, with both low and high scores for a particular IAS variable being associated with low error for the related individual stimulus, and intermediate IAS scores for the variable being associated with high error for the related stimulus.

Across-subject scatterplots for each IAS variable and its related individual stimulus error were made, and it was clear

from a visual inspection that no relationships of any sort were present, nonlinear or linear. A similar absence of a relationship between the IAS scores and the individual stimulus errors was revealed by a sample of scatterplots of the data for twenty subjects at both testing sessions.

A t-test was performed to assess if there was a significant difference in the average individual stimulus error for the Dominant Self and the Ambitious Self stimuli combined, between the 25 subjects scoring the highest on the IAS variables Dominant and Ambitious combined, and the 25 subjects scoring in the intermediate range for this combined variable. No difference was found here, nor for a similar analysis comparing the group of highest scoring subjects with the 25 lowest scoring subjects on this combined variable.

Thus, it must be concluded that the individual stimulus error cannot be considered as a valid or reliable (see Table 13) indicator of the self schema. However, it is possible that the poor reliability and validity of the individual stimulus errors may be partly due to a problem in MULTISCALE II that prevented the calculation of estimates of these errors during the normal course of the iterations which the program performs. Instead, it was necessary to use post hoc estimates that may be less precise as measures of individual stimulus error.

Self esteem and certainty. The hypothesis was advanced that subjects who were certain of their self theories would have higher self-esteem scores than subjects who were not certain of

their self theories. Certainty in a self theory is assumed to be reflected in consistency in making similarity judgements about aspects of the self, as indicated by a low overall error score on the MDS test. Thus, it was expected that there would be a high negative correlation between the overall error terms and the Self Esteem scores.

The correlations between the Overall Error and Esteem scores for Times 1 and 2 were $r=-0.37$ and $r=-0.30$ respectively. These results provided modest support for the hypothesis.

IX. Discussion

The basic question asked in this study was whether the MDS test had potential as a standardized psychological test designed to assess the social self schema. In order to answer this question, it was necessary to show that the test was reliable and valid. In general, the data confirmed the reliability and validity of the MDS test.

The test-retest reliability of the stimulus configuration and the exponent were excellent, moderate for the overall error, and very poor for the individual stimulus errors. The stimulus configuration clearly showed strong relationships with the criterion measures, and the exponent and overall error showed moderate relationships. The individual stimulus errors showed no systematic associations with the criterion measures. This result was disappointing, but may be attributable to problems with the MULTISCALE II program which have been mentioned previously.

More specifically, the test-retest reliability of the stimulus configuration was good, with 72% of individual subjects showing a reliability coefficient of 0.70 or better. The temporal stability observed was in keeping with expectations derived from the model of the MDS test as an activator of the self schema which is conceptualized as being relatively constant over time. The exponent also exhibited good test-retest stability. Basically, the exponent is a measure of how polarized

a subject's similarity judgements are. In other words, it indicates the extent to which the subject is making highly differentiated responses or is using only the extreme ends of the similarity rating scale. The stability of this measure suggests that it reflects an ongoing response tendency. The overall stimulus error showed only moderate test-retest stability. It decreased from the first testing session to the second, suggesting a practice effect whereby subjects, having become more familiar with the MDS task, make more consistent similarity judgements the second time around. Repeated testings over time may show that the overall error settles at a stable level.

The criterion measures used, namely, the Interpersonal Adjective Scale and a part of the Tennessee Self Concept Scale, both showed good test-retest reliability and internal consistency, allowing for confidence in their use in this study. The circumplex structure that was hypothesized to underlie the IAS was also confirmed. The pattern of intercorrelations among the IAS variables matched well with the correlations derived from a circumplex model. In addition, a multidimensional scaling of the variable names produced an elliptical stimulus configuration that followed the circumplex ordering of the IAS variables.

Convergent validity is demonstrated when the test under study is shown to correspond with an alternative method for measuring the same underlying construct. Previous research

(Markus, 1977, 1982) has shown that an instrument like the IAS may be used as a method for measuring the presence or absence of self schemas. A high score on an Interpersonal Adjective scale was taken to indicate the presence of a schema for the trait in question. If the MDS test does indeed reflect the self schema as the IAS does, then substantial correlations can be expected between the two, particularly for the stimulus configuration variable. These expectations were satisfied. The self schema that is activated by the IAS appears to be represented in the MDS test by a cluster of three self stimuli, the Usual Social Self, the Ideal Self and the Sexual Self. Scores on the IAS were negatively correlated with the distances between these stimuli and the interpersonal stimuli corresponding to the same IAS variables. In other words, aspects of the self for which subjects held schemas were located close to the self cluster in the MDS configuration.

The worst correspondences between IAS variables and MDS distances were observed for the variables from the Nurturance dimension (Warm, Cold, Agreeable and Quarrelsome). One reason for this result may be the low variability present in the IAS data for the Nurturance variables. The Nurturance IAS variables all showed the lowest standard deviations, with Warm and Agreeable having the highest average scores and Cold and Quarrelsome having the lowest average scores for both testing sessions. It may be that the social desirability of these variables decreased their effectiveness as measures of

individual differences. In any case, the low variability in these variables may have contributed to the lowered correlations observed between them and the MDS distances. On the other hand, the Dominance variables on the IAS showed the highest standard deviations, possibly because their social desirability was less compelling than that for the Nurturance variables. Their greater variability may have been partly responsible for their higher correlations with the related MDS distances. It seems likely that the MDS stimuli were similarly affected by social desirability. In other words, the Dominance stimuli may prove to be a better vehicle for the expression of individual differences than the Nurturance stimuli. In future development of the MDS test, it might be advisable to take advantage of this tendency, and focus the test on the assessment of Dominance schemas.

Concurrent validity of the MDS test was assessed by comparing the ability of the test with that of an established test (the IAS) to predict a criterion variable (Self Esteem). The MDS test was somewhat less predictive than the IAS when the MDS variables used as predictors were the eight normalized interstimulus distances corresponding to the eight Interpersonal Adjective scales. However, a combination of seven MDS variables, the overall error, the exponent, one individual stimulus error and four interstimulus distances, was found which reliably predicted Self Esteem at a slightly higher level than the eight IAS variables. Although this combination has not been cross-validated on other samples, it does provide support for

the predictive potential of the MDS test.

Three aspects of the construct validity of the MDS test were studied. The first prediction addressed the difference between semantic processing and self-referent processing of information. The data showed that with an increase in the degree of self referencing required in the MDS task, there was a corresponding increase in the overall error. This finding indicates that there is an increasing inconsistency in the judgement of stimuli as the stimuli became more complex, moving from a task dealing simply with the meanings of words to one dealing with these words as a description of the self. The increased affective value of the self-referent stimuli may also have had an influence on the greater inconsistency observed here. The average exponent also increased with self-referent processing, indicating an increased degree of polarization in the way similarity judgements were made. This result might be attributed to the greater affective quality of the self-referenced stimuli, producing similarity judgements that were "cruder" and less differentiated than judgements involving only the meaning of the stimulus words.

The nature of the stimulus configurations for each of the stimulus sets also supported the hypothesis. Simple semantic MDS processing resulted in a well-structured, circumplex-type stimulus configuration. With the addition of self referencing to the basic semantic processing, this cirumplex was retained. However, there was a tendency for stimuli of similar meaning to

form clusters, and this may be evidence of the organizing function of the self schema coming into play. This clustering effect was even more pronounced when the four self stimuli were introduced. This seemed to suggest that the self schema had a powerful organizing function which was not present in the semantic processing task. The positive self and interpersonal stimuli formed one cluster, with the Nurturance stimuli (Warm Self and Agreeable Self) forming a core with the Usual Social Self, the Ideal Self and the Sexual Self. The Dominant Self and the Ambitious Self were on the periphery of this cluster. As was discussed earlier, it seemed likely that the presence of the Nurturance stimuli in the Self cluster was a reflection of the social desirability characteristics of these stimuli. The other cluster consisted of the Problem Self and the negative interpersonal stimuli. In this case, the self stimulus (Problem Self) was located somewhat closer to the two Nurturance stimuli (Cold Self and Quarrelsome Self), while the Submissive Self and Lazy Self (Dominance) formed a subcluster. As has been found in previous research on person perception (Carr, 1969; Irwin, Tripodi & Bieri, 1967. Cited in Wegner & Vallacher, 1977), there was a greater dispersion among the negative stimuli than among the positive stimuli in the the stimulus configuration. That is, there was greater differentiation among the negative stimuli than among the positive stimuli.

An interesting and unexpected finding was the way in which semantic processing resulted in the Dominance dimension

differentiating the stimuli the best, while the replacement of four interpersonal stimuli by four self stimuli including the Ideal Self and the Problem Self was sufficient to shift the structure so that the Evaluative dimension emerged as the most important. This clearly underscores the self-evaluative function that is emphasized in the self concept literature (e.g., Epstein, 1973), but that has, as yet, received little attention in the self-schema literature.

The second hypothesis tested was that schematic subjects, as identified by high scores on the IAS, would show low individual stimulus error for the stimuli related to the trait for which the subjects were supposed to be schematic. This hypothesis was not supported in the least, providing further evidence that the individual stimulus errors were of little value in the MDS test. They were unreliable and generally unrelated to any of the criterion measures. This may be the case simply because the level of consistency reflected by the individual stimulus error does not result from the presence or absence of a schema for the stimulus. However, this conclusion must be tentative since the stimulus error data were suspect due to a problem with the MULTISCALE II program.

The third hypothesis was that subjects who were high in self esteem would be more certain of their self theories and thus be more consistent in their similarity judgements, as reflected in the overall error term. There was modest support for this hypothesis. It seems likely that a more varied subject

sample, including subjects with serious uncertainties about their self theories, would provide a better test for the validity of the overall error term.

Problems and Future Research

Several problems became evident in the course of this study. In this section, these will be discussed and suggestions made as to how this research could be carried to a new stage. The problems arise mainly from the subject sample employed here and the composition of the stimulus set.

While the social desirability characteristics of the Nurturance-related variables in the MDS test may be partially responsible for the low variability observed for these variables, it is probably the case that the low variability was also the result of a subject sample that was too homogeneous. The subjects were all university students, mostly women, and mostly in their early twenties. Since the potential of the MDS test has generally been demonstrated, it would be justified to extend the research to a more "expensive" population that is more representative of the real world. Any further development of the MDS test should include a sample of adults in the work force, as well as a clinical sample. At this point, the theory behind the test is not developed enough to specify a particular clinical group, but a good choice might be clients at an adult outpatient clinic at a Community Mental Health centre or a

similar institution. With this type of sample, it seems likely that the overall error and exponent variables of the MDS test, since they appear to be influenced by an increase in affect and may represent cognitive distortions, might have a better chance of revealing their potential.

The second major problem lies in the composition of the stimulus set, which was deliberately designed to be as simple as possible so that the best elements of it could be retained as the core stimluli for the next stage of test development. The low variability of the four Nurturance stimuli and the poor correlation of the Problem Self stimulus make these stimuli candidates for omission from a new stimulus set. This step would require the addition of five new stimuli, since twelve stimuli have been found to provide reliable data without overtaxing subjects. The stimuli to be retained in the new stimulus set are those that show the best association with the criterion measures. They are Your Usual Social Self, Your Ideal Self, Your Sexual Self, Your Dominant Self, Your Submissive Self, Your Ambitious Self and Your Lazy Self. It is recommended that the "Usual Social Self" be changed to "Yourself" to reduce the social desirability value of this stimulus. In addition, since "Submissive Self" was not one of the best stimuli in terms of its correlations with the criterion measures, it may be useful to try a change of name here, for example to "Weak Self". Wiggins (1984) suggests that "Ambitious" and "Lazy" be replaced by "Assured" and "Unassured", or some such designation, since

these terms have been shown to be more appropriate as external correlates of the IAS since they are more interpersonal in nature than the former terms.

Such a core of stimuli, by their content, will define the general purpose of the MDS test. In its revised composition, the stimulus set provides a means to assess a person's perception of his or her own level of dominance and self esteem. Since these kinds of evaluations are always made in comparison with other people, the most logical choice of new stimuli would be other people known by the subject and to whom comparisons with the self can be made (e.g., mother, father, siblings, lover, boss, peers, etc.). One question that would arise here is how standardized these particular stimuli should be. This issue is merely raised but will not be discussed here.

Two improvements have been suggested for the next stage of development of the MDS test. One is to modify the stimulus set to include other people with whom the subject may be expected to have "political" as well as affiliative relations. Thus, the MDS test would begin to take shape specifically as a measure of Dominance schemas. The other improvement is concerned with the particular sample of subjects on whom the test is developed. A more varied adult population, including a clinical sample, is recommended.

It is also suggested that a major area of further research on the MDS test might be to extend the construct validation of the test. In particular, it would be important to study the ways

in which the MDS scores vary as a result of experimental manipulations designed to change subjects' feelings of dominance and self esteem.

The Self Schema and the MDS Test

While this research has employed the concept of the self schema to throw light on the nature of the MDS test, it is reasonable to ask what the MDS test can reveal about the nature of the self schema. Perhaps the most important contribution in this context is the evidence from this study relating to the difference between self-referent and semantic processing. It is clear from the data that there is a difference between prototypic social schemas as applied to the self, and the semantic relationships underlying the meanings of the words representing these prototypes.

Ebbesen (1981) claims that when a subject is rating him or herself in a personality self-rating task, the responses reflect mainly the semantic relationships among the trait words used as test items rather than the subject's actual personality structure, or at least how the subject perceives that structure. This study did not support this argument. Instead, it appeared that semantic relationships become distorted by the overriding evaluative tendency of the self concept when self referencing was in operation. This tendency may be interpreted as an aspect of the basic need for self esteem to which almost all other

needs are subordinate (Epstein, 1973).

In addition to distorting the semantic relationships among prototypic schemas, the activation of the evaluation function, with its associated affect, also appeared to make subjects more inconsistent in their ability to categorize and make similarity judgements, as well as causing them to become more polarized and "black and white" in their thinking.

In general, this study reinforces the suggestion made in Chapter IV that the self schema construct would be enriched if it was expanded to include the basic structural principle of a good-bad classication of self-referent information. In addition, if the self functions as a superordinate schema as Rogers et al. (1977) suggest, then a complete model of this schema must include a conceptualization of the way in which the superordinate self concept is linked to the superordinate E-P-A categories that form the biologically prewired foundations for the content of any schemas that make up this self concept.

Conclusions

The research reported here suggests that the MDS test might prove valuable as a measure of self-perceived dominance and self esteem. However, the basic methodology may well prove to be applicable to other trait domains in which an assessment of self perception is sought. For example, the four dominance stimuli might be replaced by stimuli representing

independence-dependence, or physical attractiveness, or any number of other attributes.

The value of this MDS test procedure would be enhanced if the evidence for the predictive validity of the overall error and the exponent could be increased. It is quite likely that with a more varied and interesting stimulus set and a more varied subject sample, such as those suggested in above, these MDS variables would become stronger and useful indicators of individual differences. Of particular interest here is the exponent, with its potential for measuring the degree of polarization or "black and white" thinking that is a characteristic of the cognitive distortions treated by the new cognitive therapies (Beck, Rush, Shaw & Emery, 1979). The individual stimulus errors might be shown to be useful once the problems with the MULTISCALE II program have been corrected. Finally, with a more varied stimulus set and subject population, the dimensionality (number of dimensions) used by subjects in their similarity judgements might also become a variable of interest. (Christian, 1976, using a clinical subject sample and a stimulus set consisting of "signficiant others", found a positive correlation between the number of dimensions used by a subject and his or her level of ego development.)

Even in its present form the MDS test provides a selection of information about social self perception and evaluation that is not found elsewhere. This information is presented in a graphic manner (the stimulus configuration) that is easy for the

investigator and the subject to grasp (in fact, subjects are often fascinated by this "picture" of themselves). This could provide an interesting vehicle for communication between a therapist and client in a clinical setting. The test procedure is straightforward, and the whole process could be easily computerized and thus streamlined.

The MDS test technique possesses great promise, particularly if it is found that it can be applied to other content areas. It has value not only as a standardized psychological test, but also as a method for studying social schemas.

X. Summary and Conclusions

Multidimensional scaling (MDS) is a data-analytic technique that has typically been used as a research instrument in a variety of applications ranging from psychophysiology to cognitive-social psychology. The MDS task requires subjects to make judgements about the similarities between pairs of stimuli drawn from a given stimulus set. These data are then used to construct a spatial representation of the underlying dimensions or categories upon which the subjects have been relying to organize their similarity judgements.

MDS methodology introduces several quantitative and objective features that make it potentially useful as a standardized psychological test. These features are obtainable from a particular MDS computer program, MULTISCALE II, and they include: a) the stimulus configuration, a measure of the relations among the stimuli; b) the overall error, a measure of the degree of consistency with which the subject has made the similarity judgements; c) the exponent, a measure of the degree of polarization in the way the similarity judgements have been made; and d) the individual stimulus errors, measures of the degree of consistency with which each individual stimulus has been treated by the subject in making similarity judgements.

The purpose of this study was to assess the potential of the MDS methodology as a standardized test. It was therefore

necessary for the MDS test, as it was called, to meet several criteria, in particular, the criteria of test reliability and validity. Other issues were the objectivity of the MDS measures, and the ease with which the MDS test could be standardized in terms of administration and scoring. The major difficulty with standardization arose with the development of a standardized set of stimuli. The final selection of stimuli was determined entirely by the construct domain chosen to form a focus for the MDS test.

Since MDS is a technique that can be applied to any content area, it was necessary to select an area in which the test was to predict behaviour and which would provide the underlying construct domain. The domain chosen was that of social cognition, because of the importance of individual differences in social perception as a determinant of social behaviour and personality. The major construct invoked was the "social schema", a cognitive structure analogous to the format statement in a computer program that enables us to recognize and process social information. The MDS test was seen as being particularly appropriate for the study of schemas since it depends on the cognitive acts of categorization and judgements of similarity that are considered to be manifestations of the structure of underlying schemas.

Two principles guided the selection of test stimuli. They were: a) that the stimuli should reinforce the perceptual biases known to exist in social cognition, and b) that they should, at

the same time, provide opportunities for individual differences to be revealed. These requirements resulted in the choice of two types of test stimuli. The "objective" stimuli were designed to activate the known perceptual biases in social cognition, as well as offering a normative structure for the test because of their shared public values or meanings. These stimuli were derived from Wiggins' (1979) circumplex of interpersonal adjectives based on the orthogonal dimensions of Nurturance and Dominance, which in turn traced their roots to the Evaluation-Potency-Activation dimensions of semantic meaning (Osgood, Suci & Tannenbaum, 1957). It was suggested that these basic dimensions of social perception are biologically pre-wired, and that they form the foundation of all social schemas.

The "subjective" stimuli were designed to activate the self concept, that is, the set of self schemas that provide a person with a general picture and understanding of him- or herself. These stimuli were expected to reveal individual differences in the way subjects perceived themselves in an interpersonal context. The self concept and the self schema literatures were reviewed briefly, and the constructs were compared and found to be very similar in many ways. A major difference between them was the absence of a self-evaluative, affective element in the self schema construct. This was viewed as a theoretical shortcoming. Two lines of cognitive social research were brought together. The work of Markus (Markus, 1979; Markus et al., 1982)

and Rogers and Kuiper (Kuiper and Rogers, 1979; Rogers, Kuiper and Kirker, 1977) on the construct validation of the self schema construct was outlined. Particular mention was made of Markus' method of identifying subjects who were schematic and aschematic for particular traits by their scores on a self-rating task. The other line of research discussed was Ebbesen's (1981) work on the importance of the semantic structure underlying trait words in a self-rating task. Ebbesen argues that such a task reveals more information about the subject's semantic structure than about his or her self-perceived personality structure. It was pointed out that semantic processing and self-referent processing have been shown to be substantially different (Rogers et al., 1977) in experimental tasks. Thus, the activation of the self schema in a self-rating MDS task provides an example of an interaction between self-referent and semantic processing: stimuli are recognized and categorized in terms of both their semantic relationships to each other and in terms of their presence or absence as schemas in the subject's self concept.

The stimulus set for the MDS test was developed from a series of pilot studies, and was based on the construct domain discussed above. The twelve stimuli included four self stimuli: Your Usual Social Self, Your Ideal Self, Your Sexual Self and Your Problem Self, and eight interpersonal stimuli: Your Warm Self, Your Cold Self, Your Agreeable Self, Your Quarrelsome Self, Your Dominant Self, Your Submissive Self, Your Ambitous Self and Your Lazy Self. Seventy-six university students

undertook a test-retest task with a two-week interval. At both testing sessions they completed the MDS test and two criterion measures, the Interpersonal Adjective Scale (IAS; Wiggins, 1979) and a self-esteem scale (a shortened version of the Tennessee Self Concept Scale; Fitts, 1965).

Three out of the four MDS variables studies showed generally good test-retest stability. The stimulus configuration variable had an average test-retest reliability coefficient of r=0.79, while that for the exponent was r=0.70. The overall error showed only a moderate test-retest reliability (r=0.30), and the reliability of the individual stimulus errors was poor, ranging from r=0.02 to r=0.31 with an average of r=0.16. The high test-retest stability of the stimulus configuration was expected due to the consistency that is attributed to the self concept/self schema construct. The stability of the exponent suggested that the degree of polarization in a person's similarity judgements is an ongoing response tendency. The overall error decreased from the first to the second testing session, suggesting a practice effect in the consistency with which subjects made their similarity judgements at the second testing session. The reason for the poor reliability of the individual stimulus errors could not be determined, since problems with the MULTISCALE II program prevented the use of the values computed in the most appropriate way.

The convergent validity of the MDS test was good. There was a generally high concordance between scores on the IAS and the

interstimulus distance variables of the MDS stimulus configuration, when the Usual Social Self, the Ideal Self and the Sexual Self were taken as the central self-referent points. This was demonstrated by a majority of intra-subject correlations greater that r=-0.70 between the IAS scores and the related normalized interstimulus distances on the MDS test. In an across-subject analysis, the largest canonical correlations between the two sets of variables were r=0.60 and r=0.69 at the first and second testing sessions, respectively. (The Problem Self reference point did not show any strong associations with the criterion measures.) Since high scores on particular IAS scales were taken to indicate that the subject was schematic for the traits represented by the scales, then the good agreement between these scores and the MDS test was taken to indicate that the MDS test was also capable of activating self schemas.

The circumplex structure around which the IAS was designed was confirmed in the IAS data, and was also present in the stimulus configuration of a set of stimuli based on the names of IAS scales (described below). The personality variables showed good test-retest reliability and internal consistency, allowing for confidence in their used as criterion measures.

A combination of seven MDS variables was found that reliably predicted self esteem (R=0.69 at both testing sessions) at a slightly higher level than the eight IAS variables (R=0.67 at Time 1 and R=0.61 at Time 2) in a multiple regression analysis. The eight interpersonal stimuli that were directly

related to the IAS variables were less predictive of self esteem. In general, these results were taken as support for the concurrent validity of the MDS test.

The construct validity of the MDS test was evaluated by means of three different hypotheses. One of these hypotheses was that subjects who were certain of their self theories, in other words, who were consistent in their similarity judgements about themselves as reflected by the overall error term, would have higher self esteem scores than subjects with high inconsistency and high overall error. There was modest support for this hypothesis, with correlations between overall error and self esteem of $r=-0.37$ and $r=-0.30$ at the two testing sessions. It was felt that with a more varied subject population the negative correlation between self esteem and overall error would prove to be more robust.

A second hypothesis was that subjects who were schematic for a particular trait on the IAS would show lower error for the individual MDS stimulus representing that trait. Because of the problems with the MULTISCALE II program in computing these values, the absence of the expected relationship cannot be conclusively attributed to problems with the MDS test itself, or with the underlying construct.

The third and perhaps the most important of the hypotheses tested related to the expected differences in MDS results between MDS tasks that varied in the proportions of self-referent and semantic processing involved. To test this

hypothesis, an additional two groups of 54 and 47 subjects each completed, in one testing session, a version of the MDS task. The stimulus set used by the first group consisted of twelve interpersonal adjectives taken from the names of the scales in the IAS. Eight of these were identical to the interpersonal stimuli of the MDS test except that they were not presented as aspects of the self. Thus, the MDS task here required judgements to be made in terms of semantic similarity only. The stimulus set judged by the second group was identical to the first except that all twelve stimuli were presented as aspects of the self. Thus, this MDS task required both semantic and self-referent processing. These two stimulus sets were compared with the MDS test itself, which, with its four self stimuli, involved the greatest degree of self-referent processing.

There were clear differences between the three stimulus sets: the overall error and the exponent both increased with an increase in the amount of self-referent processing involved. In addition, for the first two, primarily semantic, MDS tasks, the stimulus configuration displayed the expected circumplex structure with Dominance as the first dimension. In contrast, the MDS task involving the greatest degree of self referencing resulted in a configuration which showed evidence of a much greater degree of evaluative polarization (with Evaluation as the first dimension), and a tendency for stimuli of similar meaning to form clusters instead of being distribued evenly around the configuration as for the semantic stimulus set. These

results were taken to indicate that the self-rating involved in the MDS task was not simply a matter of reproducing the semantic relationships underlying the trait items used in the test, as might have been expected by Ebbesen (1981). Self-referent processing appeared to impose distortions on the underlying semantic structure in three different ways: a) self-evaluation appeared to result in the predominance of an Evaluative rather than a Potency dimension, with an associated tendency for judgements to become more polarized or "black and white"; b) there was an increase in the degree of inconsistency and uncertainty in the categorization of stimuli that was attributed to the increased complexity and affective value of the self stimuli; and c) self referencing appeared to have an organizing effect on the stimulus structure, resulting in a clustering of stimuli of similar meaning.

Two main problems with this study were discussed, both relating to the low level of variability in the data. It was suggested that future research should employ a more varied and representative subject population including a clinical sample. This would allow the potential, if any, of variables such as the overall error, the exponent and the dimensionality to be revealed, given that all of these variables are expected to be affected by the presence of psychopathology.

The second major problem lay with the homogeneity of the stimulus set itself. The design of the stimulus set allowed for the selection of a basic core of stimuli that showed the best associations with the criterion measures. The omission of the five least predictive stimuli would allow for the inclusion of five new and more interesting stimuli that should increase the variability of the MDS results. It was recommended that the four Nurturance stimuli, whose variability appeared to be restricted by their social desirabilty, and the Problem Self, should be replaced by five stimuli representing other people, possibly "significant others". The MDS test would then provide a vehicle for the evaluation of dominance and self esteem in a comparison of oneself with other people, the context in which such evaluations are always made in the real world. An extension of the construct validation of the MDS test was recommended, with a particular focus on changes in test scores as a result of experimental manipulations designed to affect self evaluation as measured by the test.

In conclusion, the MDS test appears to have considerable potential as a standardized measure of social self-evaluation. While a refocussing of the test as a measure of self-perceived dominance and self esteem is recommended, it is also possible and likely that the methodology of the MDS test could be applied in a number of different contexts. The test provides a unique sample of information, is easily computerizable, and provides a type of visual output that may prove to be a valuable point of

discussion between patients and therapists. The potential of the test as a way to evaluate self schemas, and to measure aspects of cognitive distortions such as "black and white" thinking, is exciting and worth pursuing.

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APPENDIX 1

MULTISCALE II - A Program for Multidimensional Scaling

Multidimensional scaling (MDS) is a data-analytic technique designed to reveal the pattern or structure contained in a matrix of empirical ratings of similarity between pairs of stimuli. The perceived relations among a set of stimuli are modelled by the geometric relations among points that represent the stimuli in a spatial model. Typically, a basic structure of two or three dimensions will provide an easily visualizable and interpretable model that is consistent with the data and does justice to their complexity.

That perceived dissimilarity can be represented by physical distance is a consequence of some basic similarities between the two measures. The first is that both dissimilarity and distance are defined relative to two objects, not by either object taken alone. Dissimilarity has an inverse relationship to the concept of similarity, as does distance with proximity. For identical points, the dissimilarity and the distance are both zero, and positive otherwise. Dissimilarity and distance are both symmetric. That is, it is not necessary to specify the order of objects when referring to their dissimilarity or distance.

Perhaps the most important similarity is the "transitivity" of both dissimilarity and distance. That is, there is an internal consistency in triples of objects, so that for

dissimilarity, if A and B are very similar, and B and C are very similar, then A and C are very similar. For distance, the "triangle inequality" applies. For example, the distance between two points must be small if the distances between each of these points and a third are both small.

Each stimulus object is represented by a corresponding point in Euclidean space, and for each dissimilarity there is a corresponding distance. MDS fits the points so that the distances among them closely correspond to the rated dissimilarities among the stimulus objects. In a successful arrangement of points, there is a correspondence between large dissimilarities and large distances, and between small dissimilarities and small distances.

There are several advantages to using the dissimilarity rating procedure employed in MDS. The major one is the fact that in requiring subjects merely to consider the dissimilarity between pairs of stimuli, the experimenter is not predisposing the subject to any particular property of the stimuli, thus ensuring that only those properties that are salient to the subject are used. This is unlike traditional rating tasks in which the properties the subject is to use are predetermined, whether they are relevant to the subject or not. In addition, the dissimilarity rating task is free of the evaluative or social desirability connotations that beset the unidimensional rating scale task. Finally, the dissimilarity rating procedure provides an improved data-to-parameter ratio. This is because

the number of judgements to be made increases dramatically as a function of the number of stimuli, so that there are usually many more observations available to estimate each stimulus value than is the case when direct questions about these values are asked. This improved data-to-parameter ratio also makes hypothesis testing a possibility in certain MDS procedures.

MDS relies on what Cliff (1973) calls a "functional model" whereby the basic procedure is to assume that the relation between the actual observations (dissimilarity judgements) and the values of the underlying parameters (distances) is in the form of a specific mathematical function or equation. Given a set of observations, the values of the parameters can be estimated from this equation. The "goodness of fit" between the model and the observed data can then be found. This is in contrast to an axiomatic model in which the relations that must exist in the data are defined before the associated model can be applied.

In MDS the first step is to specify a spatial model in which the distances between points can be represented in a k-dimensional space. Assuming that the space is Euclidean, the distances are specified using Pythagoras' theorem. For example, the spatial model for a 2-dimensional structure would be:

$$D^*_{jk} = ((X_j - X_k)^2 + (Y_j - Y_k)^2)^{1/2}$$

where D^*_{jk} denotes the distance between stimuli j and k. The X's are the coordinate values on the first dimension and the Y's are the coordinate values on the second. The geometric

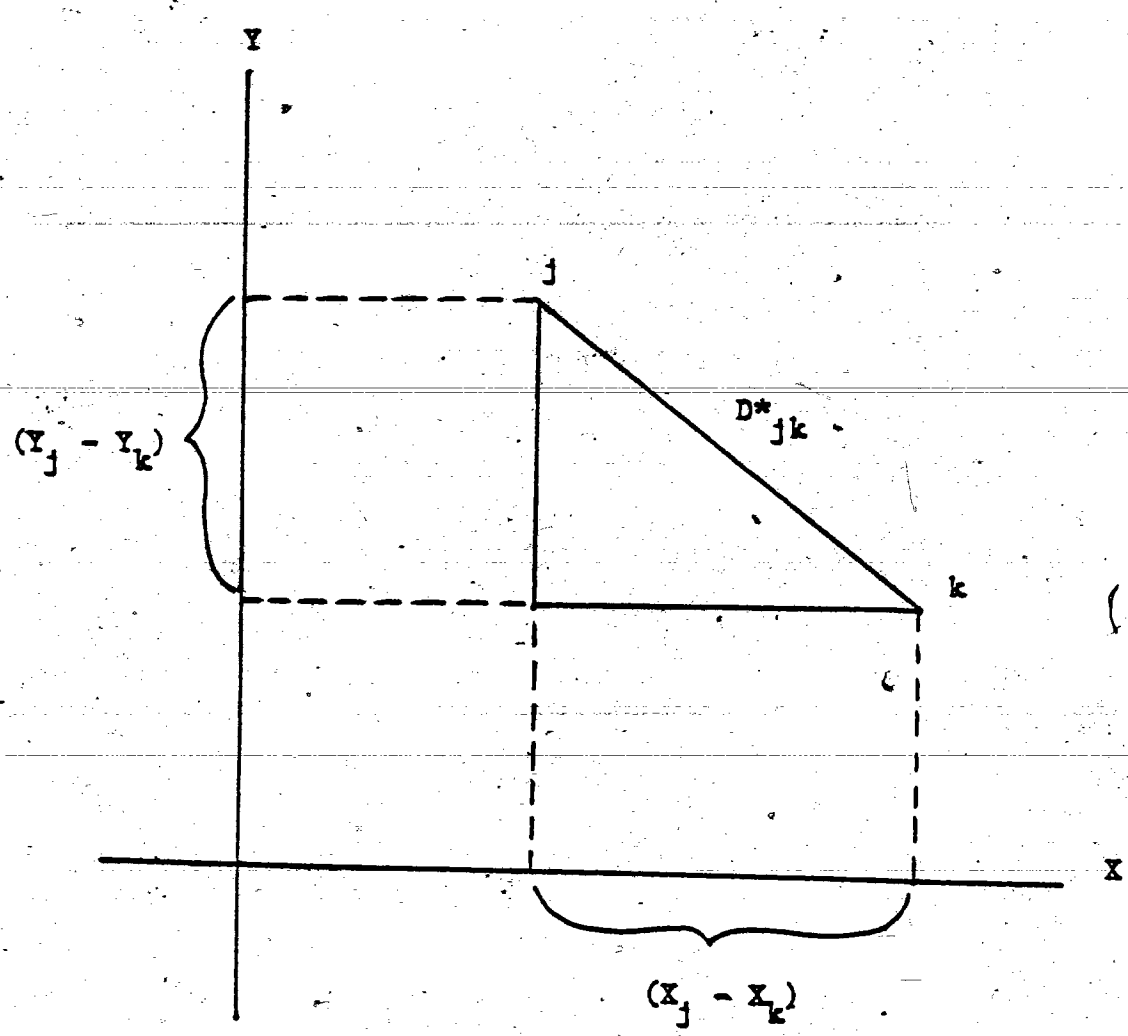

Figure 3. Geometric Interpretation of the Spatial Model.

interpretation of the spatial model is given in Figure 3.

In addition to the spatial model, MDS also requires the specification of a distance model which gives the relation between the dissimilarity judgement and the distance that represents it. The early classical form of MDS (Torgerson, 1958) assumed that this relation was linear and only involved an additive constant, that is,

$$D_{jk} = D^*_{jk} + C$$

This assumption proved to be seldom correct in practice, thus putting unrealistic restrictions on the use of the model.

It was followed by the "nonmetric" approach of Shephard (1962) which went to the opposite extreme in assuming only a monotonic relation between dissimilarity and distance. That is, for any D_{jk} greater than D_{lm}, there is a corresponding D^*_{jk} greater than D^*_{lm}. The approach is called nonmetric because it requires dissimilarity to be measured only on an ordinal scale, although the results themselves are on an interval scale. One problem with this method is that because it uses so little information (i.e., ordinal relations only), it is practically impossible to incorporate into it any statistical hypothesis testing capabilities, such as those required for assessing the appropriate dimensionality of an MDS solution. According to Cliff (1973), being able to make such statistical tests is necessary in order to prevent MDS from "drift(ing) into the inferential quagmire that holds most of traditional factor analysis" (p.484).

Ramsay's (1977) approach to MDS, which is implemented in a program called MULTISCALE II (Ramsay, 1983), provides an intermediate approach to the dissimilarity-distance function problem. Although Torgerson's additive constant function proved to be generally inappropriate, in fact, it appears that for most subjects the relation between dissimilarity and distance is only mildly nonlinear. Ramsay found that the relationship could be well approximated by a power function,

$$D_{jk} \simeq (D^*_{jk})^p$$

p is referred to as the exponent. Thus, putting the spatial and distance models together, we have for our two-dimensional example,

$$D_{jk} \simeq (D^*_{jk})^p = \left(\sqrt{(X_j - X_k)^2 + (Y_j - Y_k)^2}\right)^p$$

In practice, the procedure is first to use the distance model to find the estimated distances D^*_{jk}. Once the set of interpoint distances has been estimated, it must then be represented using the spatial model, within a structure of a specified number of dimensions. This is done by finding a set of appropriate coordinate values.

Since there are an infinite number of coordiates possible that would give rise to the same D^*_{jk}, a number of constraints must be applied to the coordinates since they are used to define the locations of the points. The first constraint specifies an origin for the data by defining the centre of the set of points as the average of the coordinate values. In other words, for any dimension, a location is found such that all the coordinates of

points in that dimension sum to zero.

A second constraint is imposed which orients the first dimension in the model in such a way that it has the largest possible variation among its coordinates, and subsequent dimensions are orthogonal to the first and to each other (principal axis orientation). Further rotational adjustments are made by a Varimax rotation procedure which improves the interpretability of the structure by attempting to make large coordinate values larger, and small ones smaller.

The major problem in determining the set of coordinates is to choose them in such a way as to maximize the "goodness of fit" between the data (D_{jk}) and the model (D^*_{jk}). While this is accomplished in nonmetric MDS by the method of least squares (i.e., by minimizing $\Sigma(D-D^*)^2$), MULTISCALE II uses maximum likelihood estimation. Essentially, what this means is that coordinate values are chosen that are most likely to give rise to the observed dissimilarities. What follows is a more detailed discussion of maximum likelihood estimation.

The likelihood (L) of finding any particular sample of size N in a population of measurements, x say, can be computed by combining the densities of f(x) for each value of x as follows: $L = f(x_1).f(x_2). \ldots .f(x_N)$ Using the log of this quantity makes computation easier and results in the log likelihood function equation

$$\log L = \Sigma \log[f(x_i)]$$

Thus, log L is a measure of the likelihood of drawing a

particular sample of x's from the population. Obviously, the larger it is, the larger is the likelihood.

In the context of MDS, it is assumed that there is a distribution of the logs of an infinite number of replications of dissimilarity judgements, and that they follow a normal distribution with a central tendency log D* and a variance ZZZ. This is called the log normal distribution. Using this model, it is possible to find the likelihood of drawing any sample of Djk's from this distribution, given that its central tendency and variance are known.

In practice, what is done is to find estimates of D^*_{jk} and σ^2, via coordinates derived from the observed sample of dissimilarities. In other words, the observed dissimilarities are used to produce coordinates which in turn give rise to a set of estimated distances. Then, using these estimates, the likelihood of obtaining the observed dissimilarities is found. Through an iterative process, successive sets of coordinates and other parameters such as the exponent p are tried, and that set is chosen which produces the largest likelihood of obtaining the observed set of dissimilarities. The program is said to converge when the log likelihood no longer increases appreciably. When the convergence criterion has been reached, this indicates that the coordinate values have stabilized.

The log likelihood can be used to test the appropriateness of a k-dimensional spatial model versus a k-1 dimensional model. It turns out that 2(log Lk - Log Lk-1) has an approximate

chi-square distribution with n-k degrees of freedom (where n is the number of stimuli and k is the number of dimensions). If this value is less than the tabled chi-square value, then it can be concluded that k dimensions are too many. If the critical value is surpassed, then at least k dimensions are appropriate, and k+1 dimensions must be tested.

Another aspect of the lognormal distribution is that its standard deviation is always roughly proportional to its mean. Therefore, as the value of D* decreases, so does the dispersion or spread of the dissimilarities. Psychologically, this is reflected by the fact that a subject is usually much surer of a dissimilarity rating between two stimuli that are nearly identical than when they are very dissimilar. This fact is useful in assessing whether the lognormal assumption made about the data is correct. The program prints out a plot of the relation between the observations D and the fitted values D*. If this is not approximately a straight line, with the greatest dispersion of D's at the highest values of D*, then one can assume that the model does not adequately account for the data. (A further transformation of the data might help.)

A further assessment of the appropriateness of the lognormal distribution assumption is made possible by another plot printed by the program. The residuals (log D - log D*) can be transformed into z-scores, or normalized ((log D - log D*)/δ). If the distribution assumption holds then these values should be distributed normally with a mean of zero and a

standard deviation of one. The z-scores of the residuals can then be ordered from smallest to largest. In a sample of 100 such z-scores, for example, if they are normally distributed, the 50th score, or the median, should be approximately equal to zero, the mean of a standard normal distribution. Likewise, the 25th score, or the first quartile, should be about equal to the z-score in a normal distribution that marks off the first quarter of the area under the normal curve, and so on. The program will plot the relation between the residual z-scores and the so-called quantiles. The quantiles are a corresponding set of values which divide the area under the normal curve into equal parts. If the lognormal assumption holds, this plot should be a straight line with unit slope.

Another useful aspect of the MULTISCALE II program is that it computes a standard error for each solution. This is a measure of the degree of discrepancy between the dissimilarities and the estimated distances, or between the data and the model. In essence, this reflects the degree of consistency that a subject is using making the dissimilarity judgements. For example, if a subject judges stimuli A and B to be very similar, and B and C to be very similar, then the model demands that the distance between A and C be small. If, however, the subject has been inconsistent and has judged A and C to be very different, then this will show up as a large residual and an increased standard error. In fact, what is computed is an estimate of the standard error that is unbiased by the number of dimensions

specified in the model. Thus, it may increase if more dimensions are used than are necessary to fit the data, rather than automatically decreasing as the number of dimensions approaches the number of stimuli, at which point the model perfectly reproduces the data. One option in the program will compute, instead of the overall unbiased estimate of error, an error term for each stimulus, indicating the subject's consistency and certainty about each individual stimulus.

MULTISCALE II can, in fact, accommodate a variety of different MDS models, the simplest being

$$D_{jk} \simeq D^*_{jk} = \sqrt{\sum_{m=1}^{k} (X_{jm} - X_{km})^2}$$

Here the simple Euclidean distances are approximated by the dissimilarities D_{jk}.

The model used for most of the MDS analyses used in the present study was

$$D_{jkr} \simeq D^*_{jkr} = Vr \left[\sum_{m=1}^{k} (X_{jm} - X_{km})^2 \right]^{Pr/2}$$

Here, Vr is a regression coefficient that allows the data for any two replications to differ from each other by a scale factor. Pr is an exponent that allows each subject's dissimilarities to have a power law relationship to the distances. Pr and Vr can vary for each subject or replication in the data. Thus, this model makes some provision for individual differences. In addition, individual stimulus errors may be computed for this model. Another model which takes into account individual differences explicitly is

$$D_{jkr} \simeq D^*_{jkr} = Vr \left[\sum_{m=1}^{k} Wrm (X_{jm} - X_{km})^2 \right]^{Pr/2}$$

where r denotes a replication. This makes further provision for individual differences within the context of a group solution for the stimulus configuration. Each dimension for each subject or replication is weighted with a coefficient Wrm that defines the "strength" of the mth dimension in contributing to the distances which are fitted to that subject's data. If Wrm = 0, then the mth dimension plays no role for that particular subject. Thus, the program prints out a group solution, and then gives the dimension weights for each subject on each dimension. Another metric program which works with a similar individual differences model is INDSCAL (Carroll and Chang, 1970), although this program uses the least squares method for goodness of fit rather than the maximum likelihood method.

APPENDIX 2

Interpersonal Adjective Scales

AMBITIOUS*	DOMINANT*	ARROGANT	CALCULATING
Persevering	Dominant	Big-Headed	Sly
Persistent	Assertive	Boisterous	Tricky
Industrious	Forceful	Conceited	Wily
Self-Disciplined	Domineering	Boastful	Cunning
Organized	Firm	Overforward	Overcunning
Deliberative	Self-Confident	Swell-Headed	Crafty
Stable	Self-Assured	Cocky	Calculating
Steady	Unself-conscious	Flaunty	Exploitative
COLD*	**QUARRELSOME***	**ALOOF**	**INTROVERTED**
Warmthless	Impolite	Anti-Social	Silent
Unsympathetic	Uncordial	Unneighbourly	Shy
Iron-Hearted	Discourteous	Impersonal	Introverted
Uncharitable	Ungracious	Unsociable	Bashful
Cold-Hearted	Disrespectful	Distant	Inward
Hard-Hearted	Uncooperative	Dissocial	Unrevealing
Cruel	Ill-Mannered	Unsmiling	Unsparkling
Ruthless	Uncivil	Uncheery	Undemonstrative
LAZY*	**SUBMISSIVE***	**UNASSUMING**	**INGENUOUS**
Unproductive	Self-Doubting	Nonegotistical	Uncunning
Lazy	Self-Effacing	Undemanding	Uncalculating
Unthorough	Timid	Unvain	Uncrafty
Inconsistent	Meek	Unwild	Unwily
Disorganized	Unaggressive	Boastless	Guileless
Unbusinesslike	Forceless	Pretenseless	Undevious
Impractical	Unauthoritative	Conceitless	Undeceptive
WARM*	**AGREEABLE***	**GREGARIOUS**	**EXTRAVERTED**
Tender-Hearted	Courteous	Friendly	Outgoing
Gentle-Hearted	Charitable	Genial	Extraverted
Tender	Well-Mannered	Neighbourly	Vivacious
Kind	Respectful	Companionable	Jovial
Emotional	Cordial	Approachable	Enthusiastic
Sympathetic	Cooperative	Congenial	Cheerful
Soft-Hearted	Accomodating	Good-Natured	Perky
Appreciative	Forgiving	Pleasant	Unshy

*These scales were used in the present study.

APPENDIX 3
Self Esteem Scale

Based on the Tennessee Self Concept Scale

The source scale of each item is indicated in brackets:

(P) = Personal Self Scale

(S) = Social Self Scale

(C) = Self-Criticism Scale (this scale not used in data analysis)

1) I am a cheerful person. (P)

2) I am a calm and easy-going person. (P)

3) I am a nobody. (P)

4) I am a friendly person. (S)

5) I am popular with men. (S)

6) I am not interested in what other people do. (S)

7) I do not always tell the truth. (C)

8) I get angry sometimes. (C)

9) I have a lot of self-control. (P)

10) I am a hateful person. (P)

11) I am losing my mind. (P)

12) I am popular with women. (S)

13) I am mad at the whole world. (S)

14) I am hard to be friendly with. (S)

15) I am satisfied to be just what I am. (P)

16) I am just as nice as I should be. (P)

17) I despise myself. (P)

18) Once in a while I think of things too bad to talk about. (C)

19) Sometimes, when I am not feeling well, I am cross. (C)

20) I am as sociable as I want to be. (S)

21) I try to please others, but I don't overdo it. (S)

22) I am no good at all from a social standpoint. (S)

23) I do not like everyone I know. (C)

24) Once in a while I laugh at a dirty joke. (C)

25) I am as smart as I want to be. (P)

26) I am not the person I would like to be. (P)

27) I wish I didn't give up as easily as I do. (P)

28) I can always take care of myself in any situation. (P)

29) I take the blame for things without getting mad. (P)

30) I do things without thinking about them first. (P)

31) I am satisfied with the way I treat other people. (S)

32) I should be more polite to others. (S)

33) I ought to get along better with other people. (S)

34) I try to understand the other fellow's point of view. (S)

35) I get along well with other people. (S)

36) I do not forgive others easily. (S)

37) I gossip a little at times. (C)

38) At times I feel like swearing. (C)

39) I would rather win than lose a game. (C)

40) I solve my problems quite easily. (P)

41) I change my mind a lot. (P)

42) I try to run away from my problems. (P)

43) I see good points in all the people I meet. (S)

44) I do not feel at ease with other people. (S)

45) I find it hard to talk with strangers. (S)

46) Once in a while I put off until tomorrow what I ought to do today. (C)

APPENDIX 4

The MDS Test

Subjects are asked to rate the similarity between each stimulus in the pair by circling the appropriate number. They are asked to try to use the full range of numbers between 1 and 9, with a "1" meaning the two stimuli are very similar to each other and a "9" meaning the two stimuli are very different from each other. A "5" means the two stimuli are neither similar nor different.

Subjects are asked not to take too long over the similarity judgements, but rather, to go with their "gut feelings". They are asked not to worry about whether or not they are being consistent from one judgement to the next. Finally, they are asked to take care not to omit any items.

The self stimuli are defined as follows:

a) YOUR USUAL SOCIAL SELF - how you generally are with other people.

b) YOUR IDEAL SELF - how you would like to be with other people, ideally.

c) YOUR SEXUAL SELF - your sexual personality.

d) YOUR PROBLEM SELF - the aspects of your social personality that you don't like.

	VERY SIMILAR								VERY DIFFERENT
	/								/
YOUR USUAL SOCIAL SELF & YR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR AGREEABLE SELF	1	2	3	4	5	6	7	8	9
YOUR SUBMISSIVE SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR COLD SELF & YOUR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR PROBLEM SELF	1	2	3	4	5	6	7	8	9
YOUR USUAL SOCIAL SELF & YR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR COLD SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR DOMINANT SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR QUARRELSOME SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR AGREEABLE SELF & YOUR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR WARM SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9

	VERY SIMILAR								VERY DIFFERENT.
	/								/
YOUR AGREEABLE SELF & YR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR WARM SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR PROBLEM SELF	1	2	3	4	5	6	7	8	9
YR USUAL SOCIAL SELF & YR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR COLD SELF & YOUR AGREEABLE SELF	1	2	3	4	5	6	7	8	9
YOUR QUARRELSOME SELF & YR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR COLD SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR AMBITIOUS SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR WARM SELF & YOUR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR USUAL SOCIAL SELF & YOUR WARM SELF	1	2	3	4	5	6	7	8	9

	VERY SIMILAR								VERY DIFFERENT
	/								/
YOUR SEXUAL SELF & YOUR COLD SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR QUARRELSOME SELF & YR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YR USUAL SOCIAL SELF & YR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR COLD SELF & YOUR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR AGREEABLE SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR USUAL SOCIAL SELF & YR AGREEABLE SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR COLD SELF	1	2	3	4	5	6	7	8	9
YOUR USUAL SOCIAL SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9

	VERY SIMILAR								VERY DIFFERENT
YOUR AGREEABLE SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR WARM SELF & YOUR AGREEABLE SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR COLD SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR WARM SELF	1	2	3	4	5	6	7	8	9
YOUR DOMINANT SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR WARM SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR QUARRELSOME SELF & YR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9

	VERY SIMILAR								VERY DIFFERENT
	/								/
YOUR USUAL SOCIAL SELF & YOUR PROBLEM SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR WARM SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR AGREEABLE SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR USUAL SOCIAL SELF & YOUR COLD SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR DOMINANT SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR COLD SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR LAZY SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9

	VERY SIMILAR								VERY DIFFERENT
	/								/.
YOUR WARM SELF & YOUR QUARRELSOME SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR SUBMISSIVE SELF	1	2	3	4	5	6	7	8	9
YOUR SUBMISSIVE SELF & YOUR AMBITIOUS SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR WARM SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR IDEAL SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR AGREEABLE SELF	1	2	3	4	5	6	7	8	9
YOUR WARM SELF & YOUR COLD SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR AGREEABLE SELF	1	2	3	4	5	6	7	8	9
YOUR SEXUAL SELF & YOUR USUAL SOCIAL SELF	1	2	3	4	5	6	7	8	9
YOUR PROBLEM SELF & YOUR DOMINANT SELF	1	2	3	4	5	6	7	8	9
YOUR IDEAL SELF & YOUR USUAL SOCIAL SELF	1	2	3	4	5	6	7	8	9