A Multivariate Approach to Social Categorization Research

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Abstract

It is argued that categorization is inherently comparative among entities, inherently multivariate among attributes and variable with perceiver perspectives and the conditions of judgment: that entities are structured into categories and attributes into constructs simultaneously in accordance with knowledge (including knowledge of categories and categorical structures) and naïve theory in ways that vary systematically with the entities under comparison and the contextual purposes and perspectives of perceivers. The outcome of this process – a structured set of ideas and relations among them – is referred to as a categorical scheme.

The core tenets of self-categorization theory (SCT) are elaborated in terms of the multi-category, multi-attribute nature of categorization processes. The links between categorization processes and social psychological phenomena forged within SCT, and their influence on the functioning of individuals and groups in social systems, indicate the potential for models of social-categorical schemes to be applied to social or organisational management initiatives with psychologically and socially important consequences.

A number of methods of data collection and analysis with the potential to model categorical schemes are described and illustrated. A sequential data-collection and modelling process is employed to build a model of the ways Australian registered nurses describe and distinguish among the main health-occupational groups with whom they share their occupational environment. Models employed include the two-way forms of multidimensional scaling (MDS), multidimensional unfolding (MDU), principal component analysis (PCA) and cluster analysis (CA), and the three-way extensions of MDS (WMDS), MDU (WMDU) and PCA (3PCA). The modelling exercise itself offers insight into the nature of categorization processes, and multivariate models of categorical schemes are potentially useful in applied contexts and a means of conducting research into categorization as an inherently multivariate process.

Certificate of authorship

Aside from the normal intellectual debts inherent in all scientific endeavour, the research reported in this thesis was carried out by myself without the collaboration of others, except where acknowledged in the text. This work has not been submitted for a higher degree to any other university or institution.
Lyndon Brooks
Signed:
Date:

Chapter 1
Introduction

Intended initially to systematise and strengthen the theoretical foundation of the social identity analysis of intergroup behaviour (Tajfel, 1978, 1981; Turner & Giles, 1981), Turner's (1982) account of the cognitive basis of the social group in terms of the fundamental cognitive process of categorization provided the basis of a theoretical position, self-categorization theory (SCT) (Turner, 1985, 1987a), with a considerably broader explanatory domain. SCT might now be considered to be a general account of the functioning of categorization processes in self-perception and social interaction having established a common theoretical basis for a wide range of ubiquitous and important social psychological phenomena including self- and other stereotyping (Oakes, Haslam & Turner, 1994), social influence (Turner, 1987b, 1991), group cohesiveness (Hogg, 1987, 1992), intergroup cooperation and competition (Turner, 1987a), group polarisation (Wetherell, 1987) and organisational psychology (Haslam, in press).
Having observed the theoretical integrity and state of development of SCT, and the importance of the phenomena it addresses to the functioning of individuals and groups in social systems, this project began as what was conceived of as a relatively straight-forward application of the theory to health promotion or organisational management. It was soon realised, however, that development of any such application made demands on measurement methodology that were not satisfied by the familiar methods of experimental social psychology in terms of which the theory was tested and developed. Whereas the emphasis of those methods was on experimental structure and measurement needed only to be adequate to illustrate or test pertinent theoretical hypotheses, the emphasis of methods of application needed to be on valid and reliable measurement of the content and structure of relevant concepts held and employed among a target population, or on appropriate description of the conceptual 'substance' in or on which the cognitive processes the theory describes operate.
In this respect the methods described and illustrated in the work of Coxon and his colleagues on cognitive representation of social structure (Coxon & Jones, 1978, 1979a, 1979b; Coxon & Davies, 1982) represented a promising avenue for investigation. The particular appeal of these methods is that they allow subjects to express their judgments in their own terms rather than in terms of researcher-defined constructs and moreover that the resulting data are subject to formal analysis in terms of mathematical data-analytic models. The data collected included direct judgments of (dis)similarity, of category membership (free sorts), of hierarchical categorical structures and subjects' verbal accounts

of their judgments, and the methods of analysis included multidimensional scaling (MDS), multidimensional unfolding (MDU) and cluster analysis (CA). In general terms, these kinds of similarity judgments and accounts appeared to provide access to qualitative data that were both directly relevant to categorization and quantifiable. Whilst quantification may not always be considered to be an unalloyed virtue, it allows among other benefits the employment of mathematical processes not only to provide control over selective and partial interpretation but also to facilitate integration and management of large amounts of data collected from each subject individually and the larger amounts of data collected from many subjects collectively. A further benefit is that the models generate variables (parameter estimates) that may be employed to relate the solutions to variables external to the measurement set.

At this point in its evolution, the objective of the project changed from development of a particular application of SCT to investigation of the relevance, appropriateness and utility of these sorts of methods for measurement and modelling of social categorical content more generally, whether for the purposes of application or of theoretical research. This indicated a careful analysis of the fundamental processes in the SCT account of social categorization in order to ensure that what was measured and how it was measured was consistent with theoretical principles. That account was itself built upon principles derived from research on natural categorization and similarity judgments in the field of cognitive psychology (e.g. Mervis & Rosch, 1981; Neisser, 1987; Rosch, 1973, 1975, 1978; Rosch & Mervis, 1975). Accordingly, a selective review of that literature was undertaken in order to establish a more general basis for understanding categorization processes, and of the relation between categorization and similarity judgments. Consequently, although SCT provided the inspiration and grounds from which this research was launched, the review of theory begins in Chapter 2 with an account of natural categorization and similarity judgments from the cognitive psychology literature.

Evidence is presented there that sets of necessary and sufficient conditions and perceptual similarity are both extremely poor candidates for principles upon which to base an account of natural categorization. Yet categorization is a fundamental, inalienable aspect of cognition and perception, and must form part of an account of human (and perhaps, more generally, animal) adaptation to the natural and social worlds, and there is intuitively an intimate relationship between categorization of entities and their attributional similarities. Despite that direct perceptual similarity cannot account for the properties of natural categories, patterns of family resemblance similarity defined in terms of features listed as shared among overlapping sub-sets of entities are regularly associated with their collection together into categories. However, there is good evidence that analytical, attribute by attribute, family resemblance sorting processes are rarely the basis of the formation or psychological coherence of categories. Consequently, it appears that perception or analytical emergence of family resemblance similarity and similarity more generally is as much outcome as input to the categorization process. It is argued that categorization is a product of an hierarchical process of judgment and inference in which a broad body of innate and accumulated world knowledge and naive theory is marshalled to

establish the viability of a categorical hypothesis in terms of the coherence, clarity and utility of the conceptual structure in which it is embedded. Details of the argument and of the proposed features of 'categorical schemes' may be left to Chapter 2 except to suggest that, although similarity judgments are not the universal basis of categorizations, categorization and similarity judgments are intimately related, and that similarity judgments may serve well to indicate the conceptual content of categorical schemes.

The nature of categorization processes and similarity judgments as summarised from the review in Chapter 2 has much in common with the SCT account described in Chapter 3 and, indeed, Turner anticipated and clarified some of the principles emerging in the cognitive psychology analysis. The hierarchical structure of categorical schemes, the mutual dependency of categorization and similarity judgments, and their joint variation with the entities being compared and the perspectives of perceivers and their purposes for comparison in context are particular examples. However, whereas the implicit theory emerging from reading the cognitive psychology literature (Chapter 2) accounts for within-category coherence and between-category discrimination in terms of the joint distributions of multiple attributes among categories (e.g. patterns of family resemblance (dis)similarity), such attributes often being presumed to be binary-valued, Turner's account was framed in terms of continuously-distributed attributes, presumed to be measurable on interval scales and considered univariately. The position taken here is that the attributes associated with categorization might themselves be categorical (binary or multiple-nominal), ordinal-categorical or continuous but that the evidence from the research reported in Chapter 2 strongly indicates that categorization is inherently multivariate among attributes and that the psychological coherence and usefulness of categories as explanatory and predictive constructs presumes and depends on it. This is not to suggest that Turner was unaware of the importance of multiple associated attributes to categorization but that univariate formulations of hypotheses and illustrations were more accessible to experimentation and readers schooled in the traditions of experimental social psychology.

Consequently, the empirical initiative of this project is to exemplify and illustrate how the principles of natural and social categorization as elaborated in SCT in particular may be further explored or applied in a multivariate context. Chapter 4 discusses the demands the more basic principles impose on empirical methods, briefly describes some available analytic models and proposes a structured sequence in which relevant data might be appropriately collected, modelled and interpreted. The empirical research process is neither directed to tests of specific hypotheses nor to implementation of any specific social change application. Rather, it is essentially an exploration and illustration of collection and multivariate modelling of categorization theory-relevant data. The underlying intention was to learn and then share ways in which social categorization research, whether theoretical or applied, might be conducted in the context of multivariate measurement so as to reflect the multi-category, multi-attribute cognitive context in which categorization naturally occurs. This is not in any way to challenge the primacy of experimentation as the most appropriate means of theory development and refinement (see Turner, 1981) but

perhaps to contribute to potential enhancement of experimental as well as applied possibilities through contributing to sophistication of measurement and modelling practices among social psychologists.

As entities are structured into categories (or categories into higher-order categories) attributes are structured into conceptually coherent sets in terms of which the similarities and differences, characteristic behaviours and forms of interaction among categories are described, explained and predicted. A model of a categorical scheme, then, should minimally represent structure among entities (or categories), structure among attributes and relations between the them. Yet, as recognised in the cognitive psychology literature and emphasised in SCT, all of the above will vary with the contextually available information, purposes, interests and knowledge of perceivers. Accordingly, a model might advantageously represent the influence of a third 'mode' of variation in the content of a categorical scheme, as due most obviously to differences in context or among perceivers. If the ways in which perceivers structure entities into categories and represent (dis)similarities and relations among them in terms of conceptually coherent attribute structures are conceived of as the outcome of their application of knowledge and naive theory for contextual purposes, then manipulation of the third mode through sampling or other means offers experimental access to categorization processes.

Several distinct sources of variation are implicated in contextual generation of the content of a categorical scheme. Minimally they include that the content of a categorical scheme depends upon the entities or categories being compared, the purposes of the comparison and the knowledge and perspectives of the perceivers. Consequently, at least three sources or 'modes' of variation are implicit in the content of any categorical scheme: among entities or categories, among the attributes in terms of which their similarities and differences are described and their relations accounted for, and among perceivers and contexts. The empirical imperative is to build multi-mode models to represent the simultaneous inter-action of minimally two modes (categories or entities and attributes) and generally three (categories or entities, attributes, perceivers/contexts) in generation of categorical schemes.

The data collection and modelling process is sequential. Chapter 5 describes collection of (dis)similarity and categorization judgments and their free accounts in 'interviews' from a relatively small sample (20) and the analysis of those data on an individual basis. The purposes of this phase of the empirical program included to access the concepts and language or attributional phrases employed among the population studied to describe and distinguish among a set of interacting occupational groups (categories, including their own) and to illustrate application of the data-analytic models in their simplest form (to individual's data). Other purposes were, at least informally, to observe the integrity of individuals' categorical schemes, to compare the results of analytical clustering of pairwise similarities with free sorts, and to compare solutions based on data collected in different ways and analysed by different models. A single case study is described in detail.

Chapter 6 reports an analysis of the aggregated dissimilarity estimates and their associated accounts, extending modelling to include the subject mode. Although an extension of the basic MDS model, weighted MDS (WMDS, INDSCAL in

particular; see Young & Hamer, 1987), well accommodates the extra mode in the set of dissimilarities, the particular challenge of the analysis is to interpret the solution in terms of the aggregated accounts. A strategy is presented for interpreting the common (among subjects) occupational group space as estimated by WMDU in terms of comments selected from accounts and appropriately sorted and managed by means of a relational database. Whilst the result is descriptively very satisfactory, collection and analysis of data by this process is subject to a number of limitations for more general research purposes. These include limitations that the data-collection methods, being face-to-face and time-consuming, impose on available samples, and informal association of attributes with among-category description and discrimination. In particular, the results do not include variables describing the structure among attributes (although that might be observed to some extent in the accounts) or their relation with the structure among groups. Given the potential utility of such variables and the desirability of more representative sampling, a research instrument was designed to collect ratings of the extent to which each of a wider, more representative sample of subjects perceives each of a set of attributes to apply to each of the set of groups, which could be analysed by a more general model.
From the perspective of design of that instrument, the primary function of the interview data was to facilitate identification of a set of relevant and diagnostic attributional statements. However, the differences between making dissimilarity estimates and offering free accounts and rating objects (entities/categories/groups) on a pre-defined set of attribute scales, and between the corresponding data-analytic models, indicate assessment of the substantive correspondence between solutions obtained by the different processes. For this purpose, a sub-set (11) of the interview sample also rated the groups on attributes selected from their own accounts. Accordingly, Chapter 6 includes a comparison between the INDSCAL solution representing the pairwise dissimilarities as interpreted from accounts and a principal components analysis (PCA) solution of the joint group and attribute relations from the ratings scale data.
Chapters 7,8 and 9 report the collection and modelling of ratings of the groups on attribute scales by a larger, more representative sample. An attempt to continue the analytical process in the MDS tradition by applying weighted multidimensional unfolding (WMDU) (see Young & Hamer, 1987) produced less than satisfactory results as has been experienced and commented upon previously (see Borg & Groenen, 1997). The results of that analysis are briefly presented in Chapter 7 as an illustration of the sorts of problems that may be encountered in fitting that model. The model finally chosen for the analysis of this three-mode data (groups, attributes, subjects) is an extension of the workhorse of multivariate analysis, ordinary or two-mode PCA, to three modes in the form of three-mode PCA (3PCA; Tucker, 1964; Kroonenberg & DeLeeuw, 1980; Kroonenberg, 1983). Chapter 7 describes the research instrument, the sample, the data and initial approaches to the analysis, Chapter 8 reports the basic 3PCA analysis and solution and Chapter 9 reports an interpretation of the 3PCA solution in terms of joint plots representing the attribute by group relations from different subject perspectives and describes

structures among the groups and attributes by application of cluster analysis to 3PCA parameters.

The concluding Chapter (Chapter 10) discusses relations between the 3PCA model in particular and three-mode models more generally and principles of social categorization theory and assesses their potential utility for social categorization research.

Australian registered nurses were chosen as a potentially fruitful group to study on account of their current heightened consciousness of their social identities as nurses and the nature of their relations to other occupational groups in the health system. This derives largely from a relatively recent and continuing process of professionalisation of the nursing occupation involving the introduction of tertiary education as the pathway into the profession with which is associated trends to increasing specialisation and negotiation for increased authority and autonomy in practice. Nurses, or others who interact with them, may well find the model developed of their socially-shared categorical scheme describing and discriminating among themselves and other groups in their professional context to be informative, and depending upon their skills and interests, useful. The main purpose of the model is, however, beyond illustrating and exemplifying a categorization theory-relevant model-building process, to constitute a point of reference for discussion of the potential utilities and limitations of such models. The principal theoretical discussion made in reference to the model is the potential for empirical processes to encourage reification of constructs and how, in view of this, interpretation and usage of such models might be approached and constrained within reasonable and appropriate bounds.

Chapter 2

Natural categorization and similarity judgments

According to the classical view, categories are defined by sets of individually necessary and collectively sufficient attributes for membership, and occur in hierarchies defined by class inclusion (taxonomies). Implications of this are that categories have clearly bounded extensions and that their exemplars have equal status, and whilst set-theoretic relations are seen to apply between taxonomic levels, the logic of this model has no implications for their relative epistemic priority. However, whilst incorporating this understanding of the logic of categories, British empiricism (e.g. Locke, 1690), associationism (e.g. Mill, 1829) logical empiricism (see Brown, 1979) and learning theory (see Fodor, 1981) accord epistemic priority to primitive percepts which, in realist versions, are conceived of as corresponding to elemental features of the physical world. In British empiricism, associationism and learning theory concepts are conceived of as being formed from experienced associations among such percepts. Logical empiricism, being less descriptive and more prescriptive as epistemology, attempted to establish secure grounds for knowledge on a combination of propositional calculus including set-theoretic relations among categories and theory-free observational primitives or sense data as propositional referents. All of these notions have suffered debilitating attack from within the discipline of philosophy - the context in which they originated - and through the force of observation and experimentation into the properties of natural categories. The result of these developments has implications, not only for the

structure of categories, but also for the ancient empiricist-rationalist debate and the relations between wholes and parts and between theory and data.

In addition to traditional arguments for the rationalist view that experience is as interpreted through a-priori knowledge and against the empiricist view that knowledge is constructed upon a *tabula rasa* on the basis of associations among pre-conceptual percepts, 20th century philosophy has set out and abandoned the attempt to establish pre-conceptual sense data as epistemic grounds and to develop a theory-free observation language in which to describe them (e.g. Hanson, 1961; Brown, 1979). Goodman (1976) eloquently rejects the viability of this enterprise:

The myths of the innocent eye and the absolute given are unholy accomplices. Both derive from and foster the idea of knowing as a processing of raw material received from the senses, and of this raw material as being discoverable through purification rites or by methodical disinterpretation. But reception and interpretation are not separable operations, they are thoroughly interdependent. The Kantian dictum echoes here: the innocent eye is blind and the virgin mind empty. Moreover, what has been received and what has been done to it cannot be distinguished within the finished product. Content cannot be extracted by peeling off layers of comment. (p. 8)

In the psychological literature, Wittgenstein (1953) is generally credited with having led the philosophical attack on the classical view of categories. His injunction, "don't think but look" recommended a shift from a-priori speculation about the basis of categories (defining attributes) and the nature of category structure (equality of exemplars within clearly delimited boundaries) to observation of the properties of natural categories. His own analysis of categories like games and numbers supported conclusions that the basis of natural categories is not defining attributes but 'family resemblances' among exemplars, identified in terms of overlapping sets of matching (shared) and mis-matching (non-shared) attributes, that members vary in the extent to which they exemplify a category, and that boundaries to category extension are not clear-cut but extendable. All of these ideas have been included in contemporary theories about categories and categorization.

Austin (1961), interpreted as conceiving of the senses of words as forming categories, argued that their commonality does not consist of their severally satisfying a common set of definitional criteria nor even of similarity in the family resemblance sense but originates in various metonymic (part stands for whole), metaphoric (structure of ideas in one domain mapped onto another) and whole-part relations. Although Austin did not use the words metonymy and metaphor, these relations may be identified in his examples. In discussing the usages of 'healthy', Austin identifies 'the primary nuclear sense' of 'healthy' as used of a healthy body and derivative senses as in 'healthy exercise' in which 'healthy' (part) stands for 'productive of healthy bodies' (whole) and in 'healthy complexion' in which 'healthy' (part) stands for 'resulting from a healthy body' (whole). The senses of 'foot' as applying to bodies, mountains and lists are related through metaphorical mappings of the term describing the bottom part of body structure onto mountains and lists. And the terms cricket, cricket bat, cricket ball and cricket umpire are related such that cricket and objects or people playing a part in the game cannot be independently described. If the senses of

words are accepted as forming natural categories, these examples undermine not only definitional criteria but also family resemblance similarity relations as completely accounting for natural category membership, clearly discriminate among exemplars (primary nuclear and derivative senses), and describe non-similarity relations (metonymy, metaphor and whole-part integrity) by which categories may be constructed and allow the possibility of category boundary extension.

Whilst there may always have been resistance to philosophical empiricism and atomism in scientific psychology, explicit through the behaviourist era in the work of the Gestaltists (see Boring, 1950) and the 'New Look' movement (see Bruner, 1983), widespread rejection of these views and of the classical view of categories has followed the experimental work of Rosch and her colleagues (e.g. Rosch, 1973, 1975; Rosch & Mervis, 1975; Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976; Mervis & Rosch, 1981). Rosch's experimental paradigms have produced results that demonstrate the universal non-equivalence of category exemplars, indeterminacy of category boundaries, construction of categories in parallel to family resemblances among attributes and the primacy of categorization near the middle of taxonomic hierarchies rather than at the level of elemental attributes.

Rosch's apparent motives, her understanding of what she was dealing with and her interpretation of her results have changed over time. In her early work (Heider, 1971, 1972; Heider & Olivier, 1972; Rosch, 1973, 1974) Rosch was concerned with the relation of linguistic to conceptual structure (cf. Berlin & Kay, 1969) and, contrary to one of Whorf's (cited in Lakoff, 1987) hypotheses, demonstrated the primacy of the latter with respect to perception of focal colours. She found that arbitrary names for focal colours were more easily learned and better remembered than arbitrary names for non-focal colours among a population whose language had no terms in which to describe them (Dani speakers in New Guinea) and that focal colours were more frequently selected as examples of colours by children than non-focal colours. Focal colours were Rosch's first examples of what she has termed prototypes or best exemplars of categories.

She and her colleagues have found, not only for focal colours, but also for geometric shapes and a variety of categories of natural objects and artefacts (e.g. furniture, vehicle, fruit, weapon, vegetable, clothing) that subjects' goodness-of-example ratings display graded structures of typicality or representativeness (see e.g. Mervis & Rosch, 1981): i.e. that exemplars vary and are graded according to how well they are thought to exemplify their categories. Studies by a number of researchers have observed graded structures in a variety of category types: in formal categories such as odd numbers and squares (Armstrong, Gleitman & Gleitman, 1983), in linguistic categories (see Lakoff, 1987 for a review) and in goal-derived (e.g. things to eat on a diet) and ad-hoc categories (e.g. ways to escape being killed by the Mafia; Barsalou, 1983,1985). As Barsalou (1987) states, "it appears that graded structure is a universal property of categories" (p. 102).

Whilst category content in terms of attributes and categorization effects are the subjects of subsequent discussion, it is clear that the internal structure of categories in terms of relative exemplar representativeness is not independent of

either. Directly obtained representativeness gradients have been shown to be associated with speed of identification of exemplars as category members, order and frequency of mention of freely-produced category exemplars, asymmetry of similarity ratings (less representative exemplars are judged to be more similar to more representative exemplars than the converse), asymmetry of generalisation (information about more representative exemplars is more likely to be generalised to less representative exemplars than the converse), measures of family resemblance, developmental order of category elaboration, ease of learning, memory accuracy, and decision-making (see Mervis & Rosch, 1981; Barsalou, 1987; Lakoff, 1987).

Although Rosch's own empirical work was minimally concerned with the indeterminacy of category boundaries (however, see Rosch, 1973), Mervis and Rosch (1981) quote a number of studies demonstrating both between- and within-group differences in the categories into which poorer exemplars are assigned. Category types reported as displaying boundary indeterminacy include colours, artefacts (e.g. cups and drawings of cups), superordinate semantic categories and subordinate semantic categories. Apparently, as Wittgenstein had suggested, the boundaries of many natural categories are extendable and overlap with those of other categories, a property of category systems modelled in terms of fuzzy-set theory (e.g. Zadeh, 1965). As representativeness gradience constrains conception of within-category structure, boundary indeterminacy constrains conception of between-category structure and, as subsequent discussion will show, both representativeness gradience and boundary indeterminacy are associated with measures of family resemblance suggesting that they are outcomes of the same categorization processes.

Demonstration of representativeness gradience and boundary indeterminacy effects constitutes an empirical attack on the classical view of within- and between-category structure, and represents one of the two principle ways in which the work of Rosch and her colleagues may be considered to be revolutionary. The other follows from demonstration of the epistemic and ontogenetic primacy of categories near the middle of taxonomic hierarchies rather than of elemental, pre-categorical environmental-feature percepts. In her early work on colour Rosch was concerned to oppose linguistic relativism and in her work on basic-level categorization to oppose the idea that natural category systems are merely optional or arbitrary with the idea that they more or less accurately model the structure of the natural world. There is a commonality here: a motive to ground cognition in reality.

Observing that the notion that conceptual segmentation of the world is in arbitrary relation to its structure is credible only on the assumption that real-world attributes form 'total sets' in which all combinations are equally probable, Rosch et al. (1976) state that the aim of their research is "to show that the world does contain intrinsically separable things" (p. 383). They argue that (a) categories corresponding to clusters among naturally correlated attributes have the properties that the numbers of attributes shared among objects is maximised within and minimised between categories; (b) as abstraction increases in taxonomic hierarchies, a level - the basic level - is reached beyond which numbers of attributes shared among exemplars within categories decreases, and below which the numbers of attributes shared among exemplars between

categories increases; (c) identification of basic-level categories results from a balance between two separate functions of categorization having opposing implications: to simplify the perceived environment ("to reduce the infinite differences among stimuli to behaviourally and cognitively usable proportions" (p. 384)), implying relatively few categories; and to provide a basis for inference from observed to unobserved attributes, most reliable if category exemplars are highly similar in these respects and implying relatively many categories; and, consequently, (d) that "basic categorization is the most general and inclusive level at which categories can delineate real-world correlational structures" (p. 384).

Four criteria - co-occurrence of attributes, common interaction sequences, overall shape-similarity and imaging of average exemplars - are taken by Rosch et al (1976) to operationally define basic objects. More attributes are listed as being possessed in common by exemplars of basic- than superordinate-level categories and relatively few attributes are listed for subordinate- in addition to those listed for basic-level categories (expt 1). Descriptions of physical interaction sequences include more movements with basic- than superordinate-level exemplars and relatively few movements are described for interaction with subordinate- in addition to those described for basic-level exemplars (and sometimes there are less; expt 2). Similarity in overall shape is greater for basic than superordinate-level exemplars and there is only a relatively small increase in shape-similarity among subordinate- over basic-level exemplars (expt 3). And averaged shapes are more identifiable as representing their categories for basic- than superordinate-level exemplars and are no more identifiable for subordinate- than basic-level exemplars (expt 4). Further experiments reported in this paper indicate that objects are recognised first as members of their basic-level category, with super- and subordinate-level categorization presumably involving additional inferential and analytic processes; that correct sorting at the basic-level ontogenetically precedes correct sorting at the superordinate-level and that this result does not appear to be dependent upon linguistic development; and that basic-level names are those by which objects are most generally designated, are acquired first by children and are the first to enter a language in development.

Rosch (1978) reports that at the time these experiments were conducted, she had thought that the attributes listed by her subjects and measured by her experimenters were unproblematically locatable in the real world and provided the 'substance' from which basic categories were constructed. She has subsequently questioned this realistic view noting that,

(1) some attributes, such as 'seat' for the object 'chair' appeared to have names that showed them not to be meaningful prior to knowledge of the object as chair; (2) some attributes such as large for the object 'piano' seemed to have meaning only in relation to categorization of the object in terms of a superordinate category - piano is large for furniture but small for other kinds of objects such as buildings; (3) some attributes such as 'you eat on it' for the object 'table' seemed to require knowledge about humans, their activities, and the real world in order to be understood. That is, it appeared that the analysis of objects into attributes was a rather sophisticated activity that our subjects (and indeed a

system of cultural knowledge) might be considered to be able to impose only *after* the development of a system of categories. (pp. 41-42)

In short, category attributes are not directly locatable in a metaphysical world-without-a-knower but are properties of human experience; they may only be meaningfully identifiable in terms of, and cannot be considered to be grounds of, their associated categories; and the meaning of attributes and associated categories is dependent upon their locations within category systems. Since attributes may themselves be considered to be categories at lower levels of abstraction, these considerations reduce to two: category attributes are human-experiential rather than real world properties and their meanings are dependent upon their locations within conceptual systems.

This retreat from direct realism, however, does not undermine the importance of the work on basic-level categorization so much as constrain how it might be accounted for. B. Tversky and Hemenway (1984) have accumulated experimental evidence to support the hypotheses of Berlin, Breedlove and Raven (1974) and Hunn (1977) that the fundamental determinant of the basic level is gestalt perception of overall whole-part configuration. Essentially, their position is that parts and the ways in which they are interrelated are commonly correlated with the functions of wholes, determine shape and hence perceived form and imageability, and that interaction with basic objects is usually via their parts.

The work on basic categorization deals specifically with categorization of highly familiar classes of concrete objects and its implications are uncertain for categorization of more abstract 'objects' in other (e.g. social) domains in which the suggested operational definitions in terms of attribute familiarity, overall shape, motor interaction and imageability are not clearly applicable. However, some authors - notably Lakoff (1987) and Johnson (1987) (also, Varela, Thompson & Rosch, 1993) - argue that basic-level categorization provides the experiential basis or model upon which categories in other domains and at other levels are formed through metaphoric and metonymic processes. Tracing reasoning and thinking in general back to basic-level categorization and its functional whole-part-perceptual and motor-interactive basis is an argument for the 'embodiment of mind' and the foundation of natural epistemology at a relatively holistic-experiential rather than atomistic-perceptual level. From this perspective, categorization at the basic level appears to be relatively direct given the organic nature of human beings and the nature of their functional relations to their physical environment and both more abstract and more analytical reasoning are "achievements of the imagination" (Brown, 1965, p. 320). Lakoff (1987), Johnson (1987) and B. Tversky and Hemenway (1984) propose that event categories, for example, are formed by the imposition of basic-object-like part-whole structures on events.

Rosch and her colleagues account for the observed properties of within- and between-category structure (representativeness gradience and boundary indeterminacy) and also for the primacy of mid-taxonomic (basic) level categories in terms of family resemblances among exemplars. According to this principle categories are formed such that attributes are shared among overlapping sub-sets of but not necessarily all exemplars. Whilst Rosch et al (1976) argued that distinctions could be made between taxonomic levels in terms of numbers of attributes perceived as being shared among objects,

identifying the basic level as the most general at which relatively many attributes are perceived as being shared among exemplars within and relatively few between categories, Rosch and Mervis (1975) argued that distinctions could be made among category exemplars within taxonomic levels on a similar basis: that is, that objects judged to be most representative of their categories are those perceived to share most attributes with more other exemplars within and least between categories at the same taxonomic level. They describe six experiments demonstrating strong and significant relations between representativeness ratings and measures of family resemblance among perceived attributes for superordinate (furniture, vehicle, fruit, weapon, vegetable, clothing), basic (car, truck, aeroplane, chair, table, lamp) and artificial (letter sequences) categories, in each case separately for within- and between-category patterns of attribute sharing. Although not directly discussed in that paper, the family resemblance principle provides for an understanding of boundary indeterminacy in terms of ambivalence arising from relatively low within- and high between-category family resemblances.

Whether employed as an account of within- or between-taxonomic-level categorization, family resemblance similarity is essentially an account of category coherence. Rosch's early realist initiative seems to imply that maximisation of within- and minimisation of between-category family resemblance similarity is a product of (pre-categorical) detection of correlational structures in the world-as-it-is. Relaxation of the realist assumptions, however, allows the alternative possibility that maximisation of within- and minimisation of between-category family resemblance similarity is a psychological principle that imposes or discovers correlational structures in the world-as-it-is-perceived. In this respect, family resemblance similarity shares with similarity considered more generally a crucial deficiency as a full account of category coherence: it leaves unexplained what is to be entered as an attribute into the putative similarity-judgment--category-formation process. Moreover, even if attribute selection is accounted for, determination of attribute meaning may not be independent of its role in the category system within which it is perceived to be distributed.

These ideas are inherent in Medin's and Wattenmaker's (1987) argument for the insufficiency of similarity as an account of category coherence. They suggest that "entities may seem to be similar precisely because they are members of the same category" (p. 26), a suggestion that may implicitly include but be more general than the idea that identification of category may at least in part direct selection of attributes in accounting for it. They contend that "what is needed is some independent method of measuring similarity uncontaminated by people's knowledge about category memberships" (p. 26), suggesting a type of research program which, whilst bypassing the problem of how nameless entities are analysed into attributes, in one (general, formal and influential) case at least has produced results that further undermine the case for similarity. A. Tversky's (1977) model expresses the similarity between objects (the presumed basis of their being categorized together) as a linear combination of measures of their common and distinctive 'features' (attributes) weighted for salienc e or importance. A. Tversky has shown that relative weights among attributes and between common and distinctive attributes vary with stimulus context and

experimental task. Consequently, an account of category coherence in terms of similarity requires a prior or simultaneous account not only of how attributes are selected or identified but also of how they are weighted in integration to judgments of overall (dis)similarity among objects. The argument that the coherence of categories derives from their mapping onto clusters of naturally correlated attributes is subject to these and further constraints including the necessity to account for how correlations appropriate to categorization are identified from among enormous numbers of possibilities: i.e. "even with some predetermined set of properties, there are so many possible correlations that it is not clear how the correct ones get picked out" (Medin & Wattenmaker, 1987, p. 29). As suggested above, conviction that sets of attributes or correlations among them are a correct basis for categorization might follow or co-occur with rather than determine formation of categories with high within- relative to between-family resemblance similarity. If this is so, that the world "contain(s) intrinsically separable things" (Rosch et al., 1976, p. 383) is premise to as much as conclusion from categorization.

Indeed, this may count among the 'naive theories' and 'more general world knowledge' in terms of which Medin and Wattenmaker (1987) frame their alternative account of category coherence, and in contrast to which they further erode the case for similarity. They contend that theories play a significant role in determining the relevance of attributes and the salience of correlations among them. Moreover, they argue that the coherence of categories derives from their role in theory-driven inferential and explanatory processes beyond the purely descriptive process of sorting according to (mis)matches among independent attributes. They present three arguments against summation of attribute values ('yes' or 'no') as the basis of categorization each of which points to involvement of 'theories' (and 'more general world knowledge') in more than selection and weighting of attributes from pre-existing sets but none of which deprives attribute matching of an important explanatory role. They hold that lists of independent attributes will not suffice to characterise concepts since many concepts include complex relational attributes that must either be described holistically or for which lists must include relational predicates (e.g. the relational attribute 'circle inside a triangle' cannot be identified from the list 'circle, triangle, inside'). Whilst this may be an argument against (non-relational) sense data as epistemic grounds, it is not a crucial difficulty for holistic-attribute-tolerant attribute-matching accounts of categorization ('eyes' for 'animals'!). Medin and Wattenmaker appear to be suggesting that concepts are more than sums of their components with this 'more than' presumably deriving from some possibly inchoate theory supporting the concept's integrity. However, what is important to this position is not that attributes may be relational with complex internal structures but that theories are implicit in complex relational structures among attributes. As they subsequently argue, "people not only notice feature correlations, but they can deduce *reasons* for them based on their knowledge of the way the world works ... (and) ... the availability of such explanations plays a causal role in the development of categories" (p. 36). They offer the example that webbed feet and water repellent feathers is not a raw correlation that just happens to emerge within the category of aquatic birds but is understood as a matter of biological necessity in birds'

adaptation to an aquatic environment, and describe experimental results that given a choice between two sets of correlated attributes as a basis for categorization, subjects "showed a strong tendency to cluster on the basis of correlated attributes for which a causal link could easily be made ... and ... justified their sortings in terms of specific causal linkages" (pp. 36-37). To the extent that attributes may themselves be considered to be categories at lower levels of abstraction, this argument that theories are involved in accounting for and directing attention to structures among attributes applies also to structures within attributes.

They further support the idea that concepts are more than component sums with the results of an experiment by Rips and Handle (cited in Medin & Wattenmaker, 1987). These authors found that subjects classified a circular object midway between the normative sizes of coins and pizzas (5") as a pizza rather than as a coin and suggested that there was more involved in this judgment - such as that coins have sizes mandated by law and serve certain functions - than knowledge of typical sizes. Since there is no compelling reason to restrict attributes to the sorts of features that 'typical sizes' is meant to represent, this argument also fails to deprive attribute matching of an important explanatory role in categorization, but it is suggestive that categorization involves knowledge of relations among concept sets – e.g. coins, laws, pizzas, purses, meals and markets - and not merely pre-existing knowledge of the constituent attributes of individual concepts. The important point here turns on the distinction between attributes previously associated with a category and those associated with it at the time of allocation of an object into that or an alternative category. That it is highly unlikely that attributes representing knowledge of relations among a potentially enormous variety of categories are pre-stored as attributes of particular categories promotes the conclusion that they are derived or re-defined from this broader knowledge base to serve the purposes of particular categorical judgments. With the reasonable proviso that such generated attributes are generally consistent with criterial or normative pre-stored category attributes, for which argument will subsequently be made, they may yet enter into attribute matching processes in effecting particular categorical judgments. Given this understanding, the force of Medin's and Wattenmaker's argument is that categorical judgments cannot be explicated without reference to theory-like processes operating in a broad knowledge base involved in attribute generation and presumably also in assessment of consistency among generated and pre-stored category attributes. Moreover, if concepts are indeed more than component sums, assessment of normative consistency involves a coherence judgment that is not identical with attribute matching. It is, however, itself a categorical judgment: it poses the question, is this (generated) attribute a member of the category of attributes of the target category? This way of posing the question assumes that the target category is not identical to any particular pre-defined set (category) of attributes but represents an entity with a potentially infinite number of attributes, the character of which is to manifest or possess but not to be perfectly describable by any particular sub-set.

As the argument above points to the conclusion that attributes not previously associated with a category may be generated from knowledge of inter-category

relations for the purposes of particular categorization judgments, Medin's and Wattenmaker's third argument points to the conclusion that attributes not previously associated with a category may nevertheless invoke the category if membership in the category 'explains' an attribute manifested by an object. They present the example that "jumping into a swimming pool with one's clothes on is in all probability not directly associated with the concept 'intoxicated', yet that information might well be used to decide that a person is drunk" (p. 33). Despite that further information would normally be marshalled to support this kind of conclusion, this example further illustrates that categorization is not generally explicable solely in terms of matching observed exemplar attributes with some pre-defined list but that theory-like deductive and inferential processes are involved. However, whilst it is not explained how categories are involved in explaining attributes (especially previously unassociated ones), it appears likely that an account of normative consistency judgments would include much of what is necessary.

Although more substantial evidence is required, these arguments indicate that theories and more general world knowledge are implicated, beyond selection and weighting of attributes from pre-defined lists, in directing attention to and accounting for relations among attributes, in deriving and re-defining attributes from relations among categories, and in inferring attributes from consistency with normative category expectations. Whilst, if these conclusions are correct, it is clear that categorization cannot be accounted for simply in terms of matching attributes with pre-defined lists, matching of contextually-defined attributes may nevertheless play an important role in categorization and in the contextual coherence of categories. Since similarities among exemplars, relative exemplar representativeness and category family resemblances are all definable and mutually transformable in terms of linear contrasts of common and distinctive attributes (A. Tversky, 1977, pp. 347-349), these judgments may also be involved in categorization and category coherence. In particular, since family resemblance is highest for those categories having most attributes in common within- and least between-categories, and is implied by and may imply sets of related attributes, it may be used in the formation of categories, as a measure of the 'discrimant validity' of categorization or as an indication or confirmation of underlying entitativity. This view of family resemblance invites a factor analysis metaphor: in exploratory factor analysis, sets of interrelated variables (attributes) are partitioned into smaller sets of discriminable (orthogonal) factors (categories) that are conceived of as 'explaining' the pattern of covariation among the variables (attributes); in confirmatory factor analysis, a priori separable factors or constructs (categories) are 'confirmed by' patterns of high within- relative to between-factor loadings on 'indicator variables' (attributes) that are conceived of as manifestations of or as 'explained by' the factors (categories); and the tendency to infer entities from, and to expect entities to manifest, correlated attributes in categorization is parallel to the tendency among factor analysts to conceive of factors as more than convenient summaries, indeed as 'real' entities of which sets of intercorrelated variables are collectively incomplete and individually imperfect indicators. This metaphor is easily extendable to include the 'measurement problem' (the reliabilities and validities of categories in terms of attributes) within the context of a purpose-driven

research design including hypothesised relations among constructs (categories). However, the validity of this metaphor to categorization depends upon the extent and ways in which 'linear separability' (high within - relative to between-category similarity) and inferences to and from entitativity are demonstrably involved in categorization.

Following earlier results by Medin and Schwanenflugel (1981) that linearly separable categories were no easier to learn than non-linearly separable categories, Wattenmaker et al. (1986) examined the idea that linear separability may become important when theories select and relate sets of attributes. In one experiment in which such a theory was invoked in the form of a theme - suitability as a hammer - they found that when the theme was provided linearly separable categories were much easier to learn than non-linearly separable categories but in its absence linearly separable categories were actually harder to learn. Although an explanation for this latter effect is wanting, the point is well made that linear separability is insufficient to categorization but it may be important in establishing the clarity of categorical distinctions for attribute distributions consistent with superordinate theories. It appears that linear separability among attributes may contribute to category coherence when a theme or theory specifies category function or identity: i.e. the 'as what?' in the categorization process. Given attribute distributions of sufficient familiarity to cue potential categorical identity this process is consistent with a confirmatory role for linear separability and with categorization processes as mental experiments in which attributes and attribute structures support inferences to themes, theories or entities which in turn support hypotheses about attributes and attribute structures that may be 'tested' in terms of attributional distinctions among categories: i.e. in the sense that failure to produce clearly separable categories may initiate iteration through an inference-deduction-validation cycle.

Pausing to expand this idea, numerous authors, following Kant, have argued for the inaccessibility of uncognised reality. This position has already been mentioned in several guises: in the earlier quotation from Goodman (1976) that 'rece ption and interpretation are not separable operations" (p. 8), in Hanson's (1961) and H.I. Brown's (1979) rejection of the notion of pre-conceptual sense data as epistemic grounds, and in Rosch's (1978) re-evaluation of the nature of the attributes listed by her subjects. McCauley (1987) holds that most contemporary philosophers maintain that observation is theory-laden (p. 302) and considers the implications of this position for theories of categorization in some detail. For present purposes, however, if observation is a prior condition of inference and if theory (of some sort) is a prior condition of observation, the suggested inference-deduction-validation cycle expands to a theory-observation-inference-deduction-validation cycle.

The role of category separation in terms of attributes in categorization was further explored by Medin, Wattenmaker and Hampson (1987). They argue that if family resemblance sorting is 'natural' then attributes that are equally perceptually salient will tend to be equally weighted in the formation of categories with high within- relative to between-category similarity. In their first experiment, using cartoon-like animals as stimuli varying on four dimensions and partitionable into two sets on a family resemblance basis, they found that no subject used this strategy, each sorting on a single but not all on

the same dimension. In a second four-part experiment - two parts using cartoon-like animals and two parts using women's names and associated trait descriptions taken from four personality dimensions - subjects were instructed to use all properties of the stimuli in setting-up their categories and the stimuli were contrived in ways that might arguably promote family resemblance sorting. Again, family resemblance sorting was almost never observed. Notably, however, subjects' accounts of their social stimuli sortings revealed two dominant strategies: to induce either contrasting evaluative categories or contrasting social stereotypes (e.g. 'loving housewife' versus 'working woman') from the trait sets. These strategies are interpretable as attempts to induce themes, theories or social-categorical identities from attribute distributions that might in turn 'explain' them.

A third two-part experiment, in which subjects were informed that the cartoon-like stimuli represented two groups of genetically related animals and in the second part identifying two specific stimuli (the best exemplars or prototypes in terms of most attributes shared within and least between categories) as "the best adapted top-dweller" and "the best adapted bottom-dweller", again failed to produce family resemblance sortings despite instruction to use all information. One-dimensional sortings justified in terms of the adaptive value of the dimension and sometimes in terms of the adaptive values of partially correlated dimensions were the norm. A fourth two-part experiment using trinary-valued dimensions (e.g. 4, 8 or 12 legs) in order to suppress one-dimensional sortings resulted in some sortings according to a family resemblance pattern but which were accounted for in terms inconsistent with a family resemblance strategy.

These results reinforce the view that family resemblance structures among independent attributes are not readily recognised and are insufficient to categorization. As Medin et al. (1987) argue, "it may be a mistake to look for family resemblance sorting in contexts where the component properties bear little or no conceptual relationships to each other" (p. 264). Whilst it was previously argued that category coherence is dependent upon the conceptual integrity of inter-attribute relations, observation of family resemblance structures in natural categories and that categorization on the basis of (sufficiently salient) attribute correlations results in high within- to between-category similarities are suggestive that the presence of family resemblance structures may nevertheless be involved in category coherence. Consequently, Medin's et al.'s (1987) fifth experiment tested sensitivity to attribute correlations as a basis for categorization and as an account of family resemblance pattern sortings.

Experiments one to four, in which attribute correlations were minimal, had resulted in a predominance of one-dimensional sortings suggesting adoption of 'easy' strategies. For two stimulus types - disease symptoms and animal attributes - they compared frequencies of sorting according to a one-dimensional strategy or according to two alternative sets of obviously correlated attributes, one for which there was not and one for which there was a readily available explanation (disease of the vestibular organ explains correlated dizziness and earache, and a general notion of adaptation explains correlated bright colour and poisonousness). One-dimensional sortings were least frequent (diseases, 4/38; animals, 2/24), indicating a preference for sorting according to correlated attributes, and of the two correlated attribute sets there was a strong preference

for sorting according to that set for which an explanation was readily available (explained:unexplained/total - diseases, 21:7/38; animals, 16:5/24). These results indicate that salient correlations among attributes are employed as a basis for categorization, that explanations are sought for correlated attribute structure and that attribute structures for which explanations can be found are preferred: i.e. correlated attribute structure is taken to indicate coherence but coherence derives largely from theories thought to account for it.

Experiments six and seven sought more directly to test the hypothesis that "salient inter-property relationships are a sufficient condition to induce family resemblance sorting" (p. 267). In experiment six the stimuli were women's names and associated trait descriptions in which the traits were known to be associated with either introversion or extraversion. Two conditions were run in each of two parts to the experiment: one in which the same eight trait terms were distributed around two prototypes factorially in sets of four among ten names and another in which closely related but not the same traits were used. The two parts of the experiment differed in that in the second the information was provided that the women were classifiable as introverts and extroverts. When this information was not provided, family resemblance sorting patterns were obtained from 25% of subjects in the factorial and 70% of subjects in the related trait conditions. Subjects' accounts of their sortings revealed that although few used the expressions introvert and extrovert they had sorted on the basis of related concepts (e.g. 'fun to be with' versus 'not the sort of person to take to a party') and had clearly attempted to induce categorical identities from the trait distributions. Provision of the introvert-extrovert concept increased family resemblance sortings in the factorial condition. Curiously, the factorial- to related-trait discrepancy is not explained. It is possible that usage of the same specific trait terms for members of alternative categories served to focus attention on a rather difficult analytic summation process whereas in the related-trait condition subjects had the freedom to be more liberal in interpreting traits as consistent with their working hypotheses. If this is so then it appears that computation of within- to between-category similarities among determinate attributes varying along several dimensions is simply too difficult to be natural. Actually, Medin et al. (1987) recognise this, assuming that detection of linear separability, to the extent that it occurs, is a global judgment process (e.g. they argue that more rather than less dimensions and the addition of unique exemplar variations on attributes should promote family resemblance sorting) resulting in family resemblance sorting effects rather than an analytic family resemblance sorting process. By the same token, detection of other than perfect correlations among attributes in experimental stimulus arrays - as employed by Medin et al. in experiment five - may also be too difficult to be natural (or be too confusing for coherence).

Experiment seven basically reproduced the results of experiment six with different stimulus materials. Attributes of cartoon-like animals were selected that could be linked both to each other and to the higher order property of flying ability, this property being made salient in the instructions. Although the majority of sortings were unidimensional (14/24) a substantial proportion fitted a family resemblance pattern (9/24). For sortings of both types, subjects' rationales were in terms of attributional adaptability to flying and some subjects

who had sorted into family resemblance categories described having picked out the best examples of flyers and non-flyers and categorizing by (dis)similarity of exemplars to these prototypes, exemplifying a true family resemblance sorting strategy. These results lend substantial support to the conclusion that when interattribute relations constitute a basis upon which higher order identities (themes or theories) can be induced or such identities are available to suggest the presence of interattribute relations global family resemblance sorting strategies may be natural. However, even given a higher order identity suggesting relations among attributes, imperfection of correlations among determinate attributes may be confusing and counter the tendency to family resemblance sorting which, alternatively, may be facilitated if attributes are sufficiently indeterminate as to be reinterpretable as consistent with working hypotheses.

A conclusion emerging from this analysis is that the identities of categories are not captured by determinate lists of determinate attributes nor even by determinate descriptions of attributional structures but involve theorylike (inferential - deductive) understandings of why certain attributes and relations among them are manifested or possessed by category exemplars. Nevertheless, none of the arguments to this conclusion has ruled out that similarity judgments have a role to play in categorization processes. Medin and Ortony (1987) develop these ideas in their discussion of 'psychological essentialism'. In the work already described, Medin and his associates have repeatedly emphasized the importance to category coherence of relations among attributes and the mutual inferential-deductive relations among theories, attributes and interattribute relations. In the discussion of psychological essentialism, Medin and Ortony propose a continuum of levels of centrality or deepness among attributes in which inferential-deductive relations apply between more central/deep and more peripheral/surface attributes. They initially introduce this distinction as between "the sorts of things people describe when asked to list properties of objects and ... psychologists have tried to use as the building blocks of concepts ... typically, so called perceptual properties" (p. 180) - such attributes as might, for example, lead to categorization of whales with fish - and the sorts of things people learn about and perhaps believe experts understand ("less accessible conceptual material" (p. 180)) - such as leads, for example, to categorization of whales with bears. Conceiving of interattribute relations as previously described as relations among attributes at the same level and of relations between central and peripheral attributes as relations between attributes at different levels, they argue that category coherence depends upon both: "properties associated with a concept are linked both between and withi n levels to produce coherence" (p .182). In parallel with the previously suggested iterative 'inference-deduction-validation cycle' model for categorization processes, Medin and Ortony claim that, "the link between surface and deep properties serves two functions: It enables surface similarity to serve as a good heuristic for where to look for deeper properties, and it functions as a constraint on the predicates that compose our mental representations" (p. 182). However, the introduction of central/conceptual attributes into category representations fails to fully capture what Medin and Ortony claim people take to be the 'essences' of concepts.

In framing their argument they take some pains to make two related distinctions: they distinguish between metaphysical essentialism, which they agree with philosophers is untenable on the grounds that "what a thing is is not independent of how it is described" (p. 183), and psychological essentialism which describes that "people find it natural to assume that concepts have essences" (p. 184); and they distinguish between properties that objects may inherently possess (metaphysical properties) and the attributes they are judged to possess by virtue of human percepts, concepts or representations of them (psychological or represented attributes). Whereas the function of the former distinction appears to be to divert an unlikely philosophical criticism of a psychological thesis, the second places constraints on attributes available to participate in similarity judgments ("By restricting ourselves to represented predicates we can restrict the predicates that contribute to the determination of similarity" (p. 182)) and allows similarity judgments to participate in categorization processes with inter-individually and contextually variable outcomes through variation in category representations (how a thing is 'described' or what it is perceived as).

Medin and Ortony (1987) present three lines of evidence that "people assume, or act as though, concepts have essences" (p. 184). They point out that it is in the nature of scientific enquiry to try to "get at the 'underlying reality' of phenomena rather than merely describing their observable properties" (p. 184) and offer the development of Linnaeun taxonomy as an example. Lakoff (1987) also uses this example in a different context and points out that psychological criteria corresponding to the those that characterise the basic level in folk biology were inherent in Linnaeus' approach to biological classification and that it is therefore no surprise that folk and Linnaeun taxonomies often correspond, in particular in the primacy they mutually accord to the genus as somehow getting close to the 'essential character' of things (pp. 34-36). McCauley (1987), also drawing a parallel between the naive and scientific theories in terms of which reality is apprehended, states that "the history of science is replete with examples of theoretical advances superceding what was, theretofore, perceptually obvious ... [and that] ... New theories (in science) and newly aquired theories (in development) enable us to see ('beyond the appearances') more and more ... [and] ... show anew what it is that we should look for" (pp. 306-307). He also points out that theoretical advance - presumably based upon the assumption that there is a reality (if not an essence) beyond the appearances - is legitimately involved in category re-definition, re-emphasising inferential-deductive theory-data interdependencies.

Beyond this analogy between naive and formal scientific processes, Medin and Ortony (1987) refer to experimental results by Rips (1987) that subjects were unwilling to change their classifications despite transformations in the superficial properties of objects that made them more similar in these terms to exemplars of alternative categories. As Medin and Ortony state, "subjects were behaving as though they believed that category membership depended upon the possession of some 'hidden' properties of which observable properties are but typical signs" (p. 184). Whilst it could be argued that subjects already knew the categorical identity of Rips' objects and weren't about to be fooled by disguises, the point remains that people assume that it is credible for categorical identities to be somewhat independent of (superficial) attributional manifestations.

The third line of evidence to psychological essences are the conclusions drawn form the Medin, Wattenmaker and Hampson (1987) results, already described, that in the absence of themes, theories or notions of categorical identity, categories constructed only in terms of family resemblances among attributes may not be psychologically coherent. Indeed, those results constitute evidence that the availability of higher order categorical identity concepts may be necessary for coherence and that subjects attempt to induce such concepts from attributional structures. Moreover, it seems reasonably clear, from evidence that certain patterns of determinate-attribute-sharing across potential categories may inhibit the 'success' of the categorization process, that subjects attempted to establish consistency, at least in part in terms of similarity judgments, between structures among manifest attributes and expectations generated from categorical identity concepts.

The distinction between central and peripheral attributes bears comparison with the distinction between conceptual cores and attributes used in identification procedures (e.g. Miller & Johnson-Laird, 1976; Osherson & Smith, 1981). Miller and Johnson-Laird and Osherson and Smith had attempted to rescue the classical view of categorization from evidence marshalled for probabilistic prototype theory by suggesting that concepts have definitional cores - explicating their relations with other concepts - but that the evidence against the classical view is structured in terms of attributes that may be used in somewhat fallible category identification procedures. Whilst Medin and Ortony (1987) accept that it is possible that central attributes may sometimes amount, as necessary and sufficient conditions, to definitional category cores, they hold that this is not always so, proposing an 'essence placeholder' that may be superordinate to central attributes and be filled with "a more complex and possibly more inchoate 'theory' of what makes the thing the thing that it is" (p. 184). On this account, both necessary and sufficient conditions and central attributes may be considered to be consequences of rather than themselves to constitute the essential natures of things.

Whereas the core/identification distinction is conceived of as discrete the central/peripheral distinction is conceived of as describing the poles of a continuum, raising the prospect of graded structures among attributes analogous to graded structures among exemplars. Be this as it may, Medin and Ortony (1987) propose similar relations between identity concepts (psychological essences) and more central attributes as between more central and more peripheral attributes. They conceive of theories as imposing constraints, from weak to strong and causal, upon attributes (and relations among them): identity concepts are more closely associated with or have more direct inferential-deductive relations with the more central attributes and theories about more central attributes support inferential-deductive relations between these and more peripheral attributes: "the linkages between surface and deep properties are a function of the theories we have about the deep ones" (p. 186).

The view emerging here may be understood as of categorical and similarity judgments being generated from a concept space pervaded by inferential-deductive relations, extending vertically to represent an hierarchy of concepts in terms of levels of explanation and horizontally to include alternative and related concepts, perhaps in several dimensions corresponding to ways in which they

may be distinguished or related. A superordinate concept supports an understanding of the domain occupied by a particular identity concept and its alternatives or relatives and supplies the grounds upon which it is meaningful to compare, contrast and relate them. At the next explanatory level, identity concepts refer to entities or essences and include an understanding of their individual separateness and mutual interrelations. At the next explanatory level, attributes and relations among them are identified as essential, central or important, in the sense of being implied by, accounting for or consistent with, the separateness and relatedness of the entities or essences referred to by identity concepts. At the next explanatory level, more peripheral attributes and relations among them are identified as implied by, accounting for or consistent with more central attributes and their interrelations. Although in some domains one of these levels may be basic in Rosch's sense, in general, they should be understood in relation to each other, as superordinate or subordinate to the level of identity concepts corresponding to the alternative categories into which exemplars may be assigned in specific categorical judgments. Categorical schemes should not be considered to be pre-determined or fixed but to be generated from available world knowledge for contextually appropriate purposes. In general, they may be initiated at and elaborated from any point, elaboration proceeding until coherence is attained.

This model incorporates the understandings that categorization and its effects may in each or any instance involve vertical (inferential-deductive) and horizontal (relative) relations in an entire domain, and that changes in any part may be reflected throughout; and is consistent with and indeed predicts contextual variation in categorical judgments following contextually appropriate variation in the content of categorical schemes.

The features of categorical schemes are summarised in Table 2.1.

Table 2.1: Features of categorical schemes

Conceptual level	Description	Relations between levels	Relations within levels
Superordinate (domain) concepts	Higher level concepts (i.e. higher order identities) that include together (as equivalent at this level) a particular identity concept (corresponding to the target category) and its alternatives and relatives.	Identify the alternatives and relatives of an identity concept and supply the grounds upon which it is meaningful to compare, contrast and relate them.	In any instance of categorization there need only be one superordinate concept. However, it is possible to generate alternatives to and relatives of domain concepts. This implies a further concept at a meta level supplying the grounds for their distinctions and relations.

Identity concepts	Concepts at the level of the target category that refer to the 'essential' natures shared among category exemplars.	A set of contrasting and related concepts supplies the grounds for induction of a superordinate concept, i.e. a concept which serves to classify contrasting and related identity concepts as equivalent at the superordinate level. Notions of essential natures or identities and relations among them have implications for sets of attributes and relations among them that are central to or important in accounting for the distinctions and relations among concepts at the identity level.	Identities are distinct, contrasted and related, i.e. any particular identity may be contrasted with others or participate in certain relations with them.
Central attribute concepts	Attributes considered important or necessary to category membership.	Relations among sets of attributes may be taken to imply entities or essences of which these attributes and their relations are manifestations. These structured sets of attributes are consistent with the distinctions and relations among the identities of which they are indicators. Central attribute structures have implications for more peripheral attributes and relations among them.	Although, rarely, simple possession or non-possession of certain sets of attributes may serve to indicate (and to be implied by) identities, generally it is relations among attributes that are taken to imply identities and are expected of entities to manifest.
Peripheral attribute concepts	Attributes associated with central attributes.	Sets of peripheral attributes and relations among them may serve as heuristics to more central attributes and relations among them.	As with central attributes, peripheral attributes may be, and may typically be, related.

Further evidence for the model and for its applicability to both categorical and similarity judgments may be gleaned from a reading of the Medin, Goldstone and Gentner (1993) paper, 'Respects for similarity'. They base development of their argument on observation of the tension between, on the positive side for similarity, the centrality of similarity as an explanatory construct in wide variety of psychological theories and the empirical (predictive) success of representations (e.g. multidimensional scaling solutions) based on similarity judgments, and, on the negative side, arguments that similarity is vacuous as an explanatory construct. Goodman (1976) had persuasively argued that the similarity between two objects is ill-defined and meaningless unless the 'respects' in which the objects are seen to be similar are specified. Medin et al.

concur, arguing that the meaning of a similarity judgment "is conveyed by the specific respects, not the general notion of similarity" (p. 254). This is in accordance with conclusions already reached in the present chapter: for example, that if similarity is to play an explanatory role in accounting for category coherence, it is necessary to provide a prior or simultaneous account of the processes involved in "selecting, weighting, relating, deriving, inferring and re-defining" the attributes in terms of which similarity judgments can themselves be expanded or explicated. A. Tversky (1977), in presenting his 'weighted common and distinctive features' model of similarity judgments, had pointed out that "the representation of an object as a collection of features is viewed as a product of a prior process of extraction and compilation" (pp. 329-30). And, in previous work, Medin and his colleagues had reached conclusions that, in categorization, similarity "is more like a dependent than an independent variable ... (, that) ... the explanatory work is on the level of determining which attributes will be selected with similarity being at least as much a consequence as a cause of conceptual coherence" (Murphy & Medin, 1985, p. 296), and that "entities may seem to be similar precisely because they are members of the same category" (Medin & Wattenmaker, 1987, p. 26).

What Medin and his colleagues are in part opposing in these statements are attempts to use similarity as 'ground' for other cognitive processes (such as categorization) which they see as frequently associated with a view of similarity as simple perceptual similarity. Against this they argue that "to claim that similarity is hard-wired and perceptual is to draw an ill-advised sharp distinction between cognitive and perceptual processes" (p. 256) and that "The reason to restrict similarity to purely perceptual aspects is to firmly ground *it*, but the cost of this restriction is a drastic reduction in similarity's dominion and, consquently, its explanatory power" (p. 256; emphasis added). The attempt to ground similarity in hard-wired perceptual processes and thence to ground other cognitive processes in similarity is reminiscent of the fruitless search for pre-cognitive sense data as epistemic grounds.

Medin et al. (1993) proceed to document evidence that similarity judgments are variable, changing, for example, with presentation time, maturation, knowledge and expertise - further undermining them as the ultimate grounds of other cognitive processes - but at the same time arguing that such variability is systematic and orderly, and that "similarity is not vacuously flexible as long as systematic changes in the process of determining similarity can be established" (p. 257). They report that Barsalou (1982) has demonstrated that similarity judgments vary with specification of context (e.g. specifying the context 'pets' for sets of animal names) and point to the role of context in activating or making salient the context-specific attributes over which similarity judgments are made; they report evidence that "children know that, in the context of a noun, shape is likely to be the relevant aspect of similarity" (p. 257); and that "when cues indicate that a comparison involves an analogy, people realise that relational structure will be the relevant aspect of similarity" (p. 257). Against this background, they argue that "as long as similarity structures are linked to corresponding processing principles that address changes with presentation time, experience, and context, one retains a reasonably coherent notion of similarity"

(p. 258) and proceed to demonstrate important ways in which such processing principles serve to 'fix respects' for similarity judgments.

Prior to discussion of the evidence they present, it is useful at this point to briefly emphasise the mutual dependency of categorical and similarity judgments. Whilst the point is not to assume (or provide) an account of processes determining the attribute space over which similarity judgments may be made so as to ground categorization in similarity judgments - the role of theories and interattribute relations in categorization has already been well documented and the conclusion reached that "family resemblance (similarity) structures are not readily recognised and are insufficient to categorization" - it remains that family resemblance structures among category exemplars in terms of similarities among attributes *listed* for categories have been shown to be closely associated with, for example, representativeness gradients, boundary indeterminacy and the level (e.g. the basic level) of categorization. Moreover, linear separability in terms of relatively high within- to between-category family resemblances, whilst not, or not universally, the psychological basis of category separation, implies and is implied by categories corresponding to clusters among correlated attributes. The point is, however, to strongly suggest that the processes determining the attributional content of categorical judgments and those determining the attribute space over which similarity judgments are made are highly similar and that categorical and similarity judgments are mutually constrained by their dependency on common processes.

In further developing their argument, Medin et al. (1993) describe a number of features of similarity judgments that, although this emphasis is not their priority, may be seen to be shared with categorical judgments. The first of these is their common heuristic function. They point out that to reduce similarity judgments, as Goodman (1976) had argued that they necessarily reduce, to statements about specific attributes shared among objects, is to deprive similarity of its heuristic function: "one reason to say 'X and Y are similar' instead of 'X and Y are similar with respect to properties P_1, P_2 and so forth' is that one may wish to leave open the possibility that unknown properties are shared by X and Y. By making a non-specific similarity claim about X and Y, one explicily creates an expectation for new commonalities to be discovered" (pp. 258-259). Without labouring the point, it is an essential function of categorization to make inferences to the unobserved attributes of objects from the known attributes of other objects with which they are perceived to share categorical identity. Moreover, if similarity is conceived of in this way, both similarity and categorical judgments are dependendent on the perceived or presumed presence of an integrated set of (multiple) shared attributes and both may involve some possibly inchoate notion of underlying entitatitivity.

Both similarity and categorical judgments involve comparative processes and inherently amount to claims of "more than identity in certain respects" (p. 259). Medin et al. (1993) observe that similarity judgments differ according to the direction of the comparison, that certain types of similarity comparison are perceived to be anomalous - such perceived anomaly arising, they suggest, from the expectation that similarity statements are informative and that "comparisons seem to presuppose entities on the same level of abstractness" (p. 259) - and argue that "the processes associated with comparisons, such as directionality and

implicit understandings about informativeness ... are crucial to providing respects for similarity" (p. 259). There is ample evidence for directional effects also in categorization (for example, as earlier reported, Rosch and her colleagues found representativeness gradients among category exemplars to be associated with asymmetry of similarity ratings (see Mervis & Rosch, 1981)), and that categorization also distinguishes among entities at the same levels of abstractness.

Experiment 1, using artificial visual stimili in which stimuli B were compared with either stimuli A or C supports two important conclusions: (a) that attributes listed for an object depend upon what it is being compared with, even to the extent that separate comparisons with A and C can produce inconsistent descriptors of ambiguous B stimuli, and (b) that perceived differences among stimuli may be derivative of perceived similarities at a higher level of abstraction. They offer the example that "one might note that a red circle and an orange circle are both circles and describe the specific colors as differences" (p. 265). Whereas this example does not distinguish among levels of abstraction, the evidence they present in the experiment does. Specifically they observed that similarities relative to differences were far more frequently described in abstract metaphorical as opposed to specific attributional form, with the abstract metaphorical alignment of stimuli appearing to form the basis upon which specific differences were identified. Whilst the evidence for this latter conclusion is not so direct as that for the former, it is consistent with the above interpretation of the results of A. Tversky's (1977) experiments on the diagnosticity and extension effects and with conclusions drawn previously by Markman and Gentner (1991). If this conclusion is correct then it constitutes support for the hypothesis in the categorization process model that an implicit superordinate concept, aligning a set of entities for comparison and representing what they are being compared or related as, plays an important role in determining the attribute space over which similarity judgments are made or the attributional content of categorical judgments.

In experiment 2 subjects were asked to rate the similarity and describe the common features of a variety of A-B conceptual stimulus pairs (e.g. England, United States; Physics, Philosophy) under the two conditions, similarity of A (target) to B (base) or similarity of B (target) to A (base). Findings were that attributes listed as common to the two concepts differed as a function of the direction of the comparison and favoured attributes associated more closely with the base than the target concept. Beyond this particular evidence that "activated properties of one concept are evaluated with respect to the other and that activation is biased toward the base concept" (p. 266), this experiment provides further evidence that 'respects' for similarity judgments - the attribute space over which similarity judgments are made - "are fixed by the comparison process itself" (p. 267). These results are suggestive more generally that the attribute space over which similarity judgments are made or the attributional content of categorical judgments is dependent not only upon what particular entities or categories are involved but also on factors relating to the purpose of the comparison, in this case as represented in its direction.

Experiment three further explored the role of the comparison process in fixing respects for similarity judgments (i.e. in defining the attribute space over which

similarity judgments are made). Subjects made A (standard) - B (comparison) and A (standard) - C (comparison) judgments of similarity in contexts in which either (A and B) or (A and C) were presented separately (separate contexts) or in which A, B and C were presented together (combined context). The A and C stimuli were always members of the same category (e.g. black, red; skin, hair) whereas the B stimuli were either antonymically (e.g. white in a black, white, red set) or metaphorically (e.g. bark in a skin, bark, hair set) related, defining antonymic versus mataphoric conditions. The basic conjecture was that respects for pairwise comparisons would be derived from the entire set of salient entities, so that "when the ... similarity ratings are contextually separated, they can be based on different respects (but) ... when the pairs appear in the same context, there may be a tendency for the same pool of respects to be involved" (p. 267). Further conjectures were that, in separate context comparisons, antonymy may result in a focus on differences and metaphor may result in a focus on abstract shared features whereas, in combined context comparisons, for antonymy, attention may shift to respects shared among the set and, for metaphor, mismatching properties may be highlighted. Relative to categorical comparisons then, the combined condition should result in similarity ratings that are higher for antonymic comparisons and lower for metaphoric comparisons than the separate context condition. Both the antonymic versus categorical and mataphoric versus categorical (comparison type) by separate versus combined context (presentation type) interactions were found to be significant in the predicted directions, although this effect was found to be primarily due to presentation type variation in the perceived similarity of antonymic comparisons in the first case and in the perceived similarity of categorical comparisons in the second. Leaving these latter details aside for present purposes, these results reemphasize the dependency of similarity judgments on the attribute space made salient by the nature of the comparison process (the available contrasts and the nature of conceptual relations among entities) and are strongly suggestive that highly similar processes are involved in determining the attributional content of categorical judgments.

It was previously argued that "an account of category coherence in terms of similarity requires a prior or simultaneous account not only of how attributes are selected or identified but also of how they are weighted in integration to judgments of overall (dis)similarity among objects". Whereas, as a whole, the experiments just described demonstrate the dependency of attribute selection on the comparison process, Medin et al. (1993) report results from experiments by Goldstone, Medin and Gentner (1991) that demonstrate also that 'feature weighting is not independent of the outcome of the comparison process" (p. 268). In one of these experiments sets of visual stimuli were constructed to share similarities with and to differ systematically from standards, the similarities and differences being of two types: 'relational' (e.g. 'two figures with the same shape, all figures have the same shading') and 'attributional' (e.g. 'triangle, circle, shading'). Participants were asked which of pairs of alternative stimuli were more similar to the standards. Medin et al. report the results as follows: "If the choice stimuli are attributionally similar to the standard, then an extra attributional match has more weight than an extra relational match; if the alternatives are relationally similar, then an extra relational match, has more

weight than an extra attributional match" (p. 269). Another experiment of the same form but in which types of (dis)similarity were other than relational and attributional produced parallel results. Whilst this tendency to more heavily weight features that maximise the number of similarities of the predominant type - termed the 'max' effect - may be subject to alternative explanations, as Medin et al. argue, "it is clear that the weight given to a particular match depends upon other matches in the scene" (p. 269). Whether these effects demonstrated with simple, highly-structured visual stimuli varying in determinate ways apply also in judgments of similarities among conceptual objects for which representations are constructed from a broad knowledge base is unclear. However, people may be generally implicitly aware that certain types of similarity are more relevant than others to comparisons among particular objects in certain contexts. Whereas in conceptual domains this will depend upon the theories and knowledge brought to bear, with conceptual-association-poor visual stimuli it may well be assumed that a particular type of similarity is important even though no theory is available to account for or identify it. In the absence of such a theory the predominance of a certain type of similarity may well be taken to indicate its relevance.

Medin et al. (1993) identify the 'alignment process' – "the process by which entities associated with the object of comparison are put into correspondence" (p. 260) - as having a particularly important role to play in determining the attribute space over which similarity judgments are made. They illustrate this process with results from two studies by Markman and Gentner (1990, 1991). The first of these employed pairs of pictorial scenes showing highly perceptually similar objects (e.g. apparently the same woman) playing different roles (e.g. as recipient or maker of a food donation) so that, in 'mapping' one scene onto the other, "the most natural perceptual correspondences conflict with the relational correspondence" (p. 269). Subjects were asked to point to the object in one of the scenes that 'went with' the perceptually salient objec t identified by the experimenter in the other scene. Two groups of subjects performed this 'mapping' task: one group which performed only that task (control) and another which had previously been asked to judge the similarities of the paired scenes. Results were that the group which had made prior similarity judgments was "far more likely to map according to the relational structure" (p. 269; e.g. from recipient to recipient rather than from woman to woman) than was the control group. They conclude that "similarity judgments involve determining the best global alignment and are sensitive to relational structure" (p. 269). It is not difficult to identify this sort of alignment between scenes with the role of an higher order identity among categories distinguishable at a lower level of abstraction. That Medin et al. do so is clear from their inclusion at this point of the following quotation from Turner (1987, p. 46): "... stimuli can only be compared in so far as they have already been categorized as identical, alike or equivalent at some higher level of abstraction...".

In sum, although it is a mistake theoretically to ground categorical judgments in perceptual similarity, categorical and similarity judgments are functionally interrelated and dependent upon common processes. Both are inherently comparative among entities (categories/identities) and dependent in context upon purposive inferential-deductive processes operating in a broad knowledge

base. Identities are contextually aligned for comparison under a superordinate identity (category/concept) supplying the grounds on which it is meaningful to compare, contrast and relate them. Categorical identity is multivariate among attributes among which category coherence is dependent upon perception of theory-consistent structure. Structure among attributes implies and is implied by patterns of family resemblance (dis)similarity in terms of which categorical identities may be distinguished and intercategory relations accounted for.

Chapter 3

Categorization processes in self-categorization theory

Tajfel (1979), in defining the role that social psychology can play in describing and analysing social reality, argued that social psychology can ascertain 'the shared interpretations of social reality' held by group members, shared perceptions of intergroup relations and the perceived location of groups within the social system, and use this information to formulate testable hypotheses. However, subsequent development of the social identity tradition, including self-categorization theory (SCT) (Turner, 1985, 1987a, 1991; Oakes, Haslam & Turner, 1994), has focused more on examination of the nature and effects of identification and categorization processes than detailed examination of the contents of particular social perceptions and judgments. Where the latter have been employed, as manipulations or dependent variable measures in experiments to these ends, the emphasis has been on experimental structure rather than measurement of social category content. As this research has itself shown, such content is highly variable with the perceptual or judgmental context and hence not, without reification, as readily ascertainable as Tajfel may have anticipated. Yet, given the understandings of processes involved in contextual variation that the research has provided, it should now be possible to approach the study of social-perceptual content expecting and anticipating the nature of its contextual variation. The present discussion is predicated on the assumption that progress can be made in this direction by elaborating upon the principal propositions of SCT in ways that clarify the effects of context on selecting and modifying attributional content from a specified knowledge domain.

As Oakes, Haslam and Turner (1998) state, SCT "… is a general analysis of the functioning of categorization processes in social perception and interaction." (p. 76). Originally developed as an account of the social psychological basis of the group, the core principles of the SCT model of self- and other-categorization (Turner, 1985; Turner, 1987a) have proven to support successful accounts (sub-theories) of a wide variety of theoretically and socially important social psychological phenomena, including self- and other stereotyping (Oakes et al., 1994), social influence (Turner, 1987b, 1991), group cohesiveness (Hogg, 1987), co-operation and competition (Turner, 1987a) and group polarisation (Wetherell, 1987). The core principles referred to have much in common with the conclusions reached about categorization and similarity in the previous Chapter, sharing with them a basis in Rosch's revolutionary work. Indeed, many of the findings reported there were anticipated by Turner: his clear, early statements (Turner, 1985, 1987a) of the essentially hierarchical nature of categorization processes, of the mutual dependency of categorization and

comparison, and of the context-dependency of categorization being particular examples (see for example Medin, Goldstone & Gentner, 1993).
However, as subsequent discussion will illustrate, it is probably fair to say that although conceived of generally, the principles Turner derived from his reading of the cognitive psychology literature, being adapted by him for specifically social psychological purposes, are presented in his early statements in a form that tends to suppress recognition of their generality. A reader could, for example, easily gain the impression that SCT proposes three specific levels of (self-) categorization (see below) when it was always Turner's intention that an hierarchical process is involved in each and every categorization, between two or within any one of the three levels he describes. In a similar vein, in stating his principles so as to facilitate their development and test within a largely univariately-oriented experimental tradition, the essentially multivariate nature of categorization processes could easily be overlooked in Turner's work. In particular, the meta-contrast principle (see below) is stated and operationalised in terms of attributes ('dimensions') taken singly and perhaps sequentially.
In SCT research to date there has been relative neglect of examination of social category content in favour of experimental test of categorization processes (with which is associated a relative de-emphasis, empirically if not theoretically, of the mutual dependency of process and content in categorization; but see Oakes' (1987) account of category salience), and of a methodologically imposed univariate tone to theoretical principles. This chapter reviews the fundamental principles of the SCT model in order to lay the foundation for proposing and exemplifying an empirical methodology for social categorization research that both respects those principles and allows for examination of specific social categorical content in a way that represents its inherently multivariate nature. Whilst description of that methodology is the subject of Chapter Four, it might be stated at this point that it is only relatively recently that the data-analytical tools it requires, such as computer programs for multidimensional scaling and multi-mode principal component (or factor) analysis, have become widely available and established as reliable procedures.
SCT proposes that categories exist or form at different levels of abstraction related by means of class inclusion. Three levels of abstraction are identified for the purposes of exegesis: the superordinate level of self (or others) as human being(s), the intermediate intergroup (social identity) level, and the subordinate individual (personal identity) level. Categories at each level are defined in terms of attributes shared within categories in contrast to other categories at the same level: 'human being' categories are defined in contrast to other species categories, 'group' categories in contrast to other social groups, and 'persons', in contrast to other people (within the same group). The theory recognises a multitude of (existing and potential) levels both between and beyond these, and a multitude of (existing and potential) categories at each level ('across and within both cultures and individuals').
According to the theory, categories at any level tend to form and become salient through comparison of individuals defined as members of the next more inclusive (higher level) category. In general, the 'next more inclusive category' is the functional or active superordinate of the pair, set or family of categories identified, distinguished or cognitively functional in any particular

categorization but is rarely a category at the previously identified (superspecies) superordinate level. If, as the theory intends, the level of categorization is the level of the family of contextually functional categories (identities), then there are as many levels of functional superordinates as of categories and as many superordinates within levels as of families of categories at the next less inclusive functional level. Because, as subsequent discussion will demonstrate, functional superordinates play a crucial role in identifying, representing or defining the contextual frame of reference for categorization - including attribute selection and denotation - 'superordinate' will henceforth refer to contextually functional rather than to superspecies level categories.

In SCT the cognitive functional role of superordinates rests on the grounds that "... stimuli can only be compared in so far as they have already been categorized as identical, alike or equivalent at some higher level of abstraction ..." (Turner, 1987a, p. 46) or, in other words, "... being able to say that two things differ always implies that they share a higher level identity in terms of which the comparison is meaningful" (Oakes, et al., 1994, p. 99). Accordingly, "... comparison of different stimuli takes place on dimensions which define their higher level identity" (Turner, 1987a, p. 48) or "... definition of a higher order identity ... provides the dimensions for more finely grained comparisons..." (Oakes, et al., 1994, p. 99). Superordinate categories, then, are considered to provide the grounds for comparison among the families of categories nested under them.

In offering an example, Turner (1987a, p. 48) points to a principle of considerable importance to the cognitive functional role of superordinates. When he writes, "'Apples' and 'oranges' can be compared as 'fruit' in terms of being more or less 'sweet', 'nutritious', 'hard to grow' and so on (dimensions applicable to all 'fruit'), but less usefully as 'forms of life' (too abstract) and not at all as 'lemons', 'animals' or 'types of citrus fruit' (things which they are all not) ...", Turner clearly indicates that, to relevantly identify or define dimensions of judgment, superordinates need to be inclusive of and only of the contextually salient family of categories: overinclusive superordinates are insensitive to context and undermine the contextual relevance of judgments made under them. Indeed, it appears that maintenance of contextual relevance may be the essential cognitive function of superordination.

However, the class inclusion property of superordinates, even where it is appropriately minimal, is, without supplementation, inadequate to this function. Whilst superordinates are indeed inclusive of families of identities and their exemplars, in categorization, this is not a simple but a meaningful or 'loaded' inclusiveness. The cognitive function of superordinates is to identify or represent the quality and quantity (content and extent) of the contextual frame of reference: i.e., the contextually relevant dimensions of comparison among cognitively present categories (identities) or individuals representing them and the ranges or scales of their (co-) variation. In this sense, a superordinate is the immediate cognitive product of or basis for the alignment of entities for comparison, holding the contextually relevant 'pool of respects' and ranges of values in terms of which comparison is made.

This latter point, of the role of superordinates in establishing or representing contextual ranges of attribute (co-) variation or, more generally, contextually

defined attribute meaning, is inherent in Rosch's (1978; Chapter 2) retrospective evaluation of her results: "… some attributes such as large for the object 'piano' seemed to have meaning only in relation to categorization in terms of a superordinate category - piano is large for furniture but small for other kinds of objects such as buildings" (p. 41).

Nominally closely related superordinates may have quite different implications for the families of categories identifiable under them, assignment of categorical identities to individuals and perceived (dis)similarities among categories and individuals. The related superordinates 'health workers' and 'health professionals' evoke different sets of occupations (are enrolled nurses health professionals?), different dimensions of comparison among them (are professionals evaluated in the same terms as workers?) and different ranges of variation on those dimensions (is the range of 'responsibility' or of 'autonomy' extended downwards if workers are included with professionals?).

However, class inclusion and specific denotation of the 'as what?' in categorization are not the only relationships among category levels (superordinates and identities): as the research reported in Chapter 2 attests, inferential-deductive relations are also present. It may be relatively rare for categorization to occur for purely descriptive purposes, for none other than its own sake: it is likely often embedded in more broadly directed cognition, in which categorization is an inherent component of an account of something else in the service of more broadly conceived perceiver purposes (needs, desires, goals, motives). Perhaps the most important accounts in which categorization processes are embedded are those that involve attempts to understand or anticipate category behaviour (i.e., the behaviour of individuals as exemplars of categories) and, in the social realm in particular, understanding or anticipating intercategory behaviour, or intercategory *structural* relations. Superordinates, then, will vary with intercategory structural relations as currently known, expected under the circumstances, or as desired to anticipate. This is inherently related to the distribution of attributes among and within categories. The argument here is that: (a) the distribution of attributes among categories, describing their *comparative* relations (relative similarities and differences), inferentially accounts for their structural relations; and (b) the distributions of attributes within categories (which attributes and how they are inter-related) inferentially account for their capacity to behave coherently and consistently (i.e., their entitativity, essence or core identity; see the report in Chapter 2 of the research by Medin, Wattenmaker & Hampson (1987) and Medin & Ortony (1987); see also Campbell (1958); McGarty, Haslam, Hutchinson & Grace (1995)).

The points made here about relationships among levels in the categorization process clearly indicate, in line with the work of Medin, that categorization creatively draws upon a rich and elaborately structured cognitive resource of world knowledge and naive theory. As Barsalou (1987) exemplifies (and SCT endorses; see, e.g., Turner & Onorato, in press), it is not credible to maintain that categories (identities or superordinates) are pre-stored, available to appropriately 'fit' a potentially infinite variety of contexts. He demonstrates that people have no problem in specifying content for completely novel categories (e.g., 'ways to avoid being killed by the Mafia') and argues that even nominally

identical categories may never invoke precisely the same content from one instantiation to the next. Clearly, a vast and subtle body of world knowledge is implicated, for example, in distinguishing among closely related categories ('health workers' and 'health professionals') or in associating categories with attributional content (and the contextually relevant extent of its variation); and naive theoretical (inferential-deductive) processes are implicated in deriving expectations about among-category behaviour and within-category coherence from the distribution of attributes among and within categories (or vice-versa), or in deriving expectations about the behaviour of categories under varying circumstances. The point is not, however, that (longer-term) knowledge does not include categories, their potential behavioural manifestations and understandings about the attribute structures that underlie them for, as Rosch (1978, pp. 41-2) pointed out, "… it appeared that analysis of objects into attributes was a rather sophisticated activity that our subjects (and indeed a system of cultural knowledge) might be considered to be able to impose only *after* the development of a system of categories." Rather, the point is that flexible, purposive, context-sensitive, functionally adaptive categorization is dependent on reference to but is not merely reproduction of categorical knowledge. Categories are pre-stored and are available as a basis upon which categorical schemes are constructed to fit contextual reality but they are not generally rigidly-imposed upon it. Whilst a system of categories is a theory about the structure of reality, reality and its categorization are dynamic and functionally interrelated: adaptation as individuals, groups and species depends on it.

What is required theoretically is an account of how perceiver purposes, knowledge and naive theories, and current (contextual) reality interact to invoke and construct a categorical scheme – an integrated cognitive structure including a superordinate, a family of identities and distributions of exemplars and attributes among them. Oakes (1987), recognizing that "… an under standing of the determinants of salience is obviously central to the development and heuristic value of the self-categorization theory" (p. 117), provided the core model, which if now more richly elaborated (see Turner & Onorato, in press), has remained fundamentally intact.

Oakes built her account on a review of past research on social group membership salience (over forty years from a 1947 paper by Festinger) and on a critique of the dominant account of social category salience available at the time of her writing: "… that where a cue to a category membership constitutes a novel stimulus [numerical infrequency, or other attention-grabbing stimulus property] it automatically attracts attention making the relevant membership salient" (p. 122). Pointing to a lack of theoretical integration among the former, she argues that the principal lesson to be learned from this research is that the various manipulations employed appear to affect salience through establishing the "separateness and clarity" (cf. Rosch, 1978) of the relevant categorization. She argues against the novel stimulus cue ('distinctiveness') hypothesis on both empirical (Oakes & Turner, 1986) and metatheoretical grounds: that to propose "distinctiveness bias" as the mechanism determining the sa lience of group memberships is to deny the "validity and adaptiveness of the perception of group behaviour" and to represent it as "the product of a capricious perceptual

bias rather than functionally related to the realities of social context, individuals' behaviour within that context and the current goals and motives of the perceiver" (Oakes,1987, p. 125).

Taking the lesson that the salience of a categorization is related to its separateness and clarity (cf. Rosch, 1978), Oakes turns to more basic theory on perception (Bruner, 1957) and social perception (Heider, 1958) to found an account of category salience that is consistent with an understanding of categorization as providing functionally adaptive, contextually appropriate, 'veridical' representation.

The ideas of Rosch (1978), Bruner (1957) and Heider (1958) converge in respect of the adaptive functionality they accord to categorization and, more generally, to perception. As described in Chapter 2, in her work on basic-level categorization, Rosch was concerned to oppose the idea that natural category systems are merely optional or arbitrary with the idea that they more or less accurately model the structure of the natural world. Categorization for Bruner and attribution for Heider are fundamental, inalienable aspects of perception and grounds for the meanings of percepts. Both conceive of perception as reference of unique, potentially infinite surface events to underlying invariances - categories for Bruner and dispositional properties for Heider. According to Bruner, "all perceptual experience is necessarily the end product of a categorization process" and "whatever is perceived …achieves its meaning from a class of percepts with which it is grouped" (p. 124). Similarly, according to Heider, "Whe never you cognize your environment you will find attribution occurring." (Harvey, Ickes & Kidd, 1976, p. 18) and "the invariances of the environment …give meaning to what [man] experiences and it is these meanings that are …precipitated as the reality o f the environment to which he then reacts" (Heider, 1958, p. 81).

Bruner's (1957) hypothesis that "…the 'capture' of a stimulus by a category depends on an interaction between the relative 'accessibility' of that category within the perceiver's repertoir and the 'fit' between input and stored category specifications" (Oakes, 1987, p. 127) forms the central structure of Oakes' account. Accessibility refers to the 'readiness' of a category to be activated: more accessible categories are more readily invoked and are perceived as consistent with a wider range of attributes than relatively less accessible categories. The contextual accessibility of categories is the outcome of a selective process depending, according to Bruner, on the perceiver's present purposes (needs, desires, goals, motives) and expectations (knowledge) about the objects and events likely to occur in the given environment (for further discussion of factors affecting accessibility see Oakes, 1987). Whilst the perceiver is thus contextually appropriately primed with potentially useful and relevant categories, the salience of a category is nevertheless conditional upon its specifications being fit by observed stimulus characteristics.

Going beyond Bruner, Oakes distinguishes two distinct but jointly necessary components of social category fit: *structural fit* refers in the simplest sense to correspondence ((bi- or multi- serial) 'correlation') of perceived similarities and differences among psychologically present individuals to their division into categories; and *normative fit* refers to correspondence ('consistency') of the specific content (attribute values) of perceived within-category similarity to the

perceiver's beliefs (stereotypes) about the nature of the nominal categories and thus, that the perceived between-category differences are in the stereotypically expected direction. Structural fit is akin to Rosch's (e.g., Rosch, 1978) 'separateness and clarity' principle whilst normative fit is closer to Bruner's original fit concept. Compactly stated, "Given equal accessibility, that categorization which maximizes the normatively consistent correlation between the observed similarities and differences and category memberships will become salient." (Oakes, 1987, p. 132).

Among the three components of the model, structural fit and the function it serves to tie categorization to observed behaviour (considered as manifesting underlying attributes) in the immediate cognitive context has received by far the greater portion of attention in SCT research. It is fundamental principle of SCT, from which the success of its accounts of a number of social psychological phenomena flows, that "..categorizing is inherently comparative and hence intrinsically variable, fluid and relative to a frame of reference" (Turner, Oakes, Haslam & McGarty, 1994, p. 8). In other words and more generally, application of a categorical scheme (a family of identities) to interpretation or anticipation of behaviour, assignment of individuals to categories (identities to individuals) and judgments of relative similarity in terms of the distribution of attributes among individuals and categories are aspects of a unitary process that is always dependent upon the context of judgment and the contextually defined frame of reference.

According to SCT, judgments of relative similarity follow the principle of meta-contrast which states that "..a collection of stimuli is more likely to be categorized as an entity (a higher order unit) to the degree that the average differences perceived between them are less than the average differences perceived between them and the remaining stimuli which comprise the frame of reference." (Turner et al., 1994, p. 6). In these terms, the principle describes the "emergence of a focal category against a contrasting background" (p. 6) or, stated in the form, "..any collection of people will tend to be categorized into distinct groups to the degree that average intragroup differences are less than average intergroup differences within the relevant comparative context" (p. 6), it describes the salience of a dichotomous (or, more generally, of a polytomous) classification. It is important to emphasise that, dependent upon the extent of the frame of reference, attribute values perceived as relatively similar and taken as describing a collective identity in one context may be perceived as relatively dissimilar and taken as consistent with a categorical distinction in another.

SCT offers both general descriptive and exprimentally-operationalised examples of the dependency of relative similarity judgment and categorization on the "contrasts available within the salient stimulus field" (Oakes et al., 1998, p. 76). Oakes et al., (1998) employ the following example in reference to Figure 3.1.

Meta-contrast predicts that we would categorize and perceive a given piece of vegetation as, say, a 'tree' (rather than as 'vegetation') to the extent that, in the current comparative context, the differences between trees (oaks, birches, etc.) are perceived to be less than the differences between 'trees' and 'shrubs' – the distinction between trees and shrubs is more marked, and more relevant, than are the features that trees and shrubs share as 'vegetation'. Alternatively, the tree

might be categorized and perceived simply as 'vegetation' to the extent that differences between types of vegetation (trees, shrubs, etc.) are seen to be less than the differences between vegetation and, say, animals. The salient categorization will be 'oak' when perceived difference between individual oak trees are less than the differences between oaks and birches (or some other comparison species).
(Oakes et al., 1998, pp. 76).

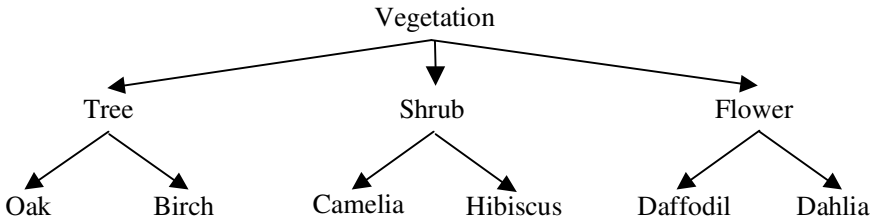


Figure 3.1: A categorical hierarchy of vegetation (from Oakes et al., 1998, p. 76)

This example achieves its purpose well in illustrating the mutual dependency in context of relative similarity judgments and the salience of linked identities and superordinates. It also serves as a focus for a number of pertinent comments: (a) the plausibility of the example depends on the intuitive understanding that there are many respects in terms of which the categories it nominates might be described and distinguished; (b) employment of the phrase 'more relevant' suggests that to the extent that the respects in terms of which comparison is made are selected according to perceiver purposes, those purposes impact on judgments of relative similarity, the fit of accessible categories and ultimately the level and content of the categorical scheme invoked; (c) the accessibility to readers of the taxonomic scheme presented and its usefulness as an example in the absence of elaboration in terms of attributes indicates that construction of contextually appropriate categories draws on a knowledge base that includes elemental categorical schemes (families of nominal identities under superordinates) that are elaborated in appropriate detail not in the abstract but in context; and (d) although relative similarity judgment may in the first instance be in terms of one or a few contextually relevant and manifest attributes, the coherence of the categories invoked is dependent on the understanding that members of each may manifest many functionally interrelated attributes.

The meta-contrast principle is operationalised in SCT research as the meta-contrast ratio (MCR), calculated on the values of to-be-judged stimuli on some attribute represented as their positions on a multi-point interval scale. Taking the labels and limits of the presented scale to represent respectively the content and extent of the contextual frame of reference, two formulations of the MCR follow the (above) alternative descriptions of the meta-contrast principle:

MCR for emergence of focal category against background

$$\text{MCR} = \frac{\text{mean within-category difference}}{\text{mean difference between within-category stimuli and others}}$$

MCR for dichotomous categorization

$$\text{MCR} = \frac{\text{mean within-category difference}}{\text{mean between-category difference}}$$

The MCR has also been calculated of a target (T) for a stereotyper (S) in order to predict T's assimilation to or contrast from the stereotyper's categorical identity (e.g. Haslam & Turner, 1992). In the example below (from Haslam & Turner, 1992, p. 8), the value of the MCR, calculated as the mean difference between T and the o's divided by the difference between T and S, is .61, which being less than unity, predicts that S will contrast T away from his or her relatively left-wing political identity:

Left wing	o	o	S	o	o	o	o	o	T	o	o	Right wing
	-5	-4	-3	-2	-1	0	1	2	3	4	5	

The theoretical functions served by the meta-contrast principle in SCT are essentially those served by the family resemblance similarity principle in the work of Rosch and her colleagues: to account for both between- and within-category structure (category inclusiveness and relative exemplar prototypicality; see Chapter 2). SCT and Rosch's ideas are also parallel in emphasising the mutual dependency of between- and within-category structure. Despite these parallels, however, there are important differences between the theories in conception, operationalisation and application.

Between-category structure has two aspects: the level and limit (boundaries) of category inclusiveness. As Rosch identified the basic level of categorization as that at which numbers of attributes shared within compared to between categories is maximised (Mervis & Rosch, 1981), SCT predicts the salient level of categorization to be that at which meta-contrast is maximised on relevant dimensions ("…categor ies form so as to ensure that the differences between them are larger than the differences within them …"(Turner & Onorato, in press, p. 18)); and as boundary indeterminacy may be understood in Rosch's scheme as arising from sharing of similar numbers of attributes within and between categories, it may be understood in SCT as occurring around near unity-valued meta-contrast ratios.

'Within-category structure' refers to the relative prototypicality of exemplars, accounted for by Rosch in terms of relative numbers of attributes shared among exemplars within- compared to between- categories (exemplars sharing more attributes within and less between categories are more prototypical; Rosch & Mervis, 1975), and accounted for in SCT in terms of relative mean within- compared to between-category differences on relevant dimensions (exemplars with smaller mean differences within- and larger mean differences between-categories are more prototypical (Oakes et al., 1998)).

An obvious conceptual difference between the theories is that whilst Rosch's work refers to multiple-simultaneous (often presumably binary-valued) attributes, SCT frames its argument in terms of a few relevant interval-scaled dimensions (presumably taken one at a time). When considered in conjunction with the observations made in Chapter 2 that: (a) correlations among attributes are inherent in family resemblance structures (e.g., Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976), (b) correlated attributes are sought as a basis

for categorization (e.g., Medin & Wattenmaker, 1987) and that (c) category coherence appears to dependent upon the conjunction of conceptually (in terms of themes or theories) and perceptually interrelated sets of attributes (observed correlations / family resemblances; e.g., Medin, Wattenmaker & Hampson, 1987), an account of how entitative, coherent, explanatory categories are identified or selected, or constructed or re-defined on the basis of observed single-dimension meta-contrasts is clearly indicated.

One suggestion is that in most situations there are likely to be more cues to the appropriateness or relevance of a categorical scheme than relatively high meta-contrast on manifest attribute values and that a categorical hypothesis generated from a variety of cues may be as much confirmed as induced on the basis of perceived meta-contrast. That this may often be so follows from (a) the functional identity between meta-contrast in SCT and family resemblance in Rosch's work, and (b) the implication of the Medin and Watenmaker (1987) and Medin et al. (1987) research on the role of family resemblance structures and linear separability reported in Chapter 2, that "…conviction that sets of attributes or correlations among them are a correct basis for categorization might follow or co-occur with rather than determine formation of categories with high within- relative to between- family resemblance similarity". Further pertinent comments were made in that section of Chapter 2 that need not be repeated here but by way of summary, an important idea to emerge from the analysis of categorization to this point is that it may be a mistake to attempt to ground the process in any one of its aspects (including detection of meta-contrast, family resemblance or linear separability) and that what is more important is, wherever the process begins in any instance, the contextual salience of a categorical scheme will depend upon the integrity or coherence of the entire structure, its functionality in context, its consistency with perceivers' more general knowledge and naïve theory (in terms of which it is contextually elaborated), and a sense of the entitativity, essence or generative capacity of the categories it includes.

These ideas seek to elaborate Oakes' (1987) account of category salience (including Turner's MCR operationalisation of the separateness and clarity principle) and to emphasise two things in particular: the requirements for contextual salience of a categorical scheme of (a) the conceptual integrity or coherence of the entire structure and (b) a sense of the entitativity, essence or generative capacity of the categories it includes.

Assignment of categorical identity to individuals serves two primary functions: to account for their observed or manifest behaviour and to provide a basis for generation of expectations about their as yet unobserved behaviour. In order to serve these functions categories must be conceived of as influential in generating members' actions or, in factor-analytic language, as latent variables. Oakes was well aware of this in identifying categorization and attribution as aspects of the same process of referring "potentially infinite surface events to underlying invariances" (Oakes, 1987, p. 132) and was able to demonstrate experimentally (Oakes & Turner, 1986) that (salient) social category memberships are perceived as both internal to persons and explanatory of their actions. This notion of social category generativity may imply notions of underlying entitativity and essentiality (cf. Medin & Ortony, 1987) and, it is suggested, is associated, in any

instance, with expectations about the nature of relations among manifest attributes (their coherence), providing grounds both for inference from one or some to others and for normative consistency judgments in respect of attributes not previously associated with a category, such as may arise from the conjunction of categories and novel contexts (see the discussion of normative consistency in Chapter 2). At least, if a categorical hypothesis might be invoked or confirmed on the basis of a single observed meta-contrast, expectation-generation from categorical identification implies the presence in the categorical scheme of a multivariate distribution of attributes among categories: natural categories imply and may be implied by coherently interrelated *sets* of attributes.

One important aspect of contextual variability not yet discussed is psychological accentuation of similarities within and differences between salient categories. Accentuation effects were observed in the 'New Look' research by Bruner and Goodman (1947) who found that coins were perceived to be larger than identically sized cardboard disks, and more so by poorer subjects. Tajfel and Wilkes (1963) (see also Tajfel, 1969; and McGarty & Turner, 1992), extending work in this tradition, demonstrated that when stimuli (lines) that differ on some dimension (length) are classified such that all the members of one class differ in the same direction on that dimension from all the members of the other, judged similarities within and differences between classes are accentuated. Subsequently such effects have been shown to depend upon a number of factors (McGarty & Turner, 1992) and appear to be more reliably obtained for social than physical categories (McGarty, 1996). McGarty (1996) argues that, because (a) "…a primary behavioural purpose of (social) categorizations is to generate expectancies …about the members of …categories", (b) "…categorization is not just something we do to other groups, it is something that those groups do to themselves", (c) "…people engage in social differentiation to achieve separability on relevant dimensions", and (d) 'through processes of mutual social influence (people) shift to positions which are similar to other ingroup members", 'Categorization effects therefore allow us to make predictions which have a good chance of being correct, because they capitalise on the tendency of social groups to cohere and differentiate" (pp. 1,2). One implication of this argument is that accentuation should favour dimensions that are perceived to be normative (stereotypical) within (and normatively different between) groups as an early result (Tajfel, Sheikh & Gardner, 1964) indicated that it was. Apparently, as a categorical scheme emerges or is constructed or elaborated it accentuates to clarity.

A further suggestion follows from the previous argument that the salience of a meaningful categorical distinction implies the cognitive presence of a structured multivariate distribution of attributes among categories. Invocation or confirmation of a categorical distinction on the basis of meta-contrast observed on one or a few attributes prompts retrieval or inference of further attributes that are perceived as normative within and normatively different among categories, upon which expectation generation depends. That coherence of the categories requires perception of correlation or structure among attributes implies that meta-contrast be expected on not only observed but on as yet unobserved attributes also. In other words, recognition that groups that are sufficiently social-psychologically real to serve explanatory and anticipatory purposes

correspond to categories that are coherently attributionally structured within (normatively structured) and different between implies that the categories differ in respects yet to be manifest. Accentuation on experimenter-presented dimensions might possibly reflect respondents' understanding that the categories they distinguish among are more different in more ways than the opportunity they've been presented with allows them directly to express.

This Chapter has described the core principles of the SCT approach to social categorization and elaborated upon them in respect of the inherently multivariate nature of categorization processes. It has been argued, in accordance with SCT, that categorization is inherently comparative among entities and the categories to which they referred and that the specific content of categorical identity is dependent both upon the contrasts available to perceivers and their purposes in context. It has been argued also, elaborating upon SCT, that contextually-defined categorical identity is inherently multivariate among attributes and that the multivariate distribution of attributes within and between categories, describing their similarities and differences (comparative relations) inferentially accounts for both their internal coherences (entitativities) and the ways in which they are known or expected to interact (the relations among them or their structural relations). It has also been suggested that normative consistency judgments and categorical accentuation – themselves related to cognitive clarification of the entitativities and structural relations among categories – are both dependent upon the multivariate distribution of attributes within and between categories, in accordance with inferential schemata. Chapter 4 discusses the implications of these principles for data collection processes and multivariate modelling of categorical schemes, reviews available analytic models and proposes a plan of research towards building an example.

Chapter 4

Modelling social categorical schemes: Demands on methodology, available analytic models and a research plan

This chapter summarises inherent features of social categorical schemes that might be represented in modelling them and discusses attendant demands on data collection processes and analytic methods. A number of relevant data-analytic models are described prior to proposal of a research plan directed towards building a model of a specific social categorical scheme. The potential of data collection processes and models of this type for the purposes of social categorization research is evaluated in Chapter 10 following description of development of the example in Chapters 5 - 9.

The theoretical material reviewed in Chapters 2 and 3 indicates that categorization is inherently comparative among entities (and the categories with which they are identified), multivariate among attributes and variable among perceivers and with their contextual purposes. For a single perceiver under a specific purpose-forming condition, a model of a social categorical scheme should minimally represent a family of identities (at least two social categories under an implicit or explicit superordinate) and a structured ('correlated') set of attributes that together describe and account for their comparative relations (similarities and differences). Such a representation of structure among social entities (relative (dis)similarities), structure among attributes ('correlations') and

relations between them is a description of the core features of a contextually (perceiver by condition) defined social categorical scheme.

In relation to the theoretical model of categorical schemes presented in Chapter 2, 'structure among entities' refers to comparative structure or their relative similarities and differences in terms of which sets may be identified among them that are more similar within than between ('clusters') and which 'point to' shared identities. 'Structure among attributes' refers to the ways in which they are associated to account for the coherences ('entitativities') of categories and the relations among them. The relations between attributional structures and clusters among entities indicate the character of but do not fully define the identity concepts associated with the categorical distinctions or the pattern of shared and distinct identities. More fully, the description of identities inherent in the relations between attributional structures and clusters among entities are both normatively consistent with the identities and their contextually-defined attributional representations. The distinction between core and peripheral attributes may not be readily identifiable in an empirically-based model of these sets of entities, attributes and relations among them, although there may be indications of which attributes are more influential in effecting categorical distinctions.

The sets of entities under comparison and of attributes in terms of which distinctions among them are effected or described are referred to as (the first two) 'modes' of the data to be modelled. They will be present in any empirically-based model of a social categorical scheme and representation of the relations within and between the sets of elements of two modes according to the concepts outlined above is the primary objective of the analysis upon which it is built. However, a model representing only these two modes is descriptive only of a social categorical scheme for single perceiver under a specific condition.

Social categorical schemes are self-referential in two senses: the perceiver implicitly or explicitly defines self in relation to cognitively present categories (Turner, 1987a) and mutual definition of self and others is in terms of perceiver background knowledge and inferential schemata from the singular, motivated point of view of social-categorical self (Turner & Onorato, in press). Perceived similarities and differences among categories in terms of attribute structures will vary accordingly among perceivers both between and, to a lesser extent, within social identities. This brief discussion has referred to three distinct kinds of 'entities' (categories, attributes and perceivers) and to relations within each kind (similarities and differences among categories; 'correlations' or other structure among attributes; and emphases and perspectives among perceivers).

Moreover, these kinds of entities (and relations within kinds) are interrelated and mutually dependent: similarities and differences among categories are stated or accounted for in terms of relations among attributes according to varying emphases and perspectives among perceivers. These three distinct modes of interrelated variation will be present in any model representing the relative dissimilarity of social categorical schemata among a sample of individuals (who may be representatives of distinct social categories) and set the agenda for the modelling exercise.

They do not, however, exhaust the modes (or sources) of variation that might advantageously be simultaneously modelled: an obvious fourth source of

variation is among circumstances or points at issue, relating to the purposes of comparison and as may be invoked perhaps in a set of experimental conditions. Accordingly, there appear to be four broad ways in which context might be manipulated or naturally vary: with the entities or categories under comparison; with the circumstances or the issue under which they are bought into conjunction; with the perspectives of perceivers; and with the attributes in terms of which comparison is made. However, it may not be possible to effectively manipulate all of these ways simultaneously or for these elements of context to vary independently because categories, circumstances and attributes are interrelated in terms of perceiver knowledge, inferential schemata, interests and purposes. Whilst we may therefore contemplate building models that represent the joint interaction of four kinds of entities (entities or 'objects', attributes, perceivers and conditions) as represented in four modes of data, the complexity of analysis and interpretation of solutions increases powerfully with numbers of modes and modelling three is already complex. In respect of modelling categorical schemes, representation of the relations among two modes (objects and attributes) is necessary and modelling three may set a sensible limit to ambition. Given the capacity to build three-mode models, the third mode might be used to represent individual perceivers or categories of perceivers, conditions, or combinations of perceivers (or categories of perceivers) and conditions.

In the present research, the third mode is employed to represent a set of individuals sampled from within the same nominal category under the same nominal condition. Indeed, both a set entities (themselves social categories or groups) and a set of perceivers are sampled from respective nominal categories (populations). As the judgmental condition is fixed by the uniform nature of the measurement context, attributes constitute a 'free' mode in terms of which perceivers can express their judgments about dissimilarities among the groups. Under these conditions, it is basic that models representing the similarities and differences among the groups be constructed in terms of attributes or attributional phrases as freely and naturally expressed by subjects as possible. Only in this way is it possible to gain insight into the nature of the knowledge, inferential schemata and interests or commitments that perceivers bring to bear. Whilst a 'standard' list of personality-descriptive adjectives might serve to experimentally demonstrate certain theoretically-derived hypotheses about the effects of, say, variation among conditions on judgments about certain social categories among certain groups of perceivers, the results of such an experiment would offer little insight into the attributional content and structure of the categorical schemes cognitively invoked. Indeed, such an experiment might well fail to generate data that is consistent with valid theoretical propositions were it not for the insight of the researcher into both probable social identifications among subjects and contextually relevant adjectival phrases. Alternatively, the extent of attributional relevance required to demonstrate a significant difference among experimental conditions, for example, may be little more than that the attributional stimuli presented for rating correlate reasonably well with the attributional content of the 'natural' categorical schemes invoked (although such schemes are likely to be modified or displaced in response to the stimuli presented). In general, theoretical propositions may be more reliably and

meaningfully demonstrated and social-psychological change or organisational management initiatives more securely founded on the basis of sound measurement models of contextually relevant categorical schemes.

Two seemingly counteractive objectives are implicit in these comments: to build formal models of social categorical schemes on relatively unstructured, 'naturalistic' data. Whilst reconciling these objectives at one go is not envisaged, a sequential process of increasing formality and population representativeness in model development is proposed and examined.

Whilst there may be a variety of means by which naturalistic judgments may be obtained as part of a process of formal model building, the present research capitalises on the ability of perceivers to make global (dis)similarity judgments among a set of entities and generally to account for them in terms of attributional similarities and differences. The research reviewed in Chapter 2 indicates that perception of global (dis)similarity among entities is directly relevant to their collection together into categories. Moreover, the experience of administering the research protocol described in Chapter 5 was that subjects found it relatively straightforward to estimate the relative (dis)similarities of pairs from a set of entities and subsequently to account for them. Without anticipating too much the content of Chapter 5, subjects' pairwise dissimilarity judgments on a scale (1 to 9 in this instance) among a set of groups and their associated attributional accounts yielded, from each subject, a set of data that could be formally modelled (the dissimilarity ratings) by means of such procedures as multidimensional scaling (MDS; see below) or cluster analysis (CA; see below) and a set of attributional statements serving to collect together and distinguish among the categories that could be employed to interpret the MDS or CA models and/or be employed subsequently as attributional statements on which the categories might be rated. Free expression of attributional accounts with minimal prompting or attendant reactivity to interviewer input counts high among the virtues of this relatively simple procedure. In addition, the formal models of among-category (dis)similarity structure provide a central, empirically-derived focus for identification of attributional structure and summarisation of among-category attributional similarities and differences, a feature of particular utility in interpretation of the aggregated sets of dissimilarities and attributional accounts reported in Chapter 6.

Sorting and recording 'interview' processes of this type place time and place constraints on the research endeavour: interviewing, transcription, analysis and interpretation are relatively time-consuming, and subjects are limited to those who are geographically accessible and willing to volunteer for a relatively challenging face-to-face exercise. Depending upon the population it is intended to study, samples available for this sort of process are likely to be too small and too convenient to be representative. If so, the primary function of the data such samples provide may be to inform development of a self-report instrument that may be more widely distributed. Whilst such an instrument yields data that is more broadly representative of the target population, it also has a different form and requires different models for its analysis. Relevant models in this context include variants of MDS, such as multidimensional unfolding (MDU) and principal components analysis (PCA). Moreover, a pertinent feature of data and

models of these types is that both modes are modelled simultaneously to formally represent the relations among the two sets of entities.
Such models may be fit separately to each subject's group by attribute data (or, indeed, to any two of the three subject by attribute by group modes). Extensions of these models are required to fit the complete three-mode set of subjects by groups by attributes data and include weighted MDU (WMDU) and three-mode PCA (3PCA). In the research process outlined – dissimilarity judgments, accounts and analysis of individuals, analysis of aggregated data, development of a self-report instrument and analysis of those data – a number of opportunities arise for comparison of the results of data-collection and analysis methods and assessment of their relative utilities and the reliabilities.

Review of data analytic models

The statistical techniques of current interest are a sub-set of models from what might be referred to as multivariate descriptive statistics. They are primarily data-analytic or, in the present application, psychometric rather than statistical-inferential models, although many may be used in statistical inferential procedures as well. Jackson (1991, p. 4) writes that such techniques "…consider two or more related random variables as a single entity and attempt to produce an overall result taking the relationship among the variables into account" and offers the Pearson correlation coefficient and PCA as simple and more complex examples. Whilst Jackson's description is appropriate to the PCA and factor analysis traditions, Coombs' (1964) *A Theory of Data* established the conceptual foundations for systematic development in the MDS tradition. Building upon Coombs' work, Young (Young & Hamer, 1987; ch. 3) sets, as his goal, "…to develop a theory of data that allows th e precise classification of data gathered in any type of situation likely to arise in the course of scientific enterprise" (p. 43). The generality of Coombs' ideas has led researchers in three-mode PCA to employ many of them in that context as well. Accordingly, a summary description of Young's (development of Coombs') data theory is provided in order to introduce concepts that help to systematise subsequent discussions of principal components and multidimensional scaling models.

Data theory

Young (Young & Hamer, 1987) makes the fundamental assumption that data are always categorical because it is always possible to decide whether any two observations fall into the same category or whether they are, in terms of the measurement or categorization scheme employed in an experiment, empirically equivalent. That all data are assumed to be categorical implies, according to Young, "…nothing about the measurement characteristics of the data" which "relate to the relationships assumed to exist among the observations" (p. 44). In particular, "the measurement *level* of a set of observations is related to the relationships that are assumed to exist among observations in *different* categories" (i.e., the relationships assumed to exist among the values of a single variable); "the measurement *process* is related to the relationships that are assumed to exist

within the *same* category" (i.e., whether being measured into the same category is the result of a discrete or continuous generating process, or whether two observations within the same category are necessarily identical or equivalent only up to the experimental level of measurement precision); and "the measurement *conditionality* is related to the relationships that are assumed to exist within *sets* of observation categories" (i.e., the relationships assumed to exist among the values of different variables).

The shape of data

A set of data may be described in terms of the number of ways by which it is classified or the dimensionality of the data cross-table. Young's treatment is more general than is required here and it simplifies our discussion to proceed by example. It may be useful to refer throughout this discussion to Figure 4.1 which represents two- and three-way data structures and introduces some notation for subsequent reference. A typical multivariate data matrix is a two-way structure with the ways being subjects and variables. A matrix of correlations among variables is also two-way with the ways being variables and variables, as is a matrix of pairwise distances among objects for which the ways are objects and objects. Three-way data structures arise if subjects are measured on a set of variables under different conditions (subjects by variables by conditions) or if a set of correlation (or distance) matrices are derived from data obtained under different conditions (variables by variables by conditions / objects by objects by conditions). Two sets of three-way data are analysed in subsequent chapters: a set of objects by objects matrices of dissimilarity estimates, one for each subject (subjects by objects by objects), is analysed in Chapter 6 and a set of attributes by objects matrices of ratings, one for each subject (subjects by attributes by objects) is analysed in Chapters 7, 8 and 9. A four way data set would be generated by a set of subjects rating a set of objects in respect of a set of attributes under a set of conditions.

A set of data may also be described in terms of the number of modes by which it is classified. Among the examples offered above were several in which two ways referred to the same sets of categories such as variables and variables or objects and objects. Each distinct set of categories is considered to be a mode of classification. The concept of a mode serves to distinguish among data structures in which all ways refer to different sets of categories from structures in which some dimensions of classification are ways defined in terms of the same sets of categories. Correlation (variables by variables) or distance matrices (objects by objects), for example are two-way, one mode structures (variables / objects); the set of subjects by objects by objects data analysed in Chapter 6 is three-way, two-mode

(subjects, objects); and the set of data analysed in Chapters 7, 8 and 9 is three-way, three-mode (subjects, attributes, objects). In Figure 4.1 the ways labelling the axes of the data matrices may each be modes. The notation referring to specific subsets of the data in three-mode arrays as fibres or slices is more commonly used in the context of three-mode PCA (see below) than ordinary (two-mode) PCA or MDS. However, the term 'slice' (also called 'slab') is convenient in various places throughout the following discussion.

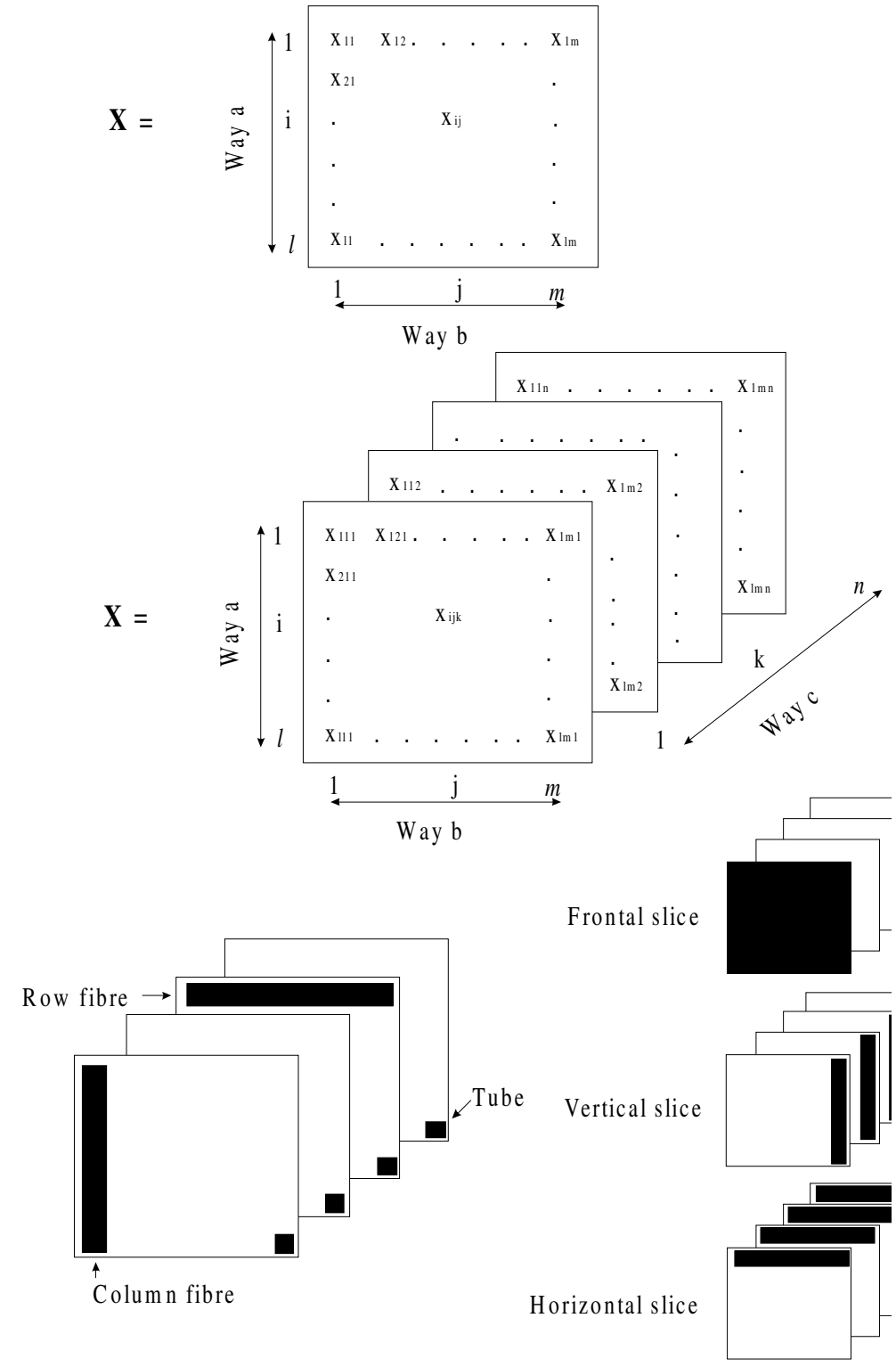


Figure 4.1 Data structures: two-way matrices and three-way arrays

Symmetry

When both ways of a two-way data matrix refer to the same set of entities or are one-mode, the matrix may be symmetric about the diagonal, as is usual, or non-symmetric. By way of example, it has been observed (see Chapter 2) that the similarity of an entity x to an entity y may be judged to differ from the similarity of the entity y to the entity x. In this case, the data matrix would be non-symmetric with the similarities as judged in one direction located below and the similarities as judged in the other located above the diagonal. Whilst MDS models include provision for analysis of square (two-way one-mode) non-symmetric matrices (see Young & Hamer, 1987), an attempt was made in the present research to ensure the symmetry of such judgments by instruction to subjects to assess the similarity of each pair of entities to each other and by deliberately scrambling the orders of mention of paired entities. When data are three-(or higher-)way 'symmetry' and 'a-symmetry' are used to refer to the structure of the first two ways of data.

Introduction to multivariate models

Among the models employed in the present research, the PCA, MDS (and MDU) and CA models for two-way data are perhaps the most familiar, with the three-way extensions that are the main focus of interest being far less frequently encountered in the social psychological literature. In the following discussion, the two-way PCA model is described in some detail in order to provide a basis for understanding the more complex 3PCA model employed for the 'final' analysis in Chapters 8 and 9. Similarly, a discussion of two-way MDS models is used as an introduction to the more complex three-way models. Two-way MDS (and MDU) models are employed for analyses reported in Chapters 5, 6 and 7, with a three-way two-mode MDS model being the main focus of Chapter 6, and a three-way three-mode MDU model being found to yield an unsatisfactory solution for the data analysed in Chapters 7, 8 and 9. Three mode extensions to CA (e.g., Basford, Kroonenberg & DeLacy, 1991), although a promising avenue for future research, are not employed and two-way CA (see Everitt, 1980; Romesburg, 1984) is presumed to be sufficiently familiar not to warrant discussion in the present context.

Principal components analysis (PCA)

PCA may be equivalently performed on a square dispersion matrix, such as of covariances or correlations derived from a rectangular raw data matrix, by means of spectral (eigenvalue-eigenvector) decomposition (SD; see below) or directly on the appropriately transformed ('pre-processed') rectangular matrix of raw scores by means of singular value decomposition (SVD; see below). Because many 3PCA and MDS solutions are obtained via SVD of a pre-processed raw data matrix while standard two-mode PCA solutions are typically obtained via SD of a dispersion

matrix, the relationship between a rectangular raw data matrix **X** and a derived square symmetric dispersion matrix **S** is described in order to provide a basis upon which commonalities between some SD- and SVD-based models can be identified.

Let **X** be a typical n x p multivariate data matrix collecting the measurements x_{ij} on n objects (often but not necessarily subjects) for p variables:

$$\mathbf{X} = \begin{bmatrix} x_{11} & . & . & . & x_{1p} \\ . & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ x_{n1} & . & . & . & x_{np} \end{bmatrix}$$

n x p

A number of transformations (centrings and scalings) may be applied to the values x_{ij} prior to analysis including:

(i) none;

(ii) column centring: each value x_{ij} is corrected for its column mean $x_{.j}$ to yield deviation scores $x_{ij} - x_{.j}$; and

(iii) column standardization: the deviation scores $x_{ij} - x_{.j}$ are each divided by their column standard deviations s_j to yield standard scores $(x_{ij} - x_{.j}) / s_j$.

The p x p square symmetric dispersion matrix **S** obtained as the product $\mathbf{X}'\mathbf{X}$ is:

(i) the product or second moment matrix if no scaling is employed;

(ii) the sums of squares matrix or n-1 times the covariance matrix if the data are column centred; and

(iii) n-1 times the correlation matrix if the data are column standardized.

To show that this is so, the operation is performed on the first two rows of $\mathbf{X}'$ and the first column of **X** , where **X** has been column centred, to yield the elements s_{11} and s_{21} of **S**.

$$\begin{bmatrix} x_{11}-x_{.1} & x_{21}-x_{.1} & . & . & . & x_{n1}-x_{.1} \\ x_{12}-x_{.2} & x_{22}-x_{.2} & . & . & . & x_{n2}-x_{.2} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ x_{1p}-x_{.p} & . & . & . & . & x_{np}-x_{.p} \end{bmatrix} \quad X \quad \begin{bmatrix} x_{11}-x_{.1} & . & . & . & . & x_{1p}-x_{.p} \\ x_{21}-x_{.1} & . & & & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ x_{n1}-x_{.1} & . & . & . & . & x_{np}-x_{.p} \end{bmatrix}$$

$s_{11} = (x_{11}-x_{.1})(x_{11}-x_{.1}) + (x_{21}-x_{.1})(x_{21}-x_{.1}) + \ldots + (x_{n1}-x_{.1})(x_{n1}-x_{.1})$ which is the sum of squares or n-1 times the variance of the first variable, and

$s_{21} = (x_{12}-x_{.2})(x_{11}-x_{.1}) + (x_{22}-x_{.2})(x_{21}-x_{.1}) + \ldots + (x_{n2}-x_{.2})(x_{n1}-x_{.1})$

which is the sum of cross products or n-1 times the covariance of the first and second variables. Note that s_{21} is identical to s_{12}, **S** being symmetric.

Dividing the elements of **S** by n-1 (the degrees of freedom of each of the p variables), although of convenience in retaining the original units of measurement, does not affect the PCA results described below and will be omitted from that description.

Jackson (1991) introduces his discussion of PCA by showing what it achieves geometrically in the two variable case. The relationship between the two variables, a and b might be described by either one of two simple regression lines defined by the equations:

$$a = c_a + \beta_a b + e_a$$

which minimises squared deviations in the direction of a in two dimensional space or

$$b = c_b + \beta_b a + e_b$$

which minimises squared deviations in the direction of b.

In the absence of grounds for choosing one of these lines over the other, it is desirable to derive an equation and hence define a line that could be used for prediction in either direction. The desired line, as identified by Pearson (cited in Jackson, 1991, p. 6), is one that minimises the squared deviations perpendicular to the line itself or the orthogonal regression line. Such a line in the two variable case is the first principal component and identifies the direction maximising the shared variation between a and b. The second PC, defined as orthogonal to the first, identifies the direction of non-shared, residual or error variation.

Geometrically this amounts to a principal axis rotation of the original coordinate axes, a and b, about their means. The new directions are the orthogonal coordinate axes of the two-dimensional principal component space, PC1 and PC2, for which PC1 and PC2 are each defined as linear sums of a and b.

Informally, PCA identifies a series of orthogonal directions through multidimensional variable space so that the first extracts the maximum amount of variance shared among the variables, the second extracts the next largest amount of variance (subject to othogonality to the first) and so on, until there are as many PCs as variables. In the three-dimensional case, in which the data points may be considered to resemble a flock, the first PC is the direction of the longest line through the flock, the second PC is the direction of the longest line orthogonal to the first, and the third PC is that direction orthogonal to both of the first two PCs.

There are three reasons why we might bother: it may be of interest to know what combinations of the p variables in terms of which our n objects (which may be subjects) were originally described account for the greatest amount of variation among them, the next greatest amount and so on; we may find it convenient to describe our n objects in terms of their 'scores' on

p orthogonal variables (the PCs) rather than in terms of their scores on p correlated variables (especially if we wish to perform subsequent analyses on variables that are independent of each other so as to free the set of analyses from redundancy); and, because PCs represent sequential maximal amounts of common variance, often the first few PCs explain such a large portion of the total variance that we may choose to retain only a few, simplifying our description of the n objects whilst still accounting for the larger portion of the variation among them. It is a caveat, however, that discarded PCs may describe variation (however small the proportion of variance within the set analysed that may be) that is importantly related in a substantive sense to some factors or variables external to the those included in the PCA itself.

If, as suggested, only a sub-set of the p PCs are retained in the interests of data reduction (simplification), it may be that the retained PCs are not readily interpretable as linear combinations of the original variables. As further outlined below, interpretability of the solution may be enhanced by rotation of the axes of the reduced space to 'simple structure'. In view of what was said above, the process, PCA, retention of a sub-set of PCs and rotation to simple structure, includes two rotations according to different criteria: the variance maximising principal axis rotation which is PCA itself and a subsequent rotation to simple (interpretable) structure.

The spectral decomposition

A p x p symmetric, non-singular matrix, such as $\mathbf{S}$, may be reduced to a diagonal matrix $\mathbf{L}$ by premultiplying and postmultiplying it by a particular orthonormal matrix $\mathbf{U}$ such that,

$$\mathbf{U'SU} = \mathbf{L} \qquad (4.1)$$

The diagonal elements of $\mathbf{L}$, $l_1, l_2, \ldots, l_p$ are called the latent roots or eigenvalues of $\mathbf{S}$ and the columns of $\mathbf{U}$, $\mathbf{u}_1, \mathbf{u}_2, \ldots, \mathbf{u}_p$ are called the eigenvectors of $\mathbf{S}$.

That $\mathbf{U}$ is orthonormal means that,

$\mathbf{u}_j\mathbf{'u}_j = 1$ for all $j = 1, 2, \ldots, p$ and $\mathbf{u}_j\mathbf{'u}_k = 0$ for all $j (= 1, 2, \ldots, p) \neq k (= 1, 2, \ldots, p)$:

i.e., that the columns of $\mathbf{U}$ have unit (normal) variance and are uncorrelated (orthogonal). An important property of the orthonormality of $\mathbf{U}$ is that its inverse is its transpose: i.e., $\mathbf{U^{-1} = U'}$.

We are not concerned here with how, given $\mathbf{S}$, the problem is solved for $\mathbf{L}$ and $\mathbf{U}$ (see Jackson, 1991, pp. 7-8, 27- 28, 450-455), but with what they are or mean for data analysis.

The eigenvalues in $\mathbf{L}$ are related to the variances of the PCs. Specifically, the sum of the eigenvalues is equal to the sum of the variances of the original variables so that the ratio of an eigenvalue to their total is the proportion of total variance among the original variables accounted for by the corresponding PC.

The columns of $\mathbf{U}$, $\mathbf{u_j}$ (j = 1, 2, …p), define the relationship between the PCs and the original variables, $\mathbf{x_1}$, $\mathbf{x_2}$, .., $\mathbf{x_p}$. Specifically, the elements of the eigenvectors are cosines of the angles between the PCs and the original variables. Because the cosine may be defined with the hypotenuse of the right triangle on either the original variable or the PC axis, the rows of $\mathbf{u_j}$ may be thought of as either the orthogonal projections of points on PC_j ($\mathbf{u_j}$) onto $\mathbf{x_1}$, $\mathbf{x_2}$, .., $\mathbf{x_p}$ or the orthogonal projections of points on $\mathbf{x_1}$, $\mathbf{x_2}$, .., $\mathbf{x_p}$ onto $\mathbf{u_j}$. For example, u_{11} is the length of the orthogonal projection onto $\mathbf{x_1}$ per unit length of $\mathbf{u_1}$ or, alternatively, it is the length of the orthogonal projection onto $\mathbf{u_1}$ per unit length of $\mathbf{x_1}$. Incidentally, this symmetry lies behind the occasional ambivalence between describing components as loading on variables or variables as loading on components.

But for scaling of its elements, $\mathbf{U}$ is reported by most statistical packages as the (unrotated) component matrix in something like the form of Figure 4.2. Common eigenvector scalings are discussed below.

	Component					
	1	2	.	.	.	p
Variable	$\mathbf{u_1}$	$\mathbf{u_2}$	.	.	.	$\mathbf{u_p}$
$\mathbf{x_1}$	u_{11}	u_{12}	.	.	.	u_{1p}
$\mathbf{x_2}$	u_{21}	u_{22}	.	.	.	u_{2p}
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
$\mathbf{x_p}$	u_{p1}	u_{p2}	.	.	.	u_{pp}

Figure 4.2: A typical component matrix

Jackson (1991, p. 11) defines the transformation, via spectral decomposition of a covariance matrix, from p correlated variables, $\mathbf{x_1}$, $\mathbf{x_2}$, .., $\mathbf{x_p}$, to p uncorrelated variables, the principal components, $\mathbf{z_1}$, $\mathbf{z_2}$, .., $\mathbf{z_p}$, in terms of $\mathbf{U}$ as follows:

$\mathbf{z} = \mathbf{U}'[\mathbf{x} - \bar{\mathbf{x}}]$, where $\mathbf{z}$ is a p x1 vector of PCs and $\mathbf{x}$ and $\bar{\mathbf{x}}$ are p x 1 vectors of observations on the original variables $\mathbf{x}$ and their means $\bar{\mathbf{x}}$.

More generally, $\mathbf{z} = \mathbf{U}'\underline{\mathbf{x}}$, where $\underline{\mathbf{x}}$ is a vector of raw scores if $\mathbf{S}$ is a product matrix, of deviation scores if $\mathbf{S}$ is a covariance matrix, and of standard scores if $\mathbf{S}$ is a correlation matrix. Consequently, rather than use the symbol $\underline{\mathbf{x}}$, we will simply employ $\mathbf{x}$ where it is to be remembered that it contains raw scores if $\mathbf{X}$ is neither centred nor scaled, deviation scores if $\mathbf{X}$ is column centred and standard scores if $\mathbf{X}$ is column standardised prior to obtaining $\mathbf{S}$ as the product $\mathbf{X}'\mathbf{X}$.

The rectangular n x p matrix $\mathbf{Z}$ of the scores of the n objects on the p PCs (in which element z_{ij} is the score of object i on PC_j) is defined after the form of the raw data matrix $\mathbf{X}$ as,

$$\mathbf{Z} = \begin{bmatrix} z_{11} & . & . & z_{1p} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ z_{n1} & . & . & z_{np} \end{bmatrix}$$

Re-writing $\mathbf{z} = \mathbf{U}'\mathbf{x}$ in matrix form and transposing, gives

$$\mathbf{Z} = \mathbf{XU} \qquad (4.2)$$

(Recall that $\mathbf{X}$ may contain raw, column centred or column standardised observations).

This expression is expanded below.

$$\begin{bmatrix} z_{11} & z_{12} & & z_{1p} \\ z_{21} & z_{22} & & z_{2p} \\ & & & \\ z_{n1} & z_{n2} & & z_{np} \end{bmatrix} = \begin{bmatrix} x_{11} & x_{12} & & x_{1p} \\ x_{21} & x_{22} & & x_{2p} \\ & & & \\ x_{n1} & x_{n2} & & x_{np} \end{bmatrix} \times \begin{bmatrix} u_{11} & u_{12} & & u_{1p} \\ u_{21} & u_{22} & & u_{2p} \\ & & & \\ u_{p1} & u_{p2} & & u_{pp} \end{bmatrix}$$

Multiplying out gives the score for the first object on the first PC,

$$z_{11} = x_{11}u_{11} + x_{12}u_{21} + \ldots + x_{1p}u_{p1}$$

or more generally, the score for the i^{th} object on the j^{th} PC,

$$z_{ij} = x_{i1}u_{1j} + x_{i2}u_{2j} + \ldots + x_{ip}u_{pj}.$$

Scaling of eigenvectors

Three scalings are commonly applied to eigenvectors: (4.3)

(i) none, the u-vectors are orthogonal and have unit length (orthonormal);

(ii) $\mathbf{v}_j = \sqrt{l_j}\mathbf{u}_j$ ($\mathbf{V} = \mathbf{UL}^{1/2}$), the v-vectors are orthogonal and have length equal to the square roots of the corresponding eigenvalues;

(iii) $\mathbf{w}_j = \mathbf{u}_j/\sqrt{l_j}$ ($\mathbf{W} = \mathbf{UL}^{-1/2}$), the w-vectors are orthogonal and have length equal to the inverses of the square roots of the corresponding eigenvalues.

A useful property of v-vectors is that PCs scaled in this way are in the same units as the original variables.

Corresponding to (4.1), we have matrices of eigenvectors:

(4.4)

(i) $\mathbf{U'SU} = \mathbf{L}$ for u-vectors;

(ii) $\mathbf{V'SV} = \mathbf{L}^2$ for v-vectors; and

(iii) $\mathbf{W'SW} = \mathbf{I}$ for w-vectors.

Corresponding to (4.2), we have matrices of object scores:

(4.5)

(i) $\mathbf{Z} = \mathbf{XU}$ for u-vectors;

(ii) $\mathbf{[\ ]} = \mathbf{XV}$ for v-vectors (these scores are rarely used and not symbolised by Jackson); and

(iii) $\mathbf{Y} = \mathbf{XW}$ for w-vectors.

The scores in $\mathbf{Z}$, $\mathbf{[\ ]}$ and $\mathbf{W}$ are orthogonal with variances equal to:

(i) the corresponding eigenvectors for z-scores;

(ii) the squares of the corresponding eigenvectors for $\mathbf{[\ ]}$–scores; and

(iii) unity for y-scores.

Statistical packages vary in the eigenvector scalings they report (see Jackson, 1991, pp. 454-455). SPSS for Windows, employed for most of the analyses reported in Chapters 5,6 and 7, reports $\mathbf{V}$ as the 'factor' (loadings) matrix and computes the matrix of object scores $\mathbf{Y}$, reporting $\mathbf{W}$ as the 'factor score coefficient' matrix.

Recovery of $\mathbf{X}$ from PC-scores and loadings

Having obtained the matrix $\mathbf{Z}$ of PC-scores and the corresponding matrix $\mathbf{U}$ of loadings, the original data matrix $\mathbf{X}$ may be recovered by inversion of Equation 4.2: i.e., $\mathbf{Z = XU}$.

Multiplying by $\mathbf{U^{-1}}$ gives $\mathbf{X = ZU^{-1}}$.

Therefore, $\mathbf{X = ZU'}$ (4.6)

because U is orthonormal and $\mathbf{U^{-1} = U'}$.

Inversion may also be performed in terms of y-scores and v-loadings, as below.

(i) $\mathbf{Y = XW}$ (Equ. 4.5). Multiplying by $\mathbf{W^{-1}}$ gives $\mathbf{X = YW^{-1}}$. However,

(ii) $\mathbf{V = UL^{1/2}}$ (Equ. 4.3), so $\mathbf{V' = L^{1/2}U'}$ and $\mathbf{V' = L^{1/2}U^{-1}}$ because U is orthonormal; and

(iii) $\mathbf{W = UL^{-1/2}}$ (Equ. 4.3), so $\mathbf{W^{-1} = L^{1/2}U^{-1} = V'}$ (from ii).

Therefore $\mathbf{X = YV'}$ (4.7)

by substitution in (i).

Retaining less than p PCs

Generally, in data analysis, less than the full p PCs are retained so that what is obtained from equations 4.6 and 4.7 are estimates of x_{ij}, $\hat{x}_{ij}$, or in matrix form, $\hat{\mathbf{X}} = \mathbf{ZU'} = \mathbf{YV'}$.

If the e_{ij} are residuals or errors in estimation, $x_{ij} = x_{ij} + e_{ij}$, or in matrix form,

$\mathbf{X} = \mathbf{ZU'} + \mathbf{E} = \mathbf{YV'} + \mathbf{E}$, where $\mathbf{ZU'}$ and $\mathbf{YV'}$ are estimates of $\mathbf{X}$, $\hat{\mathbf{X}}$.

R and Q analysis

In a typical application of PCA, the p x p product matrix $\mathbf{X'X}$ is analysed to re-describe the n objects in terms of their scores (z or y) on p (or less than p) PCs (u or v). Alternatively , the n x n product matrix $\mathbf{XX'}$ may be analysed to re-describe the p variables in terms of their scores (z* or y*) on n (or less than n) PCs (u* or v*). Analyses of the first and second kinds are referred to as R-and Q-analysis respectively (Jackson, 1991, pp. 189, 190). Q-analysis results from 'normal' PCA on the transpose of $\mathbf{X}$, $\mathbf{X'}$.

Number of non-zero eigenvectors

To this point it has been implicitly assumed both that n > p and that there are no linear dependencies among the columns of $\mathbf{X}$ so that $\mathbf{S}$ is of full rank. Linear dependencies of this kind result, theoretically, in eigenvectors of zero loadings, although rounding errors may generate non- but near-zero redundant vectors. More pertinently, the maximum number of non-zero eigenvectors is min(n, p). This is, apart from rounding-error PCs, the number of non-zero eigenvectors from the analysis of either $\mathbf{X'X}$ or $\mathbf{XX'}$. Using this number of eigenvectors allows recovery without error (other than computational error) of $\mathbf{X}$ in R-analysis and $\mathbf{X'}$ in Q-analysis.

Relations among PCs and scores form R- and Q-analysis

Jackson (1991, p. 192) shows that the y-scores from R-analysis are equal to the u-loadings from Q-analysis, $\mathbf{Y} = \mathbf{XW} = \mathbf{U^*}$, and that the y-scores from Q-analysis are equal to the u-loadings from R-analysis, $\mathbf{Y^*} = \mathbf{X'W^*} = \mathbf{U}$. Similar relations obtain for z-scores and v-loadings: i.e., $\mathbf{Z} = \mathbf{V^*}$ and $\mathbf{V} = \mathbf{Z^*}$.

Singular value decomposition

By assembling some of the results reported above it is possible to directly decompose $\mathbf{X}$ into either set of u-vectors ($\mathbf{U}$ or $\mathbf{U^*}$) and the PC-scores ($\mathbf{Z}$ or $\mathbf{Z^*}$) rather than from spectral decomposition of the product matrices

$\mathbf{X'X}$ or $\mathbf{XX'}$ via a relation known as singular value decomposition (SVD), as below.

Because $\mathbf{V = UL^{1/2}}$ (Equ. 4.3) and $\mathbf{Y = U^*}$, $\mathbf{X = YV'}$ (Equ. 4.7) may be written as

$$\mathbf{X = U^*L^{1/2}U'}, \qquad (4.8)$$

which is the fundamental identity defining SVD.

Note that the 'singular values' in the matrix $\mathbf{L^{1/2}}$ are the square roots of the eigenvalues in $\mathbf{L}$, because the SVD operation involves the data itself rather some function involving their sums of squares or products as in the analysis of a covariance or correlation matrix.

Because (i) $\mathbf{U^*L^{1/2} = V^* = Z}$ we may recover Equ.4.6, $\mathbf{X=ZU'}$; (4.9)

and because (ii) $\mathbf{L^{1/2}U' = (UL^{1/2})' = V' = Z^{*'}}$, $\mathbf{X=U^*Z^{*'}}$.

Whereas (i) corresponds to R-analysis, transposing (ii) to give $\mathbf{X' = Z^*U^{*'}}$ shows (ii) to correspond to Q analysis.

Variants of SVD

The basic form of SVD, $\mathbf{X = U^*L^{1/2}U'}$, may be written as $\mathbf{X = AB'}$ where the singular values have been absorbed into $\mathbf{U^*}$, $\mathbf{U}$ or divided between the two: i.e.,

$$\mathbf{X = (U^*L^{c/2})(L^{(1-c)/2}U')} \qquad (4.10)$$

where $0<c<1$, $\mathbf{A = U^*L^{c/2}}$ and $\mathbf{B = UL^{(1-c)/2}}$.

Joint plots displaying relations between a- and b-mode elements in component space

This relation may be used in a number of ways to produce 'bi-plots' (Gabriel & Odoroff, cited in Jackson, 1991, p. 199), to display the joint relations (according to the SVD model) between the rows and columns of $\mathbf{X}$. One of the more common is the symmetric plot in which c=.5. The elements of $\mathbf{A}$ and $\mathbf{B}$ are plotted in a common space (component space) to produce a (symmetric) joint plot from which either the a-mode elements may be described in terms of b-mode vectors (drawn from the origin to the b-mode coordinates) or vice-versa. The orthogonal projections of the a-mode (typically representing subjects or objects) points onto the vectors through the origin and the b-mode points (typically representing variables or attributes) correspond more or less closely to the columns of $\mathbf{X}$, or the vectors of scores of the a-mode 'entities' (subjects/objects) on the b-mode 'entities' (variables/attributes). They correspond exactly if the full min(n,p) components are retained (and employed as dimensions of the plot; Jackson, 1991, pp. 199,200) and are approximations according to the fit of the model when

fewer components are retained. Similarly, the scores of the b-mode entities on the a-mode entities are represented (according to the model) as the orthogonal projections of the b-mode points onto the vectors through the origin and the a-mode points. Depending upon how such a plot is read, the a-mode entities (points) are described in terms of b-mode entities (vectors) or vice-versa. Accordingly, such plots are generally known as point-vector plots. The distances between pairs of a–points are related to the 'similarities' between the corresponding pairs of a -mode entities and the distances between pairs of b–points are related to the 'similarities' between the corresponding pairs of b-mode entities, but the distances between a-mode and b-mode points should not be taken to represent similarities between the a- and b-mode entities. Plots constructed such that it is appropriate to take distances between a-mode and b-mode points as representations of similarities between a- and b-mode entities are known as point-point plots and are discussed below in the context of multidimensional unfolding. A symmetric joint plot in three dimensions is subsequently reported in Chapter 9.

If c=0 in Equ. 4.10, $\mathbf{A} = \mathbf{U}^* = \mathbf{Y}$, and $\mathbf{B} = \mathbf{V} = \mathbf{Z}^*$, where $\mathbf{Y}$ contains the scores (subjects or objects on components) and $\mathbf{V}$ the eigenvectors (components among variables or attributes) typically reported as the output from the **PCA** of $\mathbf{X}$. Gabriel and Odoroff (cited in Jackson, 1991) refer to plots based on these scalings as 'column metric preservation' plots because $\mathbf{V}$ is in the units of the original data. A joint plot of this type (again in three dimensions), in which objects (a-mode entities) are represented as points and their attributes (b-mode entities) are represented as vectors is subsequently reported in Chapter 7.

Plots of multivariate relationships (according to a model) offer insights into data that may otherwise, such as by examination of matrices of parameter estimates, be difficult to attain. This underlies, in large part, the appeal of multidimensional scaling as a set of techniques for geometric representation of multivariate data, among which joint plots derived from PCA (or SVD) solutions may be included.

Summary comment on interpretation of PCA solutions

Deciding how many of the full number of PCs are to be retained is to decide about what part of the data is to be considered systematic or important (in the retained PCs) and what part is to be considered random or unimportant (in the deleted PCs) or, by analogy, what is to be

considered 'signal' and what 'noise'. This is arguably the primary function of PCA (and perhaps of multivariate data analysis more generally). From this perspective PCA is a method for partitioning the variation in a set of data into the two major parts normally compared in analysis of variance: i.e., SS(total) = SS(model) + SS(residual/error). Whilst there has been much discussion in the literature about how to decide how many PCs to retain (see Jackson, 1991, section 2.8), such a decision is properly conditional upon the researchers' purposes and his or her ability to interpret so as to make appropriate use of the results.

The normal approach to interpretation of PCA solutions is to attempt to identify the nature of the constructs identified or measured by the PCs from knowledge of the meaning, nature or character of the entities (elements of modes; commonly scales) with the largest weights (loadings) in the linear functions defining each PC. The scores of the elements of one mode (commonly subjects) on the PCs of the other mode (commonly scales) are then understood as measures of those elements on the new constructs, sometimes called latent variables (although that terminology may be more appropriate for factor as opposed to component models). The natures of constructs defined by PCA as weighted linear sums of mode elements are not uncommonly difficult to identify. However, the utility of PCA solutions is not necessarily dependent upon such naming or comprehension of new (often complex and highly abstract) constructs.

The separation of signal from noise function of PCA may be considered geometrically. For the purposes of this discussion, the n a-mode elements are referred to as objects and the p b-mode elements as attributes. The data matrix $\mathbf{X}$ might be geometrically represented as a p-dimensional scatterplot in which the attributes are dimensions and the scores of the objects on the attributes are coordinates of points representing the objects. Following PCA, the estimate of $\mathbf{X}$ may be represented as an s-dimensional scatterplot (where s is the number of components retained) in which the attribute PCs are dimensions and the scores of the objects on the attribute PCs are coordinates of points representing the objects. Such a plot represents the systematic or signal (SS_{model}) part of the variation in the data.

Interpretation of components along the lines described above amounts to naming or labelling the dimensions of the new, reduced-dimension, scatterplot. There is, however, no need to label the dimensions of the space if

the attributes and the objects are both represented in it, according to their relations to the PCs as described respectively by loadings and scores. The PCs then simply constitute the 'frame' within which the systematic relations among objects, among attributes and between objects and attributes are displayed: i.e., the systematic part of the relations among entities is represented in component space and may be observed independently of labels for its dimensions.

Nevertheless, reification of PCs as new constructs is extremely common. Rotation of the dimensions of the space about their origin is usually employed as a means of simplifying the relations between the PCs and the entities whose variation they re-distribute and summarise: i.e., the columns of **U**. The object is to produce rotated PC-vectors whose coefficients are as close to zero or one as possible, or geometrically, to rotate the dimensions of the space to new orientations with respect to the entity-vectors embedded within it so that the new dimensions are each closely parallel to some and nearly orthogonal to others, minimising the number of vectors in the mid-range of angles. The new dimensions are then interpreted as the conceptual commonality among the sets of vectors more closely parallel to each. A number of procedures have been devised for rotation (see Jackson, 1991, ch.8), a major distinction among which is whether they maintain the orthogonality of the dimensions (orthogonal rotations) or allow the new dimensions to correlate (oblique rotations) in the interests of further PC-vector simplification. The relations among entities represented in component space are unchanged by these processes and indeed it is their fixed configuration with respect to which the dimensions of the space are re-oriented. Rotation is essentially a special form of cluster analysis in which numbers of clusters are constrained to equal numbers of components.

Whilst the motivation for rotation is to identify conceptually clear higher-order constructs, a distinction needs to be made between constructs that are meaningful to researchers and suitable to their purposes and constructs that represent higher order concepts that would be recognised as meaningful or familiar to the subjects who generated the data, or which might even be arguably implicit as functional conceptual entities among them. It would appear that rotation (by whatever method), and the relative algebraic simplicity of the PC-vectors it produces, is inadequate to support claims of the latter kind in the absence of supplementary evidence. Entity vectors may

be more or less parallel in component space either because they are aspects of coherent concepts or because they represent conjunctions in context of otherwise distinct concepts: e.g., the attributes 'water repellent feathers' and 'webbed feet' may be associated because they jointly serve to distinguish between aquatic birds and other kinds of animals in a particular context of judgment. The position taken here is that there is no justification for the assumption that whole components, however simple they may appear, correspond to unitary coherent concepts. Whilst there may be little choice but to attempt to interpret components as wholes when many (perhaps more than three) dimensions are involved, in the empirical research that follows, and in the final model reported in Chapters 8 and 9 in particular, spaces of high dimensionality were not justified and the joint plot approach offered a means for interpretation of object by attribute relations without recourse to possibly artificial higher-order constructs. An approach is made, however, to identification of likely coherent higher-order concepts or categories within component space.

Three-mode PCA

Three-mode PCA (3PCA) (Tucker, 1964; Kroonenberg & De Leeuw, 1980; Kroonenberg, 1983) extends the PCA model, specifically SVD, from analysis of two-mode data matrices to three-mode arrays. The present discussion follows that of Kroonenberg (1983, ch. 2) and, in order not to run out of symbols or create the confusion with those employed in the ordinary PCA context, employs his notation. The 3PCA model is more conveniently apprehended in scalar product than matrix form. Accordingly, scalar product forms of ordinary PCA and two-mode SVD are presented as an introduction to the model.

The three modes are referred to as a, b and c and their elements are counted by the indices i, j and k (i=1,.., l; j=1,.., m; k=1,.., n). In a typical application of ordinary PCA the row and column modes, a and b, are a sample of subjects and a set of variables respectively although they may represent sets of other kinds of 'entities' and the symmetry of the model allows that this convention might be reversed.

Kroonenberg employs the symbols **G** and **H** to represent the orthonormal matrices of loadings of the a- and b-mode elements on their corresponding PCs, and **C** to represent the matrix of singular values. In these terms the SVD of **X** is described as

$$\mathbf{X=GCH'}. \quad (4.11)$$

Accordingly, **G** corresponds to **U***, **H** to **U** and **C** to $\mathbf{L}^{1/2}$ in Equ. 4.8.

In scalar form, this may be described as

$$x_{ij} = \Sigma\Sigma\, g_{ip} h_{jq} c_{pq}, \qquad (4.12)$$

where p and q are indices counting the components of the a and b modes respectively and over which the respective summations occur.

In the two-mode case, the maximum number of components that may be extracted is min(*l*,*m*), and the number of components actually extracted and retained in analysis, indexed by s, is equal for the two modes. If, as is the usual case, the number of components extracted is less than min(*l*,*m*), the x_{ij} are estimates of the data. Despite that p and q might both be replaced by s for a particular analysis, i.e., $x_{ij} = \Sigma\Sigma\, g_{is} h_{js} c_s$, they are retained to support an analogy with 3PCA in which the numbers of components retained for each of the three modes may differ.

3PCA may be described initially by analogy with these expressions. The two-way data matrix **X** becomes a three-way data array, and the two modes, a and b, become the three modes, a, b and c. The SVD of a two-mode matrix may be understood as the simultaneous analysis of the elements of the a and b modes in which the interactions of the components of the two modes is represented by the matrix of singular values. In this case the matrix of singular values, referred to above as **C**, is diagonal with elements indexed by s (c_s; s = 1,..,<min(*l*,*m*)). These c_s are equal to the square roots of the eigenvalues associated with the s-th components of both the a- and b-mode elements.

An example may help to clarify the role of the core matrix as defining the relations among the components of the a- and b-modes.

Assume that the a-and b-modes are sets of objects and attributes and that we have extracted two components for each (p1, p2 and q1, q2). The example works from the results of the SVD to estimates of the original data. Assume also that the scores of each object PC on each attribute PC are known: i.e, that we have,

c_{11} as the score of object PC p_1 on attribute PC q_1
c_{12} as the score of object PC p_1 on attribute PC q_2
c_{21} as the score of object PC p_2 on attribute PC q_1
c_{22} as the score of object PC p_2 on attribute PC q_2.

These are the elements of the core matrix (singular values) as will become clear as the example proceeds.

Each real object a_i is represented as a weighted linear sum of the object PCs in which the weights are the elements of the component matrix **G**: i.e., we have, $a_i = g_{i1}p_1 + g_{i2}p_2$.
Accordingly, the scores of real object a_i on attribute PCs q_1 and q_2 are as follows:

$$a_{i1} = g_{i1}c_{11} + g_{i2}c_{21}$$
$$a_{i2} = g_{i1}c_{12} + g_{i2}c_{22}.$$

These results may be summarised as follows,
$a_{iq} = \Sigma g_{ip}c_{pq}$, where summation is over the p=2 components of the a mode.
Each real attribute b_j is represented as a weighted linear sum of the attribute PCs in which the weights are the elements of the component matrix **H**: i.e., we have, $b_j = h_{j1}q_1 + h_{j2}q_2$.
Accordingly, the scores of the real objects a_i on the real attributes b_j (i.e., the estimates of the x_{ij}) are as follows:

$$a_{ij} = x_{ij} = h_{j1}\{g_{i1}c_{11} + g_{i2}c_{21}\} + h_{j2}\{g_{i1}c_{12} + g_{i2}c_{22}\}.$$

Assembling these results we obtain,

$$x_{ij} = \Sigma h_{jq}\{\Sigma g_{ip}c_{pq}) = \Sigma\Sigma g_{ip}h_{jq}c_{pq},$$

where the summations are over the components of the a and b modes respectively.
When generalised beyond the two components used in this example, this is scalar product form of two-mode SVD as defined above.
In three-mode PCA the set of singular values describing the interactions or relationships among the components of the three modes is collected in a three-way structure referred to as the core array **C** which, in contrast to the matrix **C** in two-mode PCA, is no longer s x s and diagonal but p x q x r and full.
Kroonenberg gives his 'standard' matrix formulation of the 3PCA model as

$$\mathbf{X = GC(H'\otimes E')}, \quad (4.13)$$

where **E** is the orthonormal matrix of loadings of the components of the c mode, ⊗ is the Kronecker product operator and 'combination' modes are used for the data and core matrices (Kroonenberg, 1983, p. 57; p. 79).
The complexity of combination modes and Kronecker products may be avoided by expressing the model in scalar product form: viz,

$$x_{ijk} = \Sigma\Sigma\Sigma\, g_{ip}h_{jq}e_{kr}c_{pqr} \quad (4.14)$$

where k and r index the elements and components respectively of the c mode, and summation is over the components of the a, b and c modes.
What 3PCA achieves, then, is firstly to reduce the information in a three-mode data array about the entities on each of the modes to components, which extract or

describe that part of their variation over the other two modes which is systematic, and describe how the components of each of the modes are related. In other words, a 3PCA solution is a compact description of the information contained in a three-mode data array which represents the original data as a product of the interaction of the components on each of the modes in terms of the elements of the core array which describe how they are related.

The 'alternating least squares' algorithm (Kroonenberg & De Leeuw, 1980) employed to provide least squares parameter estimates in the TUCKALS3 procedure in the 3WAYPACK program (Kroonenberg, 1996) (employed for the analysis subsequently reported in Chapters 8 and 9) has a number of useful properties. In particular, the standard partitioning of sums of squares, SS(total) = SS(fit) + SS(residual), holds for both solutions as wholes and for each element within each mode, and the squares of the elements of the core array, i.e., the squares of the singular values, are proportional to the variance explained by the corresponding combinations of the components (Kroonenberg, 1983, p. 23, p. 35, ch.4). These properties allow for analysis of residuals, and assessment of the relative contributions of elements and combinations of components to the solution.

Considerations pertinent to employment of 3PCA in practice including data preprocessing (removal of means or centring and equalising variances or scaling), and rotation of components to 'simple structure' and construction of 'joint plots' as aids to the interpretation of solutions. Brief introductions to construction of joint plots and data preprocessing in the three-mode context are presented below and further details accompany the report of the analysis in Chapters 8 and 9.

Joint plots in the three-mode context

In the context of the present research or of categorization research more generally, the principal focus of interest is the nature of relations between objects (or entities or categories) and the attributes in terms of which they are described and distinguished among. The three modes of the data subsequently analysed are a = attributes, b = objects (health occupational groups) and c = subjects (registered nurses). It is very instructive to investigate the component loadings of the attributes jointly with the component loadings of the objects by projecting them together in one space to display the interaction of the objects and the attributes in a joint plot.

In the two mode case, such as of the analysis of a single subject's ratings of a set of objects on a set of attribute scales, the eigenvectors from the SVD of the data matrix, i.e., the g_{is} and h_{js} in $x_{ij} = \Sigma\Sigma\ g_{is}h_{js}c_s$, may be used in a number of ways to construct a joint- or bi-plot (Gabriel, cited in Kroonenberg, 1983). 'Symmetrical scaling', as employed in the present research, divides the variation described by the c_s equally between the attributes and groups and displays $\sqrt{c_s}g_{is}$ and $\sqrt{c_s}h_{js}$ as coordinates. Kroonenberg (1983, ch.6) describes how analogous joint plots may be constructed in the three-mode context to represent the joint relations of any two modes for each component of the third or reference mode. Because the numbers of components of the two modes to be jointly displayed may not be equal, such plots, one for each component of the reference mode, will have dimension equal to the number of components of the mode for which least were extracted. In the analysis reported in Chapters 7 and 8, three components were extracted for each of the group and attribute modes and two for the subject mode. Consequently, two three-dimensional plots of the joint group by attribute relations, one for each subject component, were constructed.

Considerations for pre-processing the raw data

One of the more challenging tasks in performing 3PCA is to decide upon the most appropriate centrings and scalings (preprocessing) of the raw data (see Harshman & Lundy, 1984b; Kroonenberg, 1983). These choices are conditioned by at least three types of considerations: how the researcher conceives of the measurement characteristics of the data including its conditionality; implications for the substantive utility of the solution or what aspects of the data are to be modeled; and avoiding sequences of centring and scaling operations that confound each other (i.e. avoiding interaction among pre-processing operations) or that result in solutions that are inconsistent with the fitted model (i.e. in which parameter estimates are biased).

Harshman and Lundy (1984b) provide a detailed examination of this third type of consideration. With respect to centring their conclusions include that,

> Fibre-centering preserves (model) appropriateness, but slab- and global-centering do not. Since the main objective of centering is to turn interval-scale data into ratio-scale data and eliminate conditionality of origin, appropriate centering methods should remove additive constants and one- and two-way effects that would otherwise interfere with the analysis. (p. 239)

Harshman and Lundy (1984b) describe algebraically what these constants and effects are, and detail the the consequences of failing to remove them.

They also point out that the effects of centring operations are independent of the order in which they are performed and that,

> In theory, …, triple application of fibre -centering leaves the data in ideal condition, with all the troublesome constants and one- and two-way components removed. In practice, however, triple-centering can have an additional, less desirable effect. It sometimes causes too severe a reduction in the 'signal-to-noise' ratio of the data.
>
> (Harshman & Lundy, 1984b, p. 235)

With respect to scaling ('re-weighting'), Harshman's and Lundy's (1984b) conclusions include that fibre-rescaling is inappropriate but that slab-rescaling is appropriate (pp. 246-247). However, unlike centring operations whose effects are independent, the effects of multiple re-scalings are not independent: "…the effects o f the second rescaling will modify the results of the first one." (p. 247). In view of this they describe an iterative procedure for finding an optimal compromise between two rescalings.

They also describe the interaction of jointly applied centring and scaling operations:

> In general, the interactions of the multiplicative (scaling) and additive (centring) preprocessing steps steps may be described as follows: size standardization of any mode disturbs prior centering on that mode but not on the other two modes; centering on a given mode not only disturbs prior standardization of that mode but of the other two modes as well.
>
> (Harshman and Lundy, 1984b, p. 252)

They describe an iterative procedure to deal with this sort of situation also.

There remain, however, a useful if limited number of combinations of centrings and scalings that do not involve the sorts of interaction among operations for which these iterative procedures were designed as remedies. For example, fibre-centring over one or both of the modes A and B followed by slab-scaling over mode C is a non-interactive sequence of preprocessing operations.

Effects of (fibre-)centring and (slab-)rescaling

The effects of (fibre-)centring and (slab-)rescaling on model parameters are, in the abstract, relatively straightforward.

As Harshman and Lundy (1984b) point out,

> Centering across any mode of the data matrix simply centers the errors across that mode and

column-centers the factor-loading matrix for that mode. For any given axis orientation, a column-centered factor matrix generally leads to the same interpretations as an uncentered factor matrix. Geometrically, after centering, the axes are parallel to the corresponding axes before centering, they have simply been translated as a unit from the arbitrary origin to a new origin at the centroid of the configuration. (p. 229)

Harshman and Lundy (1984b) discuss the effects of rescaling in terms largely of the relative 'influence' of the elements or levels of a mode on the form of the final solution, or their relative effects on the matrices of factor loadings. 'Influence' is also defined in terms of relative effects on overall fit of the model: "For least squares fitting procedures, the influence of a given part of the data is given by the amount that the error sum of squares can be reduced by fitting that part" (p. 241).

It may sometimes be desirable to equalise the influence on factor loading matrices and overall fit of the model among the levels of a particular mode by (slab)rescaling over that mode. For example, it might be advantageous to equalise the influence of subjects on an attributes by objects structure estimated from their ratings of a set of objects on a set of attributes. In the absence of this subject-mode rescaling, there will be a subject component having all positive (or all negative) loadings with their relative sizes describing the 'expressiveness' of the subjects or the 'boldness' with which they distinguish among the objects by using more or less of the attribute scales. Such a component describes the relative emphases subjects place on the common judgmental structure (i.e., relative emphases on those aspects of the structure shared among subjects). Alternatively, rescaling the subject mode to equalise the sums of squares of their attributes by objects matrices equalises the contributions made by subjects to the overall attributes by objects configuration and eliminates the component describing the relative strengths of their emphases on the common structure. Of course, the symmetry of the 3PCA model means that this example could be re-written in reference to rescaling to equally weight the influence of attributes or objects.

Multidimensional scaling

This summary closely follows Young's (Young & Hamer, 1987) monograph on the history and theory of multidimensional scaling and employs his notation.

Broadly defined MDS consists of a collection of methods which extract and summarise structure from matrices of data and which, generally, represent that structure spatially. Spatial representation of data structure capitalises on the ability of the visual system to identify sometimes complex patterns of relations among 'entities' that are less readily apprehended from inspection of matrices of parameter estimates. The elements of the data matrices represented are conceived of as describing the strength of relations among the entities naming their rows, columns and perhaps also slices: i.e., the commonality among such data is that they are taken to represent relations among the subjects, objects, attributes, experimental conditions or other kinds of entities that summarise the structure of an empirical situation. Such data may be directly-obtained or computed as indices from primary data and include distances, proximities or similarities, multiple rating scales or preference orders, and cross products, covariances or correlations; and they may be considered to be measured at nominal, ordinal, interval or ratio levels. Coxon and Davies (1982, ch.2) describe a number of indices with distance-like properties that may be computed from a variety of data types. The matrices in which the data are collected may be two-way one-mode (square) or two-way two-mode (rectangular), three-way two-mode or three-way three-mode, or many-way many-mode. As geometric representations of the relations among the entities of the elements of two modes of data, the joint plots previously described are examples of MDS models.

Torgerson's (1952) motivation for introducing into psychometrics what was previously a problem for surveyors – how to construct a map from errorful distances among sets of pairs of locations – was to provide a means of modelling judgmental data that could be collected from subjects without specifying the attributes or respects in terms of which the judgments were to be made: i.e., to model judgments of similarity among stimuli and to determine the appropriate dimensionality and scale values of the stimuli in multidimensional space as an outcome of the analysis rather than a presumption upon which the data were collected. It is primarily this feature of MDS - to allow the basis of subjects' judgments to emerge rather than to presume it in specification of response tasks - that underlies its utility for the present research.

MDS models may be roughly classified according to four major distinctions: the geometry of the space in which the entities are represented; the treatment of the data as metric (interval or ratio)

or non-metric (nominal or ordinal); whether the plot represents relations among the entities of a single mode (a 'simple' space) or the joint relations among the entities of two modes (a 'joint' space); and whether the models are two-way or include weights to represent the influence of a third way (or higher ways) on the relations among the first two ways.

All MDS models employed in the present research represent entities and their relations in ordinary Euclidean space: i.e., in which the distance between any two points is the square root of the sum of the squared distances between their coordinates on the familiar two, three or r dimensions of the space. The more general Minkowski space includes Euclidean, Manhattan (city-block), dominance and other spaces as special cases depending upon the size of the Minkowski exponent (see Young & Hamer, 1987, p. 86). Whilst a-priori considerations may sometimes dictate a preference for modelling in one of these alternative spaces, in the absence of grounds for choosing among them, Euclidean space has the advantage that it is the space in which we perceive the objects with which we normally interact and with which we are most familiar.

Young introduces his discussion of optimal scaling – which includes the processes and concepts that are employed in modelling data as non-metric – in terms of Fisher's notion of appropriate scoring: "Fisher's objective in proposing appropriate scoring was to score observations so that (a) they would fit the model as well as possible in a least squares sense and (b) the measurement characteristics of the observations would be strictly maintained." (Young & Hamer, 1987, p. 53)

The mathematical processes that generate dimension coordinates for the entities in terms of which the data are classified (see below) assume that the data they treat are measured at the ratio level. In order to produce these coordinates, then, the data as measured must be transformed to measures ('disparities') for which it is reasonable to assume ratio properties. Speaking geometrically, the space into which the data structure is projected is metric whereas the data themselves may be non-metric. From this perspective, MDS might be conceived of as a set of procedures for revealing the 'latent metric structure' in data that may itself be non-metrically measured.

If it is assumed that the level of measurement is as high as interval, this implies estimation of an 'additive constant' that when added to the data yields a scale with a 'true' zero. It is typical of MDS that this constant is estimated by optimising the fit of the transformed data to the model or which, following Messick and Abelson (1956), minimises the dimensionality of the space. If it is assumed that the level of measurement is lower than interval (ordinal or nominal), transformation of data to disparities involves monotonic transformation of response scales

in addition to estimation of additive constants. The development of non-metric scaling owes much to the work of Shepard (1962) and Kruskal (1964), with the latter having developed a 'least squares monotonic transformation' procedu re, which obtains disparities that are simultaneously monotonically related to the data and an optimal least squares fit to the distances among the entities represented in the MDS configuration.

This brief description passes over many of the important principles and processes that underlie modern MDS but seeks to emphasise the centrality of concepts and processes associated with optimisation of fit of data to model and minimisation of dimensionality in the interests of conceptual accessibility of the underlying structure. Whilst the extent to which this represents domination of data by model as opposed to separation of what is important or systematic in data from what is less important or non-systematic is an interesting philosophical issue, this is perhaps best judged in the context of particular analyses which may be performed under varying assumptions that constrain the nature and extent of data to disparities transformations.

The ratio/interval distinction constrains additive constants to be zero or otherwise, and the metric/non-metric distinction constrains transformations to be linear or monotonic. Apart from these constraints, within the non-metric situation, tied data may be untied or constrained to be equal in the disparities (Kruskals' 'primary' and 'secondary' approaches to ties, appropriate when the data are considered to have been generated by continuous and discrete processes respectively). Further, the transformations may be specified to be separately applied within different 'partitions' of the data. This relates to specification of the 'conditionality' of the data: the same transformation may be considered to be appropriate over an entire two-way matrix (matrix conditionality) or it may be considered appropriate to separately transform each row (row conditionality) or each column (column conditionality). In the case where the data are three-way, in which the third way slices commonly represent subjects or experimental conditions, separate transformations are generally applied to each matrix (slice) for which matrix, row or column conditionality is specified.

The distinctions between whether the plot represents relations among the entities of a single mode (a 'simple' space) or the joint relations among the entities of two modes (a 'joint' space), and whether the models are two-way or include weights to represent the influence of a third way (or higher ways) on the relations among the first two ways might best be illustrated in conjunction with descriptions of specific models of the particular kinds they identify. Before moving on to that, however, we note the role of SVD (in this case SD, which is a special case of SVD for symmetric matrices) in MDS and so indicate its sometimes

hidden presence in a wide variety of multivariate data analysis models.

SVD is employed to determine the matrix **X** of coordinates of points in Euclidean space from the matrix **D** of Euclidean distances among them. There are two steps to the process: (i) the cosine law is employed to convert the distances in **D** into scalar products, collected in the matrix **B**, and (ii) SVD of **B** is employed to obtain the matrix of coordinates **X**.

(i) Assume that we have three points x_i, x_j, and x_k as the vertices of a triangle (in two-dimensional Euclidean space for simplicity) where the distances between them are d_{ij} as the length of the first side (x_i to x_j) , d_{ik} as the length of the second side (x_i to x_k) and d_{jk} as the length of the third side (x_j to x_k), and θ_{jik} is the angle between the first and second sides.

For this triangle the cosine law states that, $\cos\theta_{jik} = (d_{ij}^2 + d_{jk}^2 - d_{jk}^2) / 2d_{ij}d_{jk}$.

Re-arranging gives, $d_{ij}^2 + d_{jk}^2 - d_{jk}^2 = 2d_{ij}d_{jk}\cos\theta_{jik}$.

If we define $b_{jik} = \frac{1}{2}(d_{ij}^2 + d_{jk}^2 - d_{jk}^2)$,

then b_{ijk} is the scalar (i.e., ordinary) product of the distances between the points x_i and x_j and the points x_i and x_k and the cosine of the angle between the vectors from x_i to x_j and x_i to x_k: i.e., $d_{ij}d_{jk}\cos\theta_{jik}$.

Now, x_i may be any arbitrary point in the space (say the origin) and the scalar products b_{jik} may be defined relative to it. The distances d_{jk} between all pairs of points x_j and x_k, collected in the square symmetric matrix **D**, are replaced by the scalar products b_{jik} in the square symmetric matrix $\mathbf{B_i}$.

(ii) The matrix $\mathbf{B_i}$ collecting the b_{jik} may be decomposed by SD to give (in the notation employed previously for PCA), $\mathbf{B_i = ULU'}$.

As was shown by Young and Householder (1938), the rank of $\mathbf{B_i}$ (i.e., the number of non-zero eigenvalues) is the dimensionality of the Euclidean space and $\mathbf{X = UL^{1/2}}$ is the matrix of coordinates of the points representing the objects.

Accordingly, the coordinates of the points have been recovered from the distances among them. Cox and Cox (1994, p. 26) reveal that a configuration of points in n-1 dimensional Euclidean space can always be found such that the distances among them are equal to the pairwise disparities among n objects. They show also that the columns of **X** are oriented to principal components. Although, in the interests of production of plots of low dimensionality (obtaining parsimonious solutions), only the first few components (usually two or three) might be retained, MDS solutions are not normally obtained this way. Rather, the dimensionality of the solution is chosen a-priori and dissimilarity

to disparity transformations and coordinates found that maximise the fit between the disparities and the configuration distances. The 'alternating least squares' algorithm employed to the MDS solutions in the present research is the result of a joint effort among de Leeuw, Young and Takane (1976). As Young (p. 32) reports, "Takane combined his cubic solution for coordinates with Young's regression solution for weights and Kruskal's least squares monotonic transformation according to the alternating least squares principles developed by de Leeuw."

Two measures of fit generally accompany MDS solutions: RSQ, measuring the relation between the set of disparities and the set of configuration distances; and stress (or its square, sstress), an index of badness of fit not unlike the more familiar χ^2 and which is minimised by the solution. RSQ increases and stress decreases as the dimensionality of the configuration of distances increases. Accordingly, these indices are employed as indications of suitable dimensionality for solutions (see Spence & Graef, 1974).

Unweighted models

The term 'unweighted models' refers essentially to two-way models and is used to distinguish these from three-way models in which weights are employed to represent the influence of the third-way entities on the relations between the first two ways. Two-way models may be applied to one- or two-mode data, where in the one-mode case we (typically) have a square symmetric matrix of pairwise dissimilarity estimates and in the two-mode case we have a (non-symmetric) rectangular matrix of dissimilarities between each row element and each column element. Classical MDS (CMDS) solutions describe the information in one square symmetric matrix which is considered to be matrix conditional, and classical MDU (CMDU) solutions describe the information in one rectangular matrix which is usually considered to be row or column conditional.

CMDS

The classical Euclidean MDS model is defined by the expression,

$$d_{ij}^2 = \Sigma (x_{ia} - x_{ja})^2, \quad (4.15)$$

where d_{ij} is the distance in r-dimensional space between points representing the objects x_i and x_j, and a indexes the dimensions over which the summation occurs.

As described above, in a CMDS analysis, the dissimilarites in the square symmetric matrix of observations **O** are converted to disparities by estimation of additive constants and monotonic transformation of response scales (in non-metric analyses) which are fitted as closely as possible to

distances between pairs of points (in the matrix **D**) representing the x's in a configuration in a specified number of dimensions for which the matrix **X** contains the coordinates of the x's (rows) on the dimensions (columns). The distances in **D** are obtained by applying Equ. 4.15 to the pairs of rows ($\mathbf{x_i}$, $\mathbf{x_j}$) of **X**.

The configuration of points is a compact geometric representation of the perceived dissmilarities among a set of entities. What the configuration means, or its interpretation, depends upon what is known about the entities and the respects in terms of which they might be distinguished among. This information might be formal measures of the set of entities on a set of variables (which might be embedded, 'biplot-like', as vectors in the space) or less formal qualitative or descriptive data. In the research reported in Chapters 5 and 6, MDU configurations representing perceived dissimilarities among social groups are interpreted in terms of the accounts perceivers gave of their pairwise dissimilarity judgments, or in terms of the attributes they used to describe between-group commonalities and differences. An attempt might be made to interpret a configuration dimensionally - i.e., interpret its dimensions as principal components – although it is primarily distances among the objects rather than directions through their configuration that primarily represent the data. Other interpretational approaches focus on perceived structures, such as clusters (and distances among them), in the space.

CMDU

The classical Euclidean MDU model is defined by the expression,

$$d_{ij}^2 = \Sigma (x_{ia} - y_{ja})^2, \quad (4.16)$$

where d_{ij} is the distance in r-dimensional space between points representing row entity x_i and column entity y_j, and a indexes the dimensions over which the summation occurs.

If the rows are objects and the columns are attributes (e.g., cells are reverse-coded ratings of objects on attributes) we might expect either or both the 'true' origins and patterns of non-linearity of the attribute distributions over objects to vary with the attribute. This makes the data column

conditional: i.e., the origins and patterns of response non-linearity (or the measurement characteristics of the data more generally) depend upon or are common only within and not between columns. Decisions about conditionality depend upon substantive considerations and understandings about the empirical situation in which the data were generated.

In a CMDU analysis, the dissimilarities in the rectangular matrix of observations **O** are converted to disparities by estimation of additive constants and monotonic transformations (in non-metric analyses), separately within partitions of the data defined by the conditionality specification. These disparities are fitted as closely as possible to distances between (x,y) pairs of x and y points (in the rectangular matrix **D**) representing both the x's and y's in a configuration in a specified number of dimensions. The dimension coordinates of the x's are collected in the matrix **X** and the dimension coordinates of the y's in the matrix **Y**. As the dimensions to which both the x's and y's are referred are in common, these matrices may be 'stacked' to form the supermatrix **X** containing the coordinates of both the x's and the y's. The distances in **D** are obtained by applying Equ. 4.15 to x,y pairs of rows in the supermatrix **X**.

The configuration of x and y points is a compact geometric representation that displays both an estimate of the relationship of each x to the set of y's in terms as its distance from them and an estimate of the relationship of each y to the set of x's in terms as its distance from them. Such a plot is a point-point representation of the relations between two modes of data, analogous to the point-vector representations described previously as joint- or biplots.

An appealing feature of joint plots, whether of point-point or point-vector form, is that they do not require information external to the plot itself for their interpretation: i.e, interpretation is 'internal' rather than 'external'. However, collection of appropriate data requires pre-specification of the elements of the second mode (in terms of which, say, objects are described and distinguished) and thus violates one of the primary

motivations for MDS modelling: i.e., to build models on estimates of general similarity or in terms of respects that are cognitively implicit and only presumptively known to the researcher. Some notable properties of these two-way, unweighted Euclidean distance models are that the configuration of points is invariant over rotation, permutation, reflection, translation and dilation of the dimensions: i.e., the solution fixes the relative distances among the points in the configuration and these are unaltered by these 'movements' of the 'frame' within which it is embedded.

Weighted models

In moving from analysis of two- to three-or higher-way data structures the number of forms MDS analysis increases greatly. Young (Young & Hamer, 1987, ch.6) specifies the general Euclidean model (GEM) from which many distinct forms may be obtained by restraining one or more of its parameters, including the two forms employed in the present research. One of the parameters of the GEM is a matrix (array) of third-way weights which describe the influence of each element of the third way on the relations among the elements of the first two ways. These weights correspond functionally to the core array in 3PCA except that the third way is not reduced to components, with the MDS models considered estimating weights for each of its individual elements. The frontal slices (one for each element of the third way) of the weights array, which are square and symmetric with dimension equal to the number of dimensions of the space in which the first two ways are represented, may be diagonal or full, this condition distinguishing between two 'families' of analyses. In geometric terms, the effect of diagonal weights, referring most commonly to sources of data (subjects or experimental conditions), is to stretch or shrink each of the dimensions of the space representing the first two ways relative to the average source. Thus, diagonal weights represent the relative salience, importance or relevance of each of the dimensions of a common 'group' space defined on the first two ways to each source or element of the third way. An individual space representing each frontal slice of the data may be generated from the group space by multiplying the group space dimension coordinates by the square roots of their weights for that source. Sources may be better or worse fit by the solution as indicated by RSQ and stress indices for each, and an index for sources called 'weirdness' describes the non-proportionality of each source's set of

weights to the relative contributions of each of the dimensions of the group space to the overall fit of the model. The two forms of analysis discussed below both employ diagonal weights and are distinguished by whether the first two ways are one- or two-mode or whether the group space is a simple space describing the relations among one set of entities or joint space describing the relations between two sets of entities. Briefly, non-diagonal weights describe, for each source, both an optimal rotation of the group space and the relative saliences of these idiosyncratic directions.

Probably the most well known of three-way MDS analyses is the three-way two-mode diagonally weighted model (WMDS), called INDSCAL (individual differences scaling) by Carroll and Chang (1970) who first proposed it. Both this and the parallel three-way three-mode diagonally weighted model (WMDU) are employed in the present research.

WMDS (INDSCAL)

INDSCAL solutions describe the information in a set of square symmetric (two-way one-mode) matrices each of which is considered to be matrix conditional.

The INDSCAL model is defined by the expression,

$$d_{ijk}^2 = \Sigma\, w_{ka}(x_{ia} - x_{ja})^2, \qquad (4.17)$$

where w_{ka} is the weight of source k and dimension a.

Following the original concepts of McGee (1968), individual differences are modelled as consisting of two distinct components: differences in 'response style' (individual origins and patterns of non-linear response to scales), accommodated by separate transformation to disparities of each subject's data (i.e., frontal slices partition the data); and differences in 'cognitive style', here represented by the weights describing each individual's particular pattern of emphasis (relative to the group) on dissimilarities among the first-mode entities.

A feature of the INDSCAL model is that the dimensions of the group space cannot be rotated without reducing the fit of the model (Young & Hamer, 1987, ch.6). This is sometimes referred to as 'intrinsic axis orientation' (e.g., Harshman & Lundy, 1984a) with which may be associated the notion that being intrinsic in this sense indicates a likelihood that the constructs represented by the

dimensions are cognitively 'real', and in this case, socially shared with albeit different emphases. This sort of idea, and reification of components in general, is discussed in Chapter 10.

WMDU

WMDU solutions describe the information in a set of rectangular (two-mode) matrices each of which is considered to be row (or column) conditional. The (diagonally-weighted) WMDU model is defined by the expression,

$$d_{ijk}^2 = \Sigma\, w_{ka}(x_{ia} - y_{ja})^2. \qquad (4.18)$$

In this case, the group space is a joint space displaying the relations among the entities of the first two modes and the weights describe the relative emphases of sources on the dimensions of the space to which the entities of both the first and second modes are referred. We note in passing that diagonal weighting of the core array and commonality of the dimensions for the first two modes are among differences between WMDU and 3PCA.

WMDU is a relatively simple model given the inherent complexity of three-mode data and on that account, should a solution with acceptable fit and which is otherwise satisfactory be obtained, is straightforward and appealing. Unfortunately, WMDU, especially non-metric WMDU, appears to be particularly subject to failures to converge and solution degeneracies (Borg & Groenen, 1997). This is further discussed and illustrated in Chapter 7.

A research plan

The following five Chapters report a sequence of data collection and analysis processes directed towards building a three-mode model (groups by attributes by subjects) of a social categorical scheme. Those Chapters contain details of sampling and data collection protocols and, in the context of the particular sets of data they generate, further elaborate upon both the rationales for their inclusion and the models employed in the analyses. The broad structure of the empirical process is sketched below.

The data collected and analysed in Chapter 5 include estimates of pairwise dissimilarities among a set of health occupational groups together with verbal accounts of their attributional similarities and differences collected in 'interviews' from a sample of 20 Australian registered nurses. Further data consists of freely-formed clusters and hierarchical similarity structures together with their associated attributional accounts. Separate analyses were performed on the data from each nurse as 'case' studies, although only one case is reported. The primary analytic model is CMDS, employed to model the among-

group dissimilarity structure which is then interpreted 'configurationally' in terms of the associated accounts. The freely-formed clusters (higher-order categories) and hierarchical similarity structures were embedded in the configuration both as a means of assessing the extent to which these higher-order groupings were represented by coherent structures in the configuration and as a means of supporting the interpretational process. Cluster analysis on the pairwise dissimilarities (converted to similarities) was employed to assess the extent of correspondence between the freely-formed and analytically-derived clusters.

A sub-set (11) of the sample also rated the extent to which each of a set of attributes extracted separately from each individual's account applied to each of the 12 groups. These data were analysed by CMDU, and the CMDS and CMDU solutions compared in order to assess the influence on substantive conclusions of these different forms of data and analysis.

The data collected in the interviews are the primary source of attributional content in terms of which the data collection instrument employed for the research reported in Chapters7, 8 and 9 was developed. This is perhaps principal among the purposes of the interview phase of the empirical program. Other purposes include presenting the models in their simplest forms, researcher familiarisation with the concepts and language of the target population, and assessment of correspondences among substantive conclusions from different forms of data and analysis.

Chapter 6 reports an analysis of the aggregated pairwise dissimilarity estimates and accounts from the interview phase. The INDSCAL model is fitted to the 20 dissimilarity matrices to produce a group space configuration in four dimensions which is then interpreted dimensionally in terms of the aggregated accounts. Cluster analysis is applied to the averaged similarities to identify the hierarchical similarity structure among the groups.

Ten of the 11 individual groups by attributes matrices are analysed by a non-metric PCA model applied to a matrix constructed with the groups as rows and the subject by attribute combinations as columns. The group scores on four components are then compared to their coordinates from the INDSCAL solution in order to assess the extent of correspondence of the among-group structures as represented from these different forms of data and analytic models.

The principal purposes of these analyses are to obtain estimates of among-group structure from the global pairwise dissimilarity estimates of a sample of subjects and to compare that structure with that obtained from their ratings of the groups on attribute scales phrased in their own language. This is an intermediate phase of the research intended to link a set of individual sets of among-group dissimilarity estimates and their associated accounts to an aggregated set of ratings of the groups on a common, representative selection of attributes. Whilst the INDSCAL solution and its interpretation are descriptively very satisfactory it suffers a number of limitations: the sample is necessarily limited by the nature of the data collection process; interpretation of the among-group structure in terms of attributes is external and informal; and, related to

the last comment, the solution parameters do not include variables that describe among-attribute structure or its relation to the among-group structure and which might be used to locate the measurement model in some more general program of research. Moreover, the diagonal subject weights may be inadequate to express the variety of differences among subjects.

Forty four attributional phrases were selected to represent the several hundreds that had been extracted from the 20 sets of accounts. There were naturally many attributes referred to in common among the 20 subjects and other potentially distinct attributes were frequently used in conjunction or as re-expressions or elaborations of each other. Clearly, observation of among-subject commonalities in among-attribute structure in this phase of the research was necessary in order to compose the relatively small set (44) of representative attributional phrases to be employed in the self-report instrument. As Table 7.1 shows, a number of the attributes referred to in that instrument were compounds that the interview phase of the research indicated would be understood as composing relatively coherent attributional concepts.

Sixty registered nurses rated the extent to which each of the 44 attributes applied to each of the twelve groups on ten-point (0..9) scales.

Chapters 7, 8 and 9 report the analysis of this three-mode set of data. Chapter 7 describes the instrument, the sample and reports initial approaches to analysis of the data. These include PCA and MDU analyses on the data collapsed (averaged) over the subject mode employed as a means of obtaining a relatively simple and accessible representation of the 'basic' group by attribute structure. There are indications in comparing the two solutions that the point-vector PCA model may be more appropriate for the data and more useful than the point-point MDU model. The Chapter concludes with description of an attempt to fit the three-mode WMDU model. It was originally intended to employ the WMDU model for the 'ultimate' analysis of the three modes but, as has been previously observed, the solution was less than useful if not completely degenerate.

Chapter 8 reports a 3PCA analysis and describes a solution in three components for each of the group and attribute modes and two component for the nurse mode. The interpretation is relatively traditional in the sense that it attempts to interpret components largely as wholes and then to describe their relations in terms of the core array. However, the analysis departs from convention in two ways: the unrotated solution is interpreted, and the second and third attribute components are interpreted as conditional upon the first. The unrotated solution was interpreted because good sense could be made of it given what was already known about the structure of the data and because rotation would have interfered with the conveniently simple structure of the unrotated core array. Beyond these considerations, it was considered desirable to avoid the tendency to reify constructs associated with simple structure and to attempt to comprehend the solution as a whole. Although non-rotation is as arbitrary as any other rotation, unrotated

solutions have the advantage that the sequential variance maximising nature of PCA is retained in the solution making it possible (depending upon the variance breakdown) to interpret subsequent components as conditional upon the first while, without loss of too much information, ignoring its conditionality upon them.

Chapter 9 reports a joint plot approach to interpretation of the solution and attempts to identify higher-order structures among the groups and among the attributes in joint (group by attribute) component space by application of cluster analysis to the inner products inherent in the joint plot. An inner product there is the orthogonal projection of the point representing an element of one mode on the vector representing an element of the other mode (conditional upon the components of the third mode). Clustering the groups on their joint products over attributes, then, identifies sets of groups that are similarly treated by what is systematic in the attribute ratings and may identify higher-order categories among them that may have been accessed in cognitive organisation of responses to the ratings task. Parallel considerations apply to clustering the attributes on their joint products over groups. At this point we have a representation of the structuring of objects (categorisation) in terms of a structuring of attributes and an example of a model of a social categorical scheme (from various perceiver perspectives) which is consonant with the theoretical position described in Chapters 2 and 3.

Chapter 5

Twenty interviews: methods and a case study

This chapter describes the methods of data collection in 'interviews' with twenty registered nurses. The 'interviews' consisted of a sequence of open response, similarity judgmental, categorization and rating tasks, including pairwise dissimilarity judgments, free sorting, hierarchy construction and rating of stimulus objects on attribute scales as described below. Also described is the process of sampling both subjects and stimulus objects. Following description of the sampling and interview protocols, a detailed analysis of one subject's data, employing non-metric multidimensional scaling (MDS), cluster analysis (CA) and non-metric multidimensional unfolding (MDU; see Chapter 4) is presented as a case study example. Part of the data collected from this subject and the remaining nineteen subjects are reported in Chapter 6 where they are collectively analysed.

Sampling

Subjects

Experienced, practising registered nurses were recruited from a major NSW regional 'base' hospital (7), a small NSW public rural hospital (2), a public hospital in the ACT (2), a public general hospital in the Blue Mountains area of NSW (3) and a major private hospital in Sydney (6). There were four males and sixteen females, and minimum and maximum years of experience were three and thirty years (mean = 16.85 years, sd = 7.24 years). There were one each of nurses who described themselves as

'general nurse', 'community nurse', 'psychiatric nurse', 'accident and emergency nurse', 'critical care nurse', 'coronary care nurse', 'infection control nurse', 'occupational health nurse' and 'intensive care nurse'; three who described themselves as midwives; three as surgical nurses; and five as paediatric nurses. Whilst the sampling procedure was opportunistic within hospitals, the sample obtained is experienced and well qualified, and is, if weighted towards hospital-based nurses, relatively diverse in terms of rural-urban location, public and private employment and areas of specialisation. Although the sample is not sufficiently large either to be fully representative of the population of Australian registered nurses nor to allow for meaningful comparisons among nominal sub-groups, that was not its primary purpose. The results of the interviews were intended primarily to provide a basis for the development of an instrument that could be employed among a larger, more representative sample (see Chapter 7).

The interview process is demanding of subjects' time and attention, and many nurses naturally declined to participate. It might be speculated that those who did volunteer were particularly interested in the status of nursing as a profession and in relations among health occupational groups.

Objects

Stimulus objects were a number of occupational groups in the health sector. Strictly, because subjects were required to characterise and make judgments about occupational groups as represented by their group names, it is these group *names* to which subjects responded. It was necessary, therefore, to ensure that as far as possible the group names used as stimuli were such as are commonly used among nurses and that the groups named were comprehensible as wholes and not as sets of people whom nurses would naturally partition into distinctly different sub-groups.

The set of objects was to be not so large in number as to impose an unreasonable burden on subjects in terms of the number of pairwise comparisons implied. The number of pairs of a set on n objects is ½ n(n-1), so that, for 10 objects the number of pairs is 45; for 11, 55; for 12, 66; and for 13, 78. At the same time the set was to be not so small that the number of data points (pairwise dissimilarity estimates) was small relative to the number of parameters estimated in scaling analyses (number of objects by number of dimensions). A ratio of two data points per parameter estimated is usually taken as the minimum required for reliable non-metric scaling solutions (Coxon & Davies, 1982, p. 88). This provides confidence in the reliability of two-dimensional solutions with as few as nine objects and in three-dimensional solutions with as few as 13.

Clearly, some compromise was here called for: thirteen objects implied an unacceptably large 78 pairwise comparisons yet it appeared likely that, for some subjects, three-dimensional solutions may have been appropriate. It was decided to limit the number of objects to twelve and to interpret three-dimensional solutions, where model fit statistics and configurational interpretability called for them, with a degree of caution. However, it is only in analyses of single (individuals') matrices where this is of concern as sets of matrices greatly increase the data points to parameters ratio.

Beyond these considerations, the set was to be inclusive of the more prototypical exemplars of the superordinate category 'health occupations' and provide for sufficient variety among the groups to allow for discrimination among them along several dimensions.

A discussion was initiated among nurse academics at Southern Cross University as a means of achieving these sampling objectives. They were informed of the nature of the study and of the common usage, homogeneous groups, set size, prototypicality and sufficient range criteria and asked to contribute group names to a blackboard list. Following discussion of the blackboard list in terms of the sampling criteria, each participant was asked to construct and contribute a list of twelve occupational group names. These lists were then used to select the following twelve health occupational group names to be used as stimulus objects (Table 5.1):

Table 5.1: Stimulus objects (health occupational group names) and their object codes

Occupational group	Object code
dietitians	DT
enrolled nurses	EN
general practitioners	GP
occupational therapists	OT
pharmacists	PH
physicians	PN
psychologists	PS
physiotherapists	PT
resident doctors	RD
registered nurses	RN
surgeons	SG
social workers	SW

Interview protocol

The 'interviews' consisted of an ordered sequence of tasks.

Introduction

The project was introduced to subjects as follows:

The project is a study of registered nurses' perceptions of their occupational environment. As part of the process of 'professionalisation of nursing', we believe that many nurses are

re-evaluating their professional identities and that an important aspect of this is a process of inter-group comparison and contrast - comparisons and contrasts between nurses and other groups, and between other groups. In particular, we're interested in nurses' beliefs about the nature of various occupational groups in the health system, the ideas they use to categorize and distinguish among them, and how they use these ideas to define themselves and their role as registered nurses.

This sort of information has implications for nurses' self-esteem, for the relations between nurses and members of other professional groups, and for the functioning of multi-disciplinary teams of health workers.

Occupational groups to be considered are dietitians, enrolled nurses, general practitioners, occupational therapists, pharmacists, physicians (non-surgical medical specialists), psychologists (counsellors), physiotherapists, resident doctors, registered nurses, surgeons and social workers.

The interview is designed to elicit your spontaneous ideas rather than your answers to a set of questions. You will be asked to sort occupational title cards - cards on which the names of the occupational groups are written - into categories according to the ways in which you see their members and roles as similar and different. As you are performing the task, you will be asked to describe the bases of the judgments you are making. Your comments will be recorded on audio-tape and subsequently summarised.

Nurses who have gone through the exercise on a trial basis have said that they found it to be interesting if somewhat taxing. If approached in a relaxed fashion, the interview takes about an hour and a half to two hours. If you begin to feel exhausted, we can take a break.

If you're ready, I'd like to begin by asking you to provide some background information about your training, experience and so on.

Background information

Biographical information was collected from subjects including their sex, age, years as a registered nurse, type of training (hospital-based, tertiary or both), specialisation (if any), current position and 'opinion of nursing as an occupation'. These data were taken by the interviewer and recorded by him on a 'background information form'. Occasionally, with less forthcoming subjects, responses to the 'opinion of nursing' question were prompted with "What are some of the good things about being a nurse?" and "What are some of the bad things?" Apart from the data it provided, this question was intended to encourage the subject to begin thinking about the experience of being a nurse in his or her social / occupational context.

Occupational description

Subjects were presented with a set of 12 occupational title cards and asked to,

Briefly look through the cards and think about what kinds of people are members of these occupations. In other words, what most of the members or what typical members of these occupations are like. We are more interested in your impressions of people as you find them in their occupational roles than in what you might think they are like at other times.

Further elaboration was provided as,

Think about what sorts of people are attracted to the different occupations in the first place...what characteristics they need to do their work...what characteristics their jobs seem to bring out in them...what they think of themselves...how they relate to other people...what motivates them...that sort of thing.

After looking through the cards, subjects were asked to,

Please say something about your impressions of members of each of these occupations. What are they like as a rule? What is a typical member like?"

Subjects' responses were recorded on audio-tape for transcription.

This part of the interview had a number of objectives: to inform subjects of the basis for comparison to be employed in the subsequent pairwise dissimilarities task and to encourage them into that mode of thinking; and to provide data, additional to that collected in that task, with potential to contribute to interpretation of the scaling configurations. This phase of the interview also represented an opportunity for the interviewer to indicate the amount and specificity of the information required in subsequent tasks, which were often performed by subjects with very little further prompting from the interviewer.

Pairwise dissimilarities

Subjects were presented with a set of 66 pairs of occupational titles cards (i.e. one card for each pair of the 12 groups), in random order, and cards labelled with the phrases 'Most different', 'Most similar' and the integers 1, 2, 3, 4, 5, 6, 7, 8 and 9 were laid out before them on a table as below (Figure 5.1):

Most
Most
similar
different

1 2 3 4 5 6 7 8
9

Figure 5.1: Table layout and response scale for the pairwise dissimilarities task

They were then asked to,

Please sort the cards into columns beneath the numbers to indicate how similar or different the people in each of these pairs of groups appear to be to you. Pairs of groups that you think are more similar than different are close together - separated by smaller distances -represented by the smaller numbers, and groups that you think are more different than similar - separated by larger distances - represented by the larger numbers. You can put as many or as few cards together under each number as you like. Please comment on what you are thinking as you sort the cards. We need to understand something about what you had in mind when you were sorting the cards. It would be helpful if you would describe what characteristics you think the groups have in common and what characteristics you think distinguish between them.

Subjects' responses were recorded on audio -tape for transcription.

The objective of this part of the interview was to collect estimates of pairwise dissimilarities to be submitted to MDS analysis and simultaneously to collect accounts of perceived (dis)similarities in terms of characteristics or attributes to be used both to support interpretation of the MDS configurations and as items for rating scales.

Following completion of this part of the interview, the cards were stacked in order with their category numbers interposed and bound for later coding. A blank pairwise dissimilarities coding form is present as Table 5.2.

Table 5.2: Pairwise dissimilarities coding form

	DT	EN	GP	OT	PH	PN	PS	PT	RD	RN	SG	SW
DT	-	-	-	-	-	-	-	-	-	-	-	-
EN		-	-	-	-	-	-	-	-	-	-	-
GP			-	-	-	-	-	-	-	-	-	-
OT				-	-	-	-	-	-	-	-	-
PH					-	-	-	-	-	-	-	-
PN						-	-	-	-	-	-	-
PS							-	-	-	-	-	-
PT								-	-	-	-	-
RD									-	-	-	-
RN										-	-	-
SG											-	-
SW												-

Free sorts

Subjects were presented with a set of 12 occupational titles cards, in random order, and asked to,

Sort the cards into piles, as many or as few piles as you wish, so that each pile contains occupations which have members who are

similar and the different piles contain groups of occupations whose members are different in some way.

When you finish this sort I'll ask you if you can think of another way to do it. So, if you like you can do several different sorts based on different kinds of characteristics. You might like to do one based upon your impression of overall similarity and others based upon particular different kinds of similarity.

When a subject had completed a sort, he or she was asked,

Can you describe what the people in each pile have in common and how they are different from the people in the other piles?

Upon completion of a sort and accounting for it, subjects were asked,

Can you think of another way to do it?

Subjects' verbal responses were recorded on audio-tape for transcription.

The purposes of these data were two-fold: to assess the correspondence between freely-formed clusters and both analytical cluster solutions and relatively coherent groupings of the objects in the MDS configurations, and to use the accounts of their similarities and differences to assess, support or elaborate interpretation of the configurations. Such clusters identify superordinate categories at intermediate levels of generality between some overall superordinate and the level of the individual groups (identities).

Subjects generally found this task relatively easy to perform. However, their investment of time in it was largely dependent upon how long they had spent on the previous tasks. Whereas some subjects produced up to three sorts, others were content to produce one that they considered to be the most important.

Hierarchy construction

A description of what was required in this task was provided to subjects as follows,

In this exercise, we want you to construct a kind of 'tree' in which the branches connect occupational groups whose members are similar in one way or another. It's a bit like a game in that you are asked to make moves and are given choices about what kinds of moves you can make. I'll demonstrate this in a minute, with a small set of names of foods. At each move, you can do one of three kinds of things: you can match two groups because you think their members are similar (we call this 'matching'); you can connect a group to an already existing pair because the members of the third group are more or less similar to the members of the already existing pair (we call this 'chaining'); or you can join whole sets of groups because the members of each set have something in common (we call this 'joining'). Because there are twelve groups, there are eleven moves and, in the end, all branches are connected to form a 'tree'. I'll show how it can be done with six foods.

This task was then demonstrated with a set of 6 cards on which were listed the food names apple, pear, banana, potato, onion and bread as follows,

I think that, of all these foods, apple and pear are most similar: they are both fruits, I think they are related genetically, they grow in similar climates, they taste alike - perhaps pears are a bit sweeter in general, and less crunchy. My first move is to match apples and pears.

I could match potato and onion next - they are both commonly used vegetables, especially cooked - but I don't think I will because bananas seem more similar to both apples and pears than potatoes are to onions. So, my second move is to chain bananas to apples and pears. But they are different (bananas), they're tropical, they look different, they're squishier (but pears can be squishy)...Still, that's my next move.

Next, I think I'll match potatoes and onions - they're more similar to each other than they are to either of the fruits and, as I said before, they're both common cooking vegetables - staples really - but onions do tend to be used in salads or on sandwiches more and they taste quite different.

I don't think I can use bread yet - the fruits seem more similar to the vegetables than bread does to either. So, I think I'll join the fruits and vegetables next - they have a different texture to bread - juicier - not grains - it's probably the most basic food really - it seems to go with everything.

The last move is to join bread to the fruits and vegetables - they're all foods.

So that's it. We have our food tree. Everything is connected.

At this point, subjects were presented with the set of 12 occupational title cards and asked,

Would you like to practice with the occupational groups before we get started? Its important to try to make the move that represents the next most similar connection at each step, so that we start with the most similar pair, then the next most similar pair or set of groups, and so on. When you're ready we'll start. Please say what you're thinking as you make your moves.

Subjects' verbal responses, prompted if necessary, were recorded on audio-tape for transcription.

This task provides a potentially rich source of data, both in terms of the sequence of perceived similarity - giving information similar to that obtained from the pairwise dissimilarities task, and in terms of clustering or higher order structure - giving information similar to that obtained from the free sorting task. As for the sorting data, the hierarchy structures were embedded in the MDS configurations and both the structures themselves and the accounts given of them were used to support interpretation of those configurations.

Although it was intended that the hierarchies be constructed in order of increasing similarity, it often appeared that subjects were able to anticipate the completed form of the structure and abandoned similarity order to build the structure more directly. Whilst step by step instructions without prior mention of the tree-building objective may be a more effective protocol for observation of hierarchical similarity structures, to the extent that subjects were aware of 'taxonomy-like' categorical structures prior to them emerging with progress of the sequential similarity judgment process is suggestive, in accordance with the discussion in Chapters 2 and 3, that judged dissimilarities may follow or co-occur with salience of an elemental categorical hierarchy.

Rating of stimulus objects on attribute scales

Upon completion of these tasks, subjects were asked whether they would be willing to complete a questionnaire to be subsequently sent to them by mail. It was explained that the questionnaire would contain statements they had made during the interview and that they would be asked to use a rating scale to indicate the extent to which each statement applied to each group. It was pointed out that the purpose of the questionnaire was to help form a more complete and reliable picture of the ideas they used to categorize and distinguish among the health occupations, in particular because it is often not clear from interviews, in which characteristics are mentioned in respect of one, two or a few groups, to what extent they are perceived to apply to each of the set of twelve groups.

As subjects had already made a substantial contribution of time and effort in the interviews, it was made clear that this was a free choice and that they were in no way obliged to volunteer for this further task. Fourteen subjects agreed to be sent a questionnaire and eleven returned completed forms.

Subjects generally employed around thirty relatively distinct ideas in categorizing together and distinguishing among the twelve occupational groups. Following transcription of the audio-taped accounts and interpretation of the MDS configurations, statements representing these ideas - each of which identified an attribute - were collected for use as rating scale items.

The questionnaire was formatted as a matrix, with rows as attribute statements (e.g. 'have a scientific attitude') and columns as groups, with cells to be filled with the integers 0 to 9 to indicate the extent to which each attribute applies to each group (Figure 5.2):

never/not at all (0) . (1) . (2) . (3) . (4) . (5) . (6) . (7) . (8) . (9) always/very much so

Figure 5.2: Response scale for rating stimulus objects on attributes

The main purpose in obtaining these data was to compare configurations generated from them with those generated from direct judgments of pairwise dissimilarity. The underlying objective was to estimate the extent to which ratings of objects on attribute scales, with items constructed from subjects' own accounts, produced results conformable to those obtained from their direct judgments of dissimilarity.

Further, however, whereas configurational interpretation (i.e. interpretation of the relations among objects in terms of attributes) to this point is external and not, perhaps, highly determinate, these multivariate data may be analysed by MDU to represent both the objects and the attributes in the same space (simultaneously representing relationships among objects, among attributes and between objects and attributes) offering an internal and more determinate interpretation (see Chapter 4).

An example in detail: RN002

RN002 was the second subject interviewed and the first to return a questionnaire rating the objects on attribute scales. A 39 year old woman with 19 years nursing experience, she is a hospital trained paediatric nurse who considers nursing to be 'caring', 'helping to get well' and 'working as a team'.

Global interpretation of the interview transcript

RN002 focuses more on the nature of the roles of the various groups than on the characteristics of their members and states that she judges them specifically from the perspective of her paediatric ward. From this perspective, she sees experienced paediatric nurses, but also experienced enrolled nurses, and paediatricians as central. Others are called in ('outreach') to help in various ways according to their specialised skills (related to certain 'needs' of the patients): "ju st call in the physiotherapists for their specialised field"; "we both call them in for their different... (SWs, PTs)": "outreach systems - still part of the team (OTs, PTs)".

Doctors seen as less central to the ward's functioning than paediatricians are sometimes seen as interfering (e.g. GPs: "even though they are admitted under a paediatrician will still try and change their treatment...like just can't let go") or ill-placed on the ward (e.g. RDs: "don't know how to associate with them as children"; "t hey haven't had the experience"; "he isn't dealing with adults"; "on the whole they usually try and help and we offer advice because we've seen all the symptoms before"). She views the expanded role of RDs relative to paediatricians following recent Health Department changes to the hospital-VMO (visiting medical officer, generally specialists) relationship with concern ("we've got the residents on first call...I'm not as happy with that") and will by-pass the RD, contrary to policy, to

ring a paediatrician who has suggested "You ring me if you're worried".

Her central concept in the health occupation domain is 'caring', which she uses in a number of senses. With respect to nurses (ENs and RNs), this is "caring for the body"; "immediate care for the patients all the time"; "nurses doing all the care" as opposed to (merely?) ordering treatment (GPs); "nurses are looking after them all the time"; "the nurse deals with the patient" as opposed to the patient's 'need' for drugs or diet. In terms of caring, she sees ENs and RNs as very similar. However, in view of the greater responsibility of the RN – drugs, "iv's" (intra-venous injections), "bureaucracy", "legality" - the RNs role "it's not as straight caring". She values ENs highly: "they play a very important role in our ward...they do know the symptoms ... you can rely on their information, their diagnoses" and, interestingly, "they do it as a group". This latter comment is associated with the "working as a team" idea which, she feels, has somewhat diminished with changes in the RNs role and the growth of the local hospital: "it's not the family as it was ... you don't really get to know the people you nurse with ... but on the whole we are still caring just the same ... we try to help each other work as a team". There is some suggestion that the greater responsibility of the RN tends to individualise her role.

Whilst 'caring' is used as almost definitional of the nurse, she does not deny the appellation to the other groups. Rather, she distinguishes among kinds or ways of caring. In particular, she distinguishes between "immediate care" "for the patient" "all the time" from caring for particular 'needs', such as for diet or drugs, or for their 'problems', such as in their home lives (SWs) or in their minds (PSs). These distinctions among ways of caring are related to the various specialised roles and are largely used to characterise them. 'Specialised', in turn, is used in two senses: the first distinguishes between 'levels' of knowledge, skill or expertise within otherwise similar roles: "surgeons are more specialised in their care and the general practitioners are just the basic care"; "resident doctors haven't got the specialised field paediatricians have got"; "they're both caring but the physicians have got the more specialised field (RDs)"; "physicians have got the more skill even though we're both caring (RNs)"; "physicians have that extra expertise but they're both doctors (GPs)"; "on different levels (ENs, GPs)".

As used in the second sense, 'specialised' distinguishes between role fields and carries a hint of a 'narrowness' notion: "he just comes in and orders the treatment and we ... we do all the caring (GPs)"; "one's caring for their medical needs and one's caring for their social problems" (GPs, SWs: but both are dealing with "in our ward...not the most serious things"); "carers, but pharmacists doing the drugs and occupational therapists caring for their

different needs"; "both caring for their needs in their own specialised fields (OTs, PNs)"; "basically registered nurses doing all the care and just call the physiotherapists for their specialised fields"; "we both call them in for their different ... (SWs, PTs)".

Two further distinctions, previously mentioned but yet to be illustrated, crossover to characterise the specialisation of roles: between caring for patients 'hands on' and a more distant caring for their 'needs', and between caring for patients' bodies and caring for their minds or social problems. The 'hands-on' versus distant caring distinction is exemplified in contrasts between DTs and PHs and a number of other groups: "the occupational therapist is caring for the patient and the pharmacist hasn't really got a lot to do with the patient"; "physician's got more to do with the patient...dieticians play a small(er) part than the physicians"; "one's caring for the needs, one's caring for the patients (PHs, PTs)"; "one's looking after the patient ... (DTs, OTs)"; "nurses are looking after them all the time and the pharmacist just comes up to the bed and looks at drugs"; "one's looking after the drug side and they don't have a lot of contact with the patient"; "one's dealing with the patients in lots of ways and the other comes up and sees the patient and only has dealing with the food (PTs, DTs)"; "the nurse deals with the patient ... but the pharmacists' main ... just drugs"; "both ... don't have a lot to do with patients (DTs, PHs)".

With respect to the body-mind distinction, carers for the body may be medical or non-medical (e.g. OTs, PTs) and others may be carers for mental or social problems. Some groups are carers for both medical or bodily and mental or social wellbeing: GPs are seen as similar to SWs in that "they're both with the home problems" ('lesser' problems from the perspec tive of the ward); GPs are seen as similar to PSs because "the general practitioner has a lot to deal with the patients' problems as well"; RNs are similar to PSs in that "I think a lot of times registered nurses have to be sometimes called on to help with their problems" and SWs to ENs in that "they're all very caring and that ... because they are called on to help with problems". Beyond these overlaps, dealing with patients and their bodies is frequently contrasted to dealing with their minds or 'problems': "one's caring for their medical needs and one's caring for their social problems (GPs, SWs)"; "they work in together, social workers and psychologists, similar roles"; "one's playing with their minds and one's playing with their bodies (PSs, GPs)"; "on e's dealing with the mind and one dealing with the body (PSs, PTs)" and "resident doctors are dealing with their body and illnesses and psychologists are dealing with their minds and problems".

Dealing with patients bodily is contrasted to dealing with their bodily needs such as for diet and drugs: "one's caring for the needs and one caring for the patients (PHs, PTs)"; "one's looking

after the patient...(DTs, OTs)"; "one's looking after the food department and one's looking after the body (DTs, RDs)"; "one 's dealing with the body and one's dealing with the diet side (PTs, DTs)" and "one's dealing with the patients' dietary needs and the other's dealing with the body as you'd call it (DTs, RDs)".

In sum, 'caring' characterises the health occupations as a whole but for nurses caring is general, immediate, constant, hands on and bodily. Medical care is distinguished from other kinds of bodily care, hands on care is distinguished from more distant caring for bodily needs and medical-bodily caring is distinguished from caring for social and mental problems. 'Specialisation' serves to distinguish between different kinds of care and between levels of skill or knowledge within similar kinds of care. Nurses and paediatricians in particular, but medical carers more generally, are at the core of the ward's activities and others are more peripheral (but still part of the team) being called in for their special skills. GPs and SWs work at the interface of the ward and the community and, within the ward, the RN, located close to the patient, relates to both the medical and non-medical carers, thus playing a focal role in the health care team.

Interpretation of the multidimensional scaling solution

The numeric data from the pairwise dissimilarities task (Table 5.3) were non-metrically scaled in two and three dimensions with ties untied (2D stress = .108, RSQ = .943; 3D stress = .042, RSQ = .984). Although the three-dimensional solution offers only small improvements in stress and RSQ values over the two-dimensional solution, all three dimensions are interpretable and the third dimension most clearly separates the nurses from the other groups. Consequently, the three dimensional solution was chosen for interpretation (Figures 5.3, 5.4 and 5.5). Figures 5.3, 5.4 and 5.5 are the three projections of the three dimensional configuration on to each pair of the three dimensions.

Table 5.3: RN002: Perceived pairwise dissimilarities

	DT	EN	GP	OT	PH	PN	PS	PT	RD	RN	SG	SW
DT	-	-	-	-	-	-	-	-	-	-	-	-
EN	9	-	-	-	-	-	-	-	-	-	-	-
GP	9	8	-	-	-	-	-	-	-	-	-	-
OT	9	5	6	-	-	-	-	-	-	-	-	-
PH	2	9	7	9	-	-	-	-	-	-	-	-
PN	9	9	2	8	7	-	-	-	-	-	-	-
PS	9	9	6	2	7	4	-	-	-	-	-	-
PT	9	8	8	3	9	9	9	-	-	-	-	-
RD	9	8	1	8	8	2	8	9	-	-	-	-
RN	9	4	7	5	8	5	7	7	5	-	-	-
SG	9	9	4	9	9	1	9	9	4	5	-	-
SW	9	7	4	2	9	8	4	4	8	9	9	-

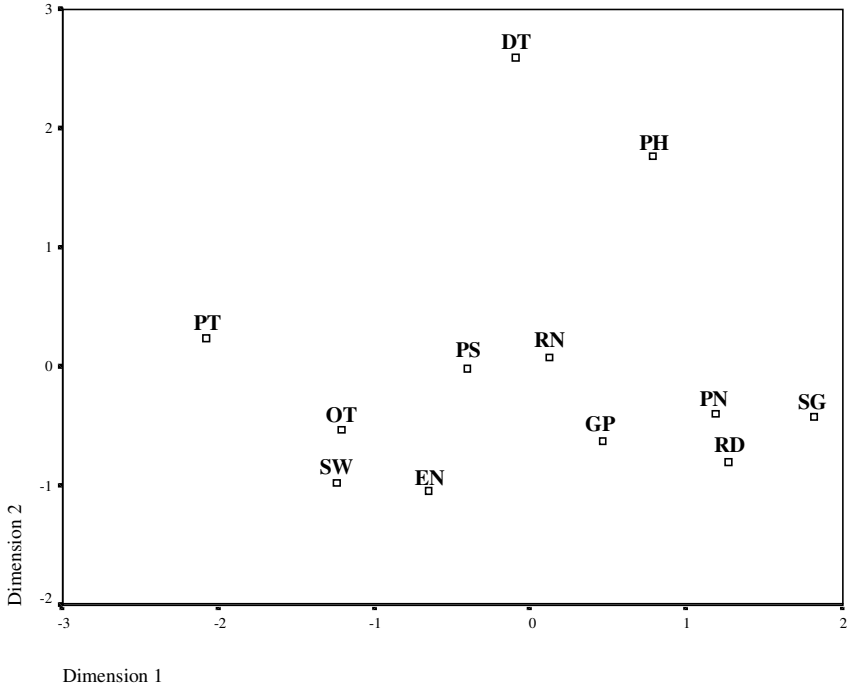


Figure 5.3: RN002: Three dimensional MDS configuration, dimension 2 by dimension 1

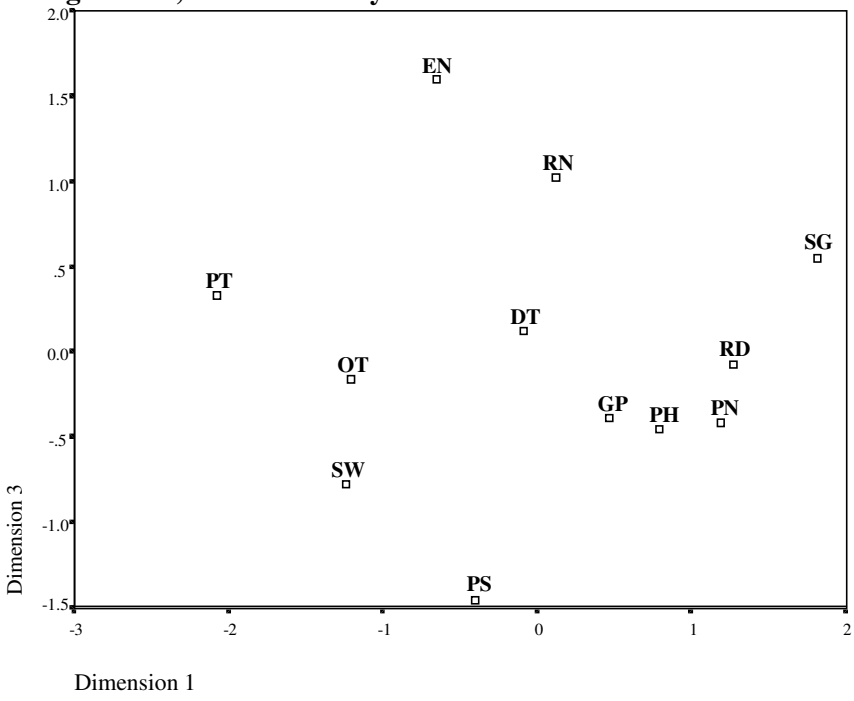


Figure 5.4: RN002: Three-dimensional MDS configuration, dimension 3 by dimension 1

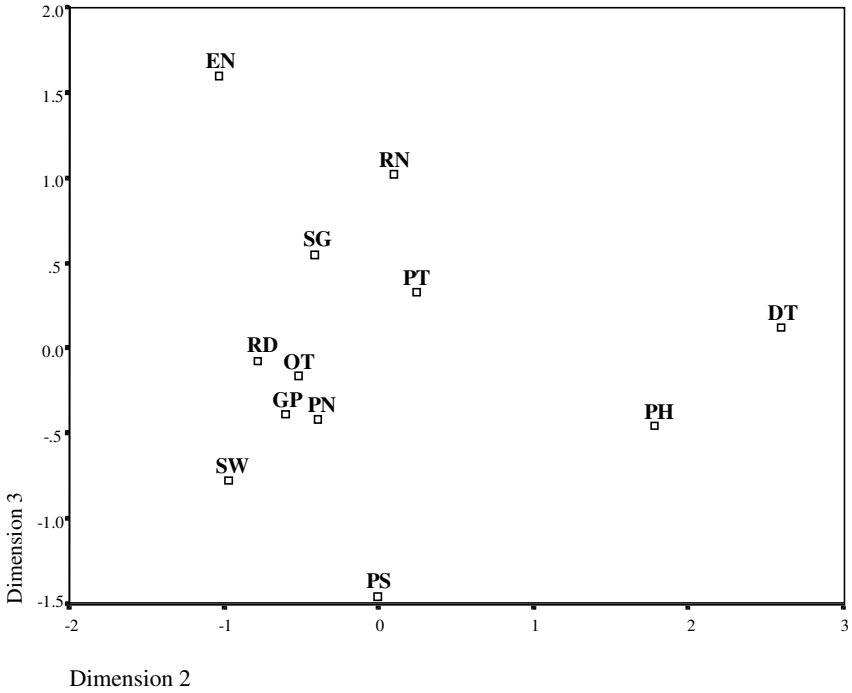


Figure 5.5: RN002: Three-dimensional MDS configuration, dimension 3 by dimension 2

Although, as described in Chapter 4, it is inter-object distances in the configuration space rather than their spread along orthogonal dimensions that primarily represent the data, it is nevertheless often possible to interpret configurations in dimensional terms. And although dimensional interpretation may be facilitated by rotation of the axes from their default orientation to principal components, dimensions oriented to principal components are often directly interpretable. Consequently, interpretation of unrotated dimensions was in each case attempted prior to resorting to rotation or searching for circular, radial or other structures.

The first step towards interpretation of the configuration was to link the fifteen most similar pairs of groups (dissimilarities 1 to 4) in order to expose such clusters or other 'connectedness' among groups as may be present in the solution (Figures 5.6, 5.7 and 5.8). Although identifying the lowest dissimilarities in the configuration is often useful as a way to begin the interpretive process, it is not always so. Whilst in this case it provides a convenient initial focus, it remains that, in this research, it is subjects' accounts of perceived (dis)similarities that is the essential interpretive resource.

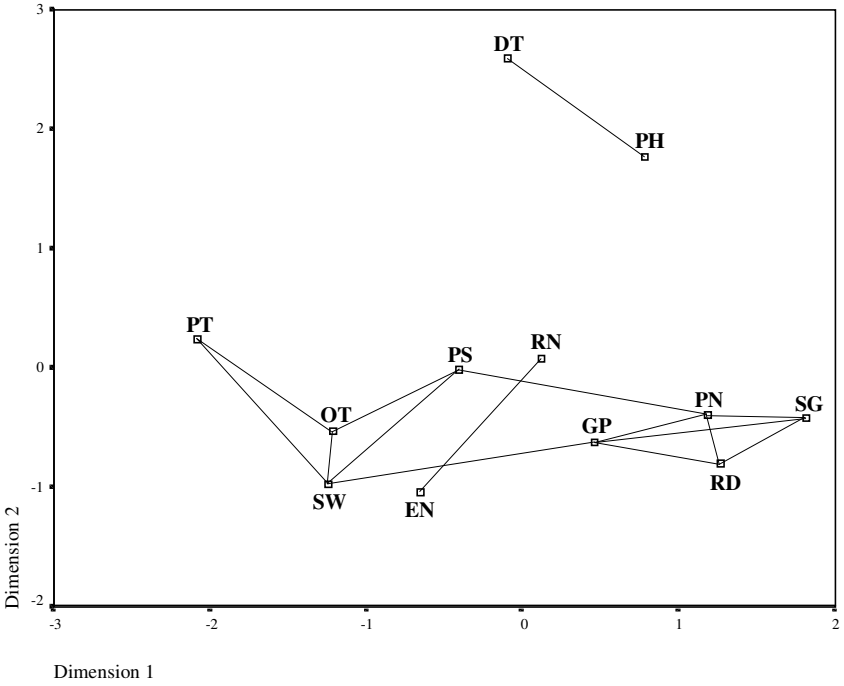


Figure 5.6: RN002: Lowest dissimilarities (1 - 4) embedded in the MDS configuration, Dimension 2 by dimension 1

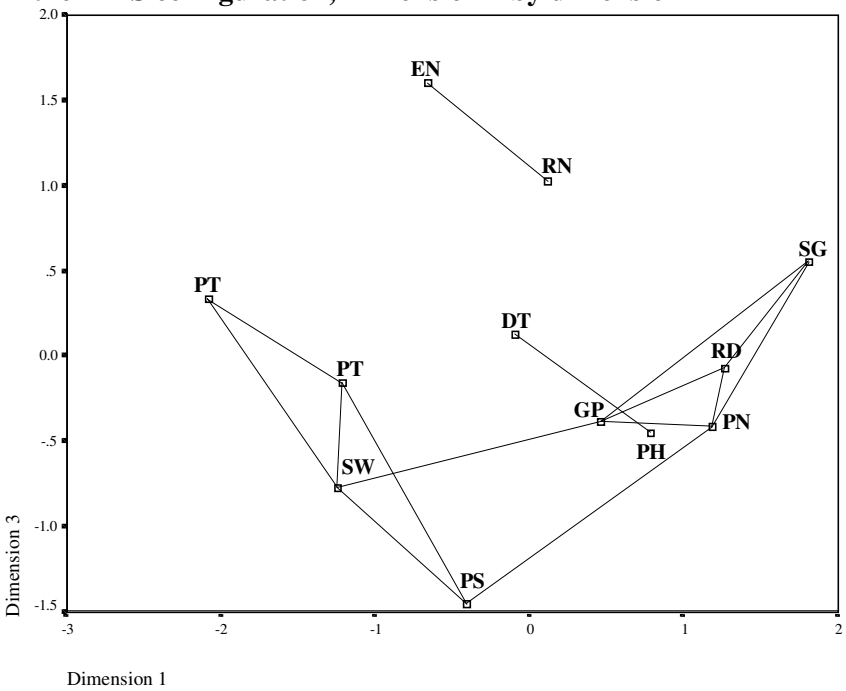


Figure 5.7: RN002: Lowest dissimilarities (1 - 4) embedded in mds configuration, dimension 3 by dimension 1

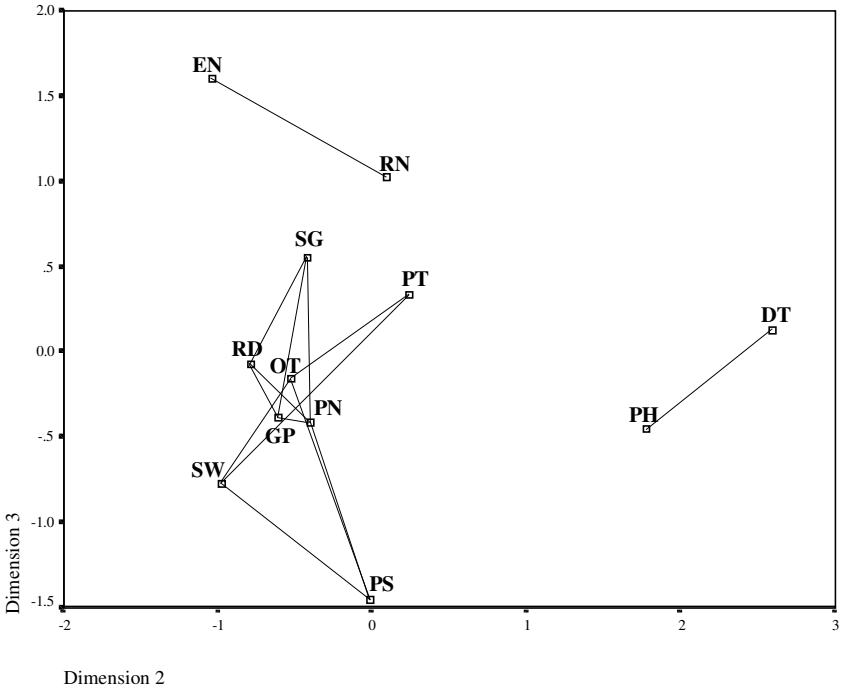


Figure 5.8: RN002: Lowest dissimilarities (1 - 4) embedded in mds configuration, dimension 3 by dimension 2

At this level of perceived similarity, each group is linked to at least one other and reveals four relatively distinct clusters (Figures 5.6, 5.7 and 5.8):

Cluster 1

The medical cluster in which each of GP, PN, RD and SG is linked to each of the others.

Cluster 2

A cluster of the non-medical professional groups OT, PT, PS and SW, each of which is linked to each of the others, except that PS is not linked to PT.

Clusters one and two are connected via links between PN and PS and GP and SW. Indeed, PS is perceived to be more similar to PN than to PT, this pair being perceived to be most dissimilar (9). Apart from the PS-PN link, however, PS is perceived to be more similar to each of the groups in cluster two (except PT) than to other groups in the medical cluster. PS and PN are seen as similar in so far as both are "specialists in their own field...they deal with special needs of the patients". There is evidence of confusion between psychologists and psychiatrists (e.g. mention of drugs in reference to psychologists) and usage of the word specialist with respect to both PS and PN may carry a medical connotation.

Whilst SW is linked to GP at level four, no other SW-medical link is closer than level eight. Similarity is

perceived between SW and GP in that "they are both with the home problems" and deal with "the lesser problems in our ward".

Cluster 3

The nurses' pair, RN and EN. Level 5 links occur between RN and each of the medical groups except GP (7) and with OT. This places RN closer to the medical cluster than to cluster 2. In contrast, EN is perceived to be more similar to OT (5) and SW (7) than to any other groups, placing EN closer to cluster 2 than to the medical cluster.

Cluster 4

The dietitians-pharmacists pair, DT and PH (level 2). Apart from their close link with pharmacists, dietitians are perceived to be most different (9) from all other groups. Similarly, pharmacists are perceived to be very different from all other groups except dietitians with links at level 7 being made between PH and GP, PN and PS.

As wholes, the four clusters are separated on the three dimensions as follows:

Dimension 1

Dimension one separates clusters one and two placing the nurses between with RN closer to the medicals and EN closer to cluster two. DT is also centrally located (between the nurses) whilst PH is aligned with the medical cluster, accounted for by the association of drug usage with the medical profession: PHs go 'hand in hand' with PNs and "physicians rely heavily on drugs" ("but they are not really the same"); RDs "have to deal with drugs (but with pharmacists its just drugs)"; GPs and PHs "both have dealings with drugs".

Broadly, then, in terms of the clusters as wholes, dimension one may be interpreted as a medical - non-medical dimension in which the usage of drugs is associated with the medical pole.

Although fine-grained distinctions on this interpretation of the dimension seem to be appropriate within the RN-EN and PH-DT pairs, they do not appear to be faithfully reproduced within clusters one and two. Although there is a drug association with PS, pulling it closer to the medical pole than the other groups within cluster two, there is no reason to assume that OTs and SWs are more medical or drug oriented than PTs. Similarly, although PNs and RDs are more closely associated with drugs than GPs, since they deal with critical problems whereas the GP is something of a social-worker, there was no mention of drugs in reference to SGs at all. Nevertheless, it is

possible that SGs are perceived to be quintessentially medical.

Relative levels of responsibility may also be associated with the spread of groups along dimension one. Certainly, within the nurses' pair, RNs are seen as having "a lot more responsibility" and are involved with "a lot of bureaucracy" and "lot of legality", whereas ENs "can't give drugs and look after 'i.v.s'". Among the medicals, PNs and SGs are seen as being more "specialised", and to have "extra expertise" and "a lot more responsibility" than GPs and RDs. There is little transcript, however, pertinent to deciding whether the responsibility interpretation applies within cluster two or between clusters one and two, although SGs are described as being "a lot more specialised in their caring of the patient" than OTs. Nevertheless, at risk of over-interpretation, medical training, specialisation, administration of drugs and responsibility all appear to be represented in dimension one.

Dimension 2

Dimension two essentially separates the dietitian-pharmacist pair from the remaining groups. Both DTs and PHs "don't have a lot to do with patients" and each is perceived to deal exclusively with a particular, limited domain of patients' well-being. Contrasts between DTs and PHs with other groups support this interpretation: {DT-PN} "physician's got more to do with the patient - caring for them." "Dietitians play a small part..."; {DT - OT} "one's looking after the patient..."; {RN -PH} "nurses are looking after them all the time and the pharmacist just comes up to the bed and looks at drugs"; {SW-PH} "one' s looking after the drug side and don't have a lot of contact with the patient..."; {PT-DT} "one is dealing with the patients in lots of ways and the other comes up and sees the patient and only has dealing with the food".

Dimension two is clearly interpretable, then, as opposing perceived limited contact with patients and narrow focus in their treatment among dietitians and pharmacists to more extensive contact with patients and broader focus in their treatment among the other groups. Finer distinctions on this dimension within clusters do not appear to be justified. However, it remains that, despite this apparently negative characterisation of dietitians and pharmacists, they are considered to be "in a lot of ways very helpful", to "have a very important part to play" (PH), to "play an important role" (DT) and to be "still part of the team" (DT).

Dimension 3

The nurses are more clearly separated from the other groups on this than any other dimension, whilst at the same time, PSs (and to some extent SWs) appear to be separated off at the other end of the scale. The nurses' roles are distinguished by their constant, immediate, hands-on, bodily caring and also by their teamwork nature. In response to the general question "what is your opinion of nursing as a profession?", RN002 replied, "Caring...caring for the body in a caring atmosphere, helping them to get well, basically working with others and working as a team".

Teamwork is perceived to characterise relations among nurses (ENs "do it as a group" and are "very good as a team, you can rely on them"; RNs "try to help each other and work as a team"), and also between nurses and other professional groups. This latter understanding of nurses' participation in the wider health-care team is apparent in two ways. Firstly, the nurses' role involves relating to patients in ways that are the specialities of other groups: e.g., ENs diagnose - "they do know the symptoms...you can rely on their...diagnoses a lot of times"; RNs "have...to do with the drugs"; nurses "stimulate" younger children in similar ways to OTs, having to "occupy the children's minds as well as looking after them in lots of ways"; and, "a lot of times registered nurses...have to be called on to help with (patients' psychological) problems".

Secondly, nurses participate in the wider health-care team in the sense of "calling in" other professionals for their special skills and in communicating and cooperating with them. In this sense, OTs, PTs and SWs are described as an "outreach" of the nurse: "social workers are called in but the enrolled nurse is the immediate carer"; "basically registered nurses doing all the care and just call in the physiotherapists for their specialised field"; OTs and PTs are "both an outreach of..." (nurse pointing to herself), and are "one of the outreach systems -still part of the team"; and SWs used to think of themselves as above...but now they're seeing themselves as a team...they come and ask us more". With respect to communication and cooperation, of RDs, it is said that, "on the whole they usually try and help and we offer advice because we've seen all the symptoms before"; and of GPs, "if you get a good general practitioner, he will work in with the nurses in lots of ways".

Whilst among nurses and between nurses and others team-work and a generalist role which overlaps with those of various specialists are seen as characterising nurses and

distinguishing them from other groups, the immediacy, constancy and hands-on nature of their manner of caring for their patients is their most salient characteristic: in comparing RNs with GPs, "we're both caring for the children but the general practitioner, he just comes in and orders treatment and we...do all the caring"; re. SWs, "the nurses are the immediate care for the patient all the time..."; re. PTs, "basically registered nurses doing all the care..."; re. OTs, PTs and PHs, "nurses are looking after them all the time..."; and re. PHs, "one's for drugs and one's for general nursing care".

Dimension three, then, distinguishes the nurses as generalist, immediate, team-working, constant carers from more specialised medical and non-medical groups. However, a body-mind distinction may also be discerned in this dimension. Although this distinction serves most clearly to separate PSs as players with minds and dealers with (mental) "problems" from others who deal more with medical and physical problems, SWs, who are seen as having "similar roles" to and "working together with" PSs, also appear to be separated from the more bodily carers. Briefly, to illustrate: {PS-GP} "one's playing with their minds and one's playing with their bodies"; {PS -PT} "one's dealing with the mind and one's dealing with the body"; {PS -RD} "resident doctors are dealing with their body and illnesses and psychologists are dealing with their minds and problems, so they're different". Also, for SWs: "general practitioners and social workers are dealing with the lesser problems on our ward...they're both with the home problems"; {SW -RD} "again, resident doctors dealing with their body"; {SW -PN} "to do with...different sort of problems"; and SWs "sort out the environment so the children go home to a better environment and so forth".

Although it may be too tidy not to be a coincidence, the body/physical - mental/social distinction seems also to be represented within clusters: PTs and OTs are more physical than SWs and PSs, SGs and RDs are more physical than GPs and PNs, DTs may be more physical than PHs (food and diet might be considered more physical than drugs) and RNs may be more concerned with social and mental aspects of their patients well-being than ENs whose role is more basic nursing care. If this kind of interpretation is appropriate, dimension three graduates from the generalist care of the nurses, through specialist physical and medical care to specialist social and psychological care.

Interpretation of the free-sort data

RN002 provided three separate free sorts (Table 5.4) of the twelve occupational title cards. Sorts one and two were based upon her own criteria, but sort three was requested to follow the criterion of 'the ways these people relate to their patients".

Table 5.4: RN002 freely sorted categories and summaries of accounts

Sort categories	Account
Sort 1	
PT, DT, PH, SW, PS, OT	non-medical professionals - 'called in' for their special skills
SG, PN, GP	more specialised doctors - 'called in' if RD can't handle
RD	on the ward - 'first call', less hands-on only than RN and EN
RN, EN	constant carers - hands-on all the time
Sort 2	
SW, PS	hands-on, but 'deal with minds more'
PT, OT	'hands-on, when they're called in'
DT, PH	'don't deal with the patients as such…not their bodies…not hands -on'
SG, PN	specialist doctors
RD, GP	basic level 'house doctors'
RN, EN	constant hands-on carers; 'there all the time'; 'major carers'
Sort 3	
PT, OT, SW, PS	hands-on when called in, more hands-on than SG, PN, GP (on ward)
DT, PH	not hands-on
SG, PN, GP	'just come and say hello, how are you feeling?'; consulted by RD
RD	'on ward most of the time'; relates to p more than other doctors
RN, EN	'relate to patients all the time'

Clusters, sub-clusters and overlapping clusters representing the sorts are mapped on to the scaling solution in Figure 5.9. Although it is informative to follow this procedure for each pair of the three dimensions in the scaling solution, most of what may be learned from this procedure is evident in the plot of dimension one versus dimension two.

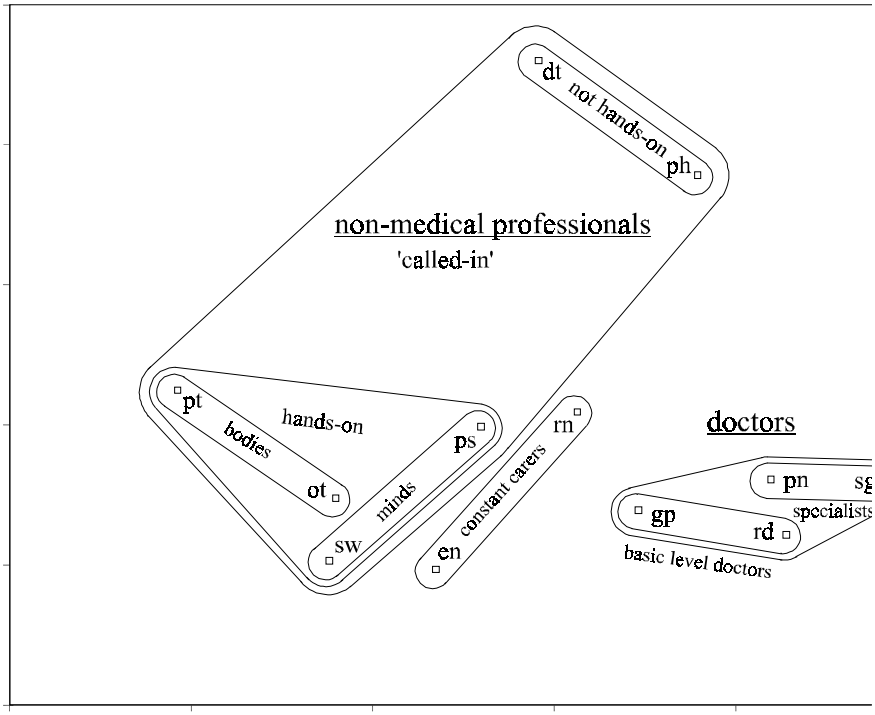


Figure 5.9: RN002: Freely sorted categories mapped on to the MDS configuration, dimension 2 by dimension 1

Sort 1

The first sort identified four categories of occupations, the first consisting of the six occupational groups that are neither doctors nor nurses. These professionals were grouped together because "they're not here (on the ward) all the time...they only come for specific needs...they're playing a role...but its only when they're called". The nurses are grouped together because "they're hands-on all the time", but the medical groups are divided into the RD alone and the set of SG, PN and GP. RDs "are there most of the time" and, apart from nurses, are "the next one's we see most of" and are "the next hands-on". The other medical groups "get called-on if the residents can't handle it", particularly the specialists, as "we don't see much of the GPs these days".

Although this sort was described as having been "done the way I see people treating the children...in my work on the children's ward", and this is captured in identification of nurses first and RDs second in the extent to which their work is hands-on, it also relates to the amount of time

spent on the ward, the inter-group communication paths by which various groups are "called in" and the reasons why. In this respect, RDs (but also nurses) call in medical expertise when they need it and, generally the doctors but occasionally the nurses, call in non-medical professionals for their special skills.

This sort clearly identifies nurses and RDs as the core of the paediatric ward's activities and goes some way towards validating the cluster approach to interpretation of the scaling solution. However, of the three sorts, the first was the least discriminating in the sense that it identified only four categories whereas sorts two and three identified six and five categories respectively.

Sort 2

Sort two was produced in response to "there might be other ways of classifying these groups, would you like to have another go?" and identified six pairs of groups. The four medical groups were re-sorted into the specialists (SGs and PNs) and the basic level 'house' doctors (RDs and GPs) who are "not as qualified" and "haven't got all the knowledge" that SGs and PNs have. The six non-medical professional groups were divided into pairs consisting of DTs and PHs, who don't "deal with the patient as such...not with their body... not hands-on"; PTs and OTs, whose work is hands-on, "as much as the nurses, when they're called in"; and the SWs and PSs, who "deal with the minds more" and who may be somewhat less hands-on than nurses, PTs and OTs. The nurses were again paired as "being there all the time" and "the major carers of the patients".

This sort goes further towards validating the clusters identified in the scaling solution and the nature of distinctions within the clusters. However, as the interview process progressed, judgments were increasingly made in terms of the nature of roles and the functioning of the paediatric ward and less in terms of the characteristics of group members. This is relatively safe territory in its apparent avoidance of stereotyping and inferences beyond immediate experience of the ward's activities. Since the first sort was described as being made in terms of "the way I see people treating the children", which has the potential to evoke characteristics of persons, but described in fact time spent and reasons for participation on the ward, it was decided to request a third sort in terms of "the ways these people relate to their patients".

Sort 3

Sort three, in terms of 'the ways the se people relate to their patients", identified five categories of groups and is identical to sort one except that DTs and PHs are separated as a pair from the other non-medical, non-nursing professionals on account of their lack of perceived hands-on involvement. Again, however, rather than styles or manners of relating, it was the amount of time spent with the patient and whether that time was spent hands-on that underlay these judgments. In this respect, PTs, OTs, SWs and PSs are perceived as being more hands-on than the medical specialists and GPs. A hierarchy of 'hands-on-edness' may now readily be perceived (Table 5.5):

Table 5.5: RN002 Categories of groups ordered according to perceived 'hands-on-edness'

Ordered categories of groups	Hands-on status
(1) EN, RN	hands-on and constantly
(2) RD	next hands-on, regularly
(3) PT, OT	hands-on but occasionally
(4) SW, PS	hands-on but occasionally and not physically
(5) PN, SG, GP	consultants on this ward but perhaps hands-on elsewhere
(6) DT, PH	not hands-on, consultants only

The sorts and the scaling solution

Whilst the sorts and their associated accounts emphasise the hands-on and centrality to the ward concepts, they correspond reasonably well to the previous interpretation of the MDS dimensions. The cluster approach to interpretation of the scaling solution is well justified by these free sort data: the medical - non-medical distinction is readily apparent, the nurses are separated off as constant carers, and dietitians and pharmacists are identified as not hands-on. The presence of the mind-body distinction is validated, at least among the non-medical groups, and the medical groups are distinguished primarily by levels of specialisation. The inter-group teamwork nature of the nurses' role is explicit, particularly in the sense that others are 'called in', as is their position at the core of the ward's activities. It is interesting to note that that RDs are now included in this, whereas in their initial characterisation they were considered somewhat to be interlopers.

The interview with this subject was held in two sessions about a fortnight apart. Apparent changes in conceptualisation of the RDs role may represent increasing acceptance of recent changes in the resident-specialist (RMO-VMO) involvement on the ward in the intervening period. However, RN002 may have become more conscious of the 'correctness' of her judgments and

accounts. There is some evidence of this in the way in which she subsequently responded to rating the groups on attribute scales, as described below.

At this stage of the interpretive process, relative levels of generality among ideas are beginning to emerge. At the most general level, medical, non-medical and nurses sets of groups are distinguished; then, among the medical groups, those at the 'basic' level ('house doctors') are distinguished from the specialists and, among non-medical groups, those that work hands-on with patients are distinguished from those that do not; and more specifically, among the basic level medical groups, residents on the ward are distinguished from those who are visitors or 'called in' and, among hands-on non-medical groups, those who deal with bodies are distinguished from those who deal with minds.

The hierarchy construction task sought more direct information about conceptual hierarchy.

Hierarchy

The data record from the hierarchies task - the subject's 'moves' and a summary of her accounts of them - are reported in Table 5.6. The hierarchy is represented diagrammatically in Figure 5.10 and mapped on to the dimension one by dimension two projection of the scaling solution as a set of nested clusters in Figure 5.11.

Table 5.6: RN002 Data record for the hierarchies task

Move	Type	Sets of groups	Summary comment
1	Match	SG-PN	Specialist doctors
2	Chain	(SG,PN)-GP	Doctors-called in
3	Chain	(SG,PN,GP)-RD	Doctors (completes medical team - see 10 below)
4	Match	EN-RN	Nurses
5	Match	DT-PH	Technical (non-medical, not hands-on)
6	Match	SW-PS	Social-mental (non-medical, hands-on)
7	Match	PT-OT	Physical (non-medical, hands-on)
8	Join	(SW,PS)-(PT,OT)	Hands-on non-medical
9	Join	(DT,PH)-(SW,PS,PT,OT)	Non-medical team
10	Join	Nurses-Medical team	Attempt to chain RN to medicals, EN to non-medicals
11	Join	Non-med - Med team	The health worker team - 'all carers'

Health workers (carers)

Non-medical team

Medical team

Basic level

Not hands-on		Hands-on		RD
			Nurses	GP
Technical	Social-mental	Physical		Specialists
DT-PH	SW-PS	PT-OT	EN-RN	SG-PN

Figure 5.10: RN002: Hierarchy

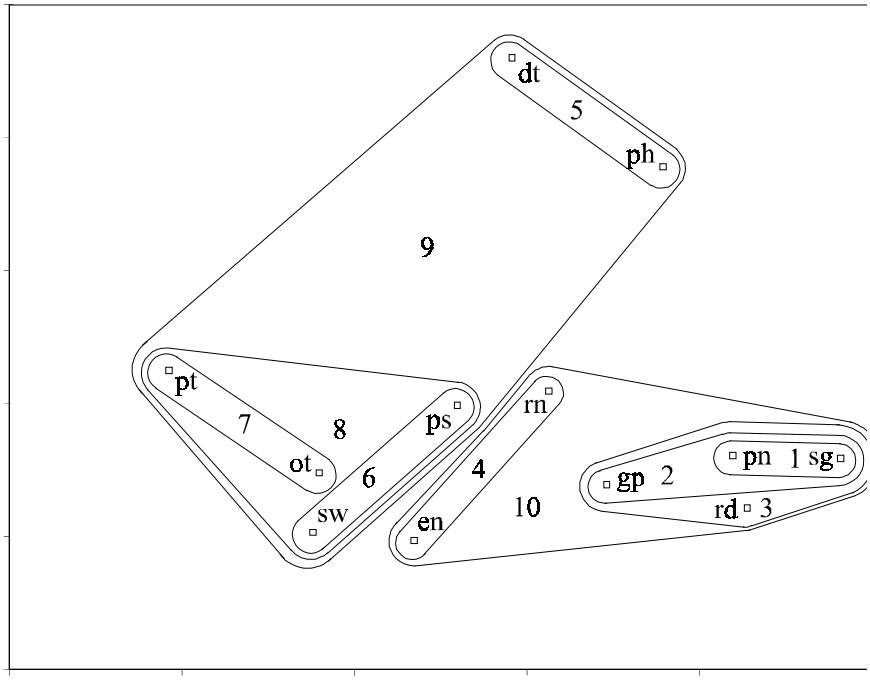


Figure 5.11: RN002: Nested clusters representing hierarchy mapped on to MDS configuration, dimension 2 by dimension 1

The moves taken and the structure revealed in the hierarchies task contain few surprises. However, the relative levels of generality of the essential ideas are now directly obtained. The commonality of all groups as 'carers' is emphasised as is the major distinction between the medical and non-medical 'teams' and the more detailed distinctions among the medical and the non-medical groups, previously observed, are re-affirmed. Although the overall structure is relatively familiar, the location of the nurses within it is interesting. Having paired the nurses early, the subject attempted to separate them, against the rules of the task, at the point of fitting them to the structure. She wanted

to chain the RN to the medical and the EN to the non-medical groups. This association of the RN with the medical and the EN with the non-medical groups has already been discerned in the pairwise dissimilarities data, but is here explicit. The distinction between the nurse groups in this respect is most likely associated with the RNs responsibility for the administration of drugs and perhaps higher level of responsibility in general. The RN-medical association is more specific than this, however. The subject's at tempt was specifically to match the RN to the RD, most likely on account of their commonality as at the core of the paediatric ward's activities. Also, in terms of knowledge and experience, there is a good deal of perceived overlap between the RD and the RN, as the transcript from the pairwise task testifies. On this basis, it is possible for the RN to assimilate to the RDs, whereas their relative levels of perceived knowledge and experience locate the other medical groups more distantly from the RN.

Overall, however, it should be observed that the nurse - medical groups association, and the association of the {DT, PH} pair are not a strong, emerging only towards the end of the agglomerative process.

Ratings of stimulus objects on attribute scales

The primary objective of this section is to examine the extent to which the results of the analyses of the directly obtained judgments in the pairwise dissimilarities, free sorting and hierarchies tasks are recoverable from multivariate data in the form of ratings of the objects on attribute scales where the attributes are based on the subject's accounts of among -object dissimilarities.

The subject's interview transcripts were combed for statements made to describe what pairs or sets of objects were perceived to have in common or which were perceived to distinguish between or among them. Each such statement identified an attribute that was perceived to apply to some extent to one or a set of objects. Each statement was used as the basis for construction of an attribute item on which the set of twelve objects could be rated according to a scale. The statements were reduced to a common form: for example, "They work well as a team with other occupational groups". The scale employed for this and, as the first, only this subject (see below) was:

Always = 5 Often = 4 Sometimes = 3 Rarely = 2 Never = 1

The questionnaire was formatted as a matrix with attributes as rows and objects as columns and was completed by filling the cells of the matrix with integers from the above scale. The data are presented as Table 5.7.

Table 5.7: RN002: Multivariate (attribute ratings by objects) data matrix

Always (5) Often (4) Sometimes (3) Rarely (2) Never (1)	DT	EN	GP	OT	PH	PN	PS	PT	RD	RN	SG	SW
They are very caring people	4	4	4	4	4	4	4	4	4	4	4	4
They care a lot about their patients' medical well-being	4	4	5	2	4	5	2	4	4	4	2	2
They care a lot about their patients' personal well-being	2	5	4	5	2	2	4	2	2	4	2	5
They care a lot about their patients' physical well-being	2	5	4	4	2	4	2	4	4	4	4	2
They care a lot about their patients' social well-being	1	4	4	4	1	4	4	2	4	4	4	4
They care a lot about their patients' mental well-being	1	4	4	4	2	4	5	2	4	4	4	5
They are nice, kind, friendly people	4	4	4	4	4	4	4	4	4	4	4	4
They are distant, aloof or peculiar people	2	1	2	1	2	2	2	2	2	1	2	1
They are reliable and dependable	4	4	4	5	4	5	4	4	4	4	5	4
They are temperamental or unpredictable	2	2	2	1	2	1	2	2	2	2	2	2
They work well as a team among themselves	4	4	4	4	4	4	4	4	4	4	4	4
They work well as a team with other occupational groups	1	4	2	4	1	2	4	4	2	4	2	4
They have a high level of knowledge and skill	4	4	4	4	4	4	4	4	4	4	4	4
They have a wide range of knowledge and skills	2	4	4	4	4	4	4	2	4	4	4	4
They communicate well with their patients	4	5	4	5	2	4	4	4	4	4	4	5
They communicate well with other occupational groups	1	5	4	5	1	2	4	4	2	4	2	4
They are experts among their colleagues	2	2	2	2	2	4	4	2	2	2	4	2
They work at the basic level in their field	2	2	2	2	2	2	2	2	2	2	2	2

They deal with a particular, specific aspect of their patients' needs	5	1	1	4	5	1	4	4	1	1	1	1
They are generalists who deal broadly with their patients' needs	2	5	5	2	2	4	2	2	5	5	4	4
They are close to their patients	2	4	4	4	2	4	4	4	2	4	4	4
They are distant from their patients	4	1	2	1	4	2	2	2	4	1	2	1
They have a lot of practical knowledge	2	4	4	4	2	4	4	4	2	4	4	4
They have a lot of theoretical knowledge	4	4	4	4	4	4	4	4	4	4	4	4
They have a lot of contact with their patients	2	5	2	4	2	2	2	4	2	5	2	4
They spend a lot of time with their patients	1	5	2	4	1	2	2	4	2	5	2	4
They work mostly 'hands-on' with their patients	1	5	2	4	1	2	2	4	2	5	4	2
They are more technical than personal in their roles	5	1	4	2	5	4	4	2	4	1	4	4
They are more personal than technical in their roles	1	5	2	4	1	2	4	4	2	5	2	4
They have a high level of responsibility	2	2	4	4	4	5	5	4	4	4	5	4
They have a wide range of responsibilities	2	2	4	4	2	4	4	4	4	4	4	4
They respect the knowledge and skills of other occupational groups	2	4	4	4	2	4	4	4	4	4	4	4
They are decision-makers	5	4	5	5	5	5	5	5	4	5	5	4
They are closely controlled in their work by the system or bureaucracy	5	5	4	4	5	4	4	4	4	5	4	4
They have a lot of freedom in how they do their work	2	2	2	4	1	4	4	4	2	2	4	4
They play a central role in the health-care system	5	5	5	5	5	5	5	5	5	5	5	5

In several respects, these are not good data: (a) a number of attribute ratings do not vary across objects, (b) some attribute ratings vary little across objects, and (c) the mid-point of the scale (3) was not used.

Attribute ratings that are constant across objects and their common values are presented in Table 5.8.

Table 5.8: RN002: Attribute ratings invariant across objects

Attribute statement	Common value
They are very caring people	Often
They are nice, kind, friendly people	Often
They work well as a team among themselves	Often
They have a high level of knowledge and skill	Often
They work at the basic level in their field	Rarely
They have a lot of theoretical knowledge	Often
They play a central role in the health care system	Always

The invariance of these attribute ratings across groups is not always easy to explain: 'caring-ness' and team-working were frequently mentioned in respect of the nurses who might have been expected to have been rated more highly on these attributes than some other groups; physicians and surgeons, frequently described as specialised and not hands-on, might have been expected to have been rated as having higher levels of knowledge and skill, and theoretical knowledge than say, enrolled nurses and resident doctors; and registered nurses might have been expected to have attracted higher ratings for centrality of role than some other groups on account of their role in coordinating and 'calling-in' others. That the subject should describe a group as "nice, kind, friendly people" (e.g. OTs) if they were in no way distinguished by this attribute is also puzzling.

It might be supposed that the subject had more control over the 'picture' she was creating in this than in previous tasks in which her largely implicit ideas were emerging piecemeal, or was becoming increasingly aware of her stance being documented and reported, and chose to represent herself more 'correctly'. In fact, being an early example, the interview process with this subject was detailed and extended in time giving her ample opportunity to observe, judge and modify her emerging representation; and, she was asked if she would permit her results to be reported to a Faculty meeting as an example of the methodology employed prior to completing the attribute ratings questionnaire. Whilst all 'interview' subjects were able to some extent to form and clarify their previously largely implicit representations as they emerged, none but RN002 had reason to expect his or her results to be singled out. It remains possible, however, that the tasks vary in the extent to which they elicit or facilitate 'correct' responses and that the attribute ratings task may be more susceptible to this effect than, for example, the pairwise dissimilarities task.

That some attribute ratings varied little across groups might be accounted for, at least in part, by the limited selection of scale

points available to the subject. Subsequently, ten scale points, rather than the five employed here, were used to allow for finer discrimination among groups and greater potential variation of attribute ratings across them.

Non-usage of scale point 3 is relatively easily accounted for: it was suggested to this subject that she should attempt whenever possible to commit herself one way or the other in answering the questionnaire. In response, her avoidance of scale mid-point was absolute. This suggestion was not made to subsequent subjects. The deficiencies of these data, however, do not detract from their usefulness as an example of analytical methodology, and, as the following analysis reveals, they carry considerable useful information nevertheless.

Analysis of the multivariate data

Three analyses are reported: constrained multidimensional scaling, multidimensional unfolding and agglomerative hierarchical cluster analysis. In the constrained MDS analysis a matrix of pairwise (object) dissimilarities computed as Euclidean distances between profiles of objects over attributes were ordinally re-scaled to optimise their fit to the direct dissimilarities configuration. Interest focuses on the RSQ value that provides an empirical measure of the extent to which inter-object distances derived from the ratings data correspond to the direct dissimilarities configuration distances. In the multidimensional unfolding model both objects and attributes are located in the same space to simultaneously represent similarities among objects, among attributes and (most importantly for present purposes) between objects and attributes. Interest focuses on the resultant characterisation of the objects in terms of attributes and its correspondence with the interpretation of the direct dissimilarities configuration in terms of accounts of inter-group (dis)similarities. The agglomerative hierarchical cluster analysis employed a matrix of pairwise (object) similarities computed as Euclidean distances between profiles of objects over attributes to obtain cluster solutions for comparison with the results of the free sorting and hierarchy tasks.

Constrained multidimensional scaling

This analysis enquires into the extent to which the object configuration from direct dissimilarity judgments is recoverable from the objects by attribute ratings data. A matrix of Euclidean distances among objects was computed from the attribute ratings and a three dimensional non-metric model was constrained to fit the direct judgments object configuration. Whilst it is correspondence between substantive interpretations of the direct judgments and objects

by attribute ratings data that is of primary interest, it is informative to note that the RSQ value from this analysis, representing the maximum possible correspondence between the object configurations derived from the direct judgments and the objects by attributes ratings is .69.

Multidimensional unfolding

Non-metric multidimensional unfolding models were fit in two and three dimensions (2D stress = .13, RSQ = .98; 3D stress = .07, RSQ = .99). There being evidently little improvement in fit in three over two dimensions, the two dimensional model is chosen. The two-dimensional point-point configuration is presented as Figure 5.12.

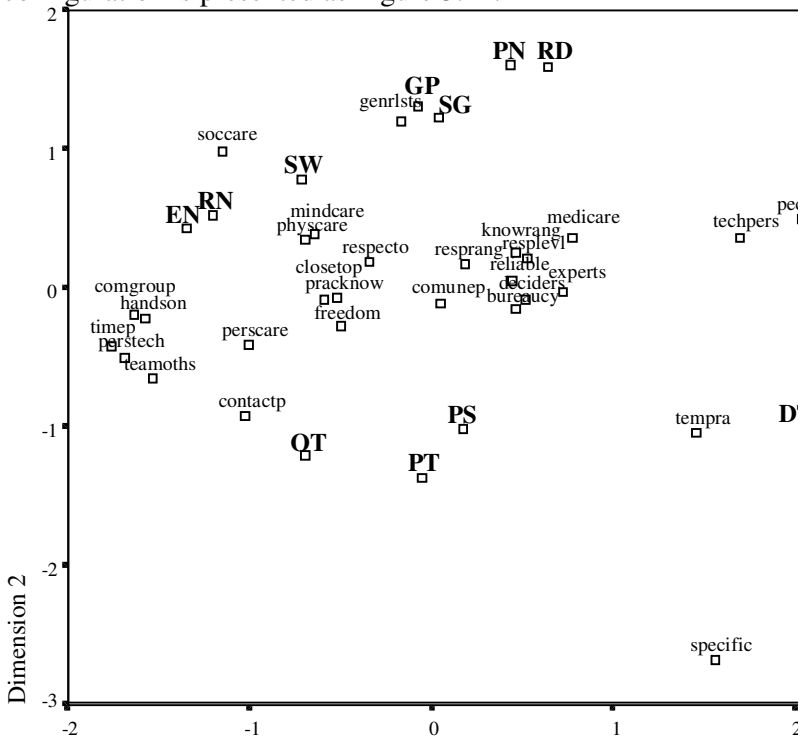


Figure 5.12: RN002: Two-dimensional multidimensional unfolding configuration

The main features of the MDS object configuration, with some exceptions, are identifiable in the MDU configuration: except that SW is here more closely associated with the nurses and doctors rather than with the {OT, PT, PS} set of groups, the four main clusters of groups identified in the MDS space are clearly separate. Indeed, dimension one separates the non - hands-on {DT, PH} pair from the other groups and, excepting SW, dimension two distinguishes

between the 'medical team' (doctors and nurses) and the 'non-medical team'.

MDS 1 was interpreted in terms of medicality, expertise and level of responsibility. The "care a lot about patients' medical well-being" ('medicare'), "level of responsibility" ('resplevl') and 'experts' points are closely adjacent in the centre of Figure 5.12 and closer to the medical than to other clusters, followed by PS, the other non-medical groups and finally, nurses. According to the MDS interpretation, the nurses and PH were more closely associated with these attributes than here. Whilst these differences might be attributed, in part, to differences between data collection methods, they might also point to the danger of interpretation of MDS configurations in terms of dimensions through rather than directly in terms of distances within object spaces. However, in defence of the interpretation proffered, nurses were associated with the doctors in the hierarchies task, although an attempt was made to 'un-pair' the nurses to associate EN with the non-medicals. In the present analysis, the overall similarity of EN and RN may be 'pulling' the RN further away from the medical cluster, and the extent of their rated differences from DT and PH in particular may be forcing both pairs away from the centre of the configuration and the doctors.

MDS 2 was interpreted as 'opposing perceived limited contact with patients and narrow focus in their treatment among dietitians and pharmacists to more extensive contact with patients and broader focus in their treatment among the other groups'. In the present analysis, DT and PH are most distant from such attribute points as 'they work mostly hands-on' ('hands-on'), 'spend a lot of time with patients' ('timep'), 'close to patients' ('closetop') and 'contact with patients' ('contactp') and closest to those for 'more technical than personal in their roles' ('techpers'), 'distant from patients' ('distantp') and 'deal with a particular, specific aspect of their patients' needs' ('specific'). In terms of the DT-PH / others distinction, the two analyses accord well. However, this contrast dominates the present analysis, being represented on dimension one, whereas it is represented on dimension two of the MDS analysis in which the medical - non-medical contrast is dominant.

MDS 3 most clearly distinguished the nurses from the other groups with this distinction being accounted for in terms of their team-working, generalist role and the immediacy, constancy and hands-on nature of their manner of caring for their patients. The attributes 'communicate well with other groups' (comgroup) and 'work well as team with other groups' (teamoths) are closely associated in the MDU configuration and more closely associated with nurses than other groups. However, whilst SW an PS were most strongly contrasted with nurses on MDS 3, in the MDU configuration, SW is relatively closely associated with the team-work and inter-group communication attributes with the DT-PH pair being most distant.

Whilst the nurses are relatively adjacent to the 'generalists' attribute point in the MDU configuration, the attribute is more closely associated with the SW and medical groups than with nurses. This generally accords, however, with group ratings on the attribute (Figure 5.12), with EN, GP, PN, RD, RN, SG and SW being rated relatively highly in contrast to DT, OT, PH, PS and PT. That the medical specialists would be rated so highly on this attribute was not anticipated from reading the interview transcript.

The 'spend a lot of time with patients' ('timep') and 'work mostly hands-on with patients' ('handson') attributes are closely associated in the configuration and located closer to the nurses than to other groups. Characterisation of the nurses is generally consistent between analyses.

Apart from distinguishing between nurses and other groups, a body-mind distinction was also discerned on MDS 3. According to that interpretation, MDS 3 'graduates from the generalist care of the nurses, through specialist physical and medical care to specialist social and psychological care'. The main point is however, that social and mental care should be more closely associated and physical and medical care less closely associated with SW and PS than the other groups. In the MDU configuration, physical and mental care are closely adjacent and both are relatively close to social care. These three modes of care are distinguished from medical care and more closely associated with nurses and SWs than PSs, and PS is more closely associated with medical care than the other three groups. There

are differences in interpretation between the analyses here that may be related to the greater overall similarity between nurses and SW and dissimilarity between SW and PS in the MDU analysis than in the MDS analysis.

Cluster analysis

The objective of this section is to examine the correspondence between the results of agglomerative hierarchical clustering analyses on the object by attribute ratings data with the free sorts and hierarchy results. Two agglomeration methods are used as being consistent with ordinal scaling procedures (Coxon & Davies, 1982, p. 103, p. 166): single linkage (sometimes called nearest neighbour) and complete linkage (furthest neighbour). Also for consistency between the cluster and scaling analyses, Euclidean distances are taken as measures of inter-group similarities. Dendograms representing the single and complete linkage solutions are presented as Figures 5.13 and 5.14.

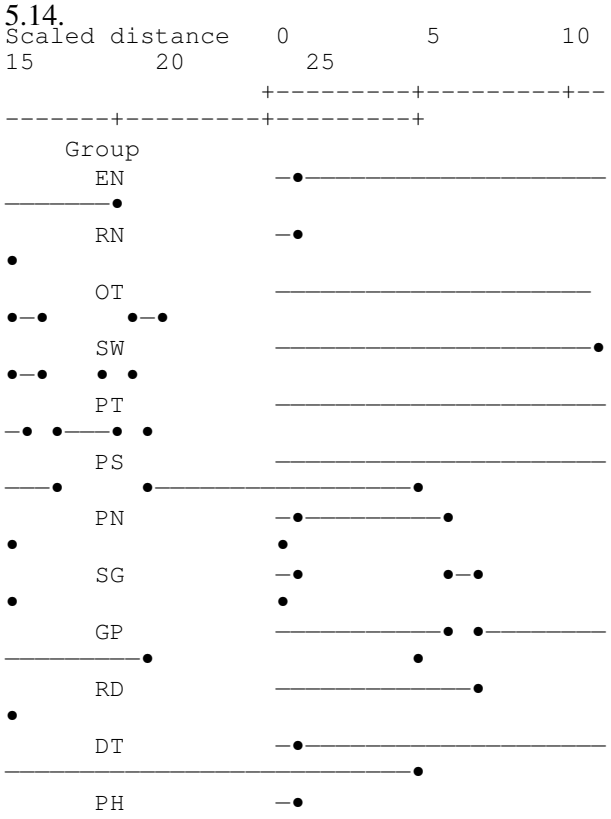
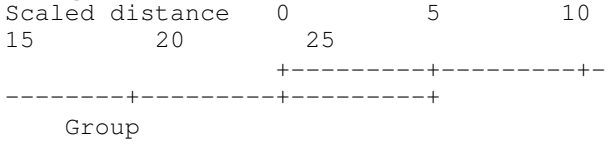


Figure 5.13: RN002: Dendogram of single linkage hierarchical cluster solution



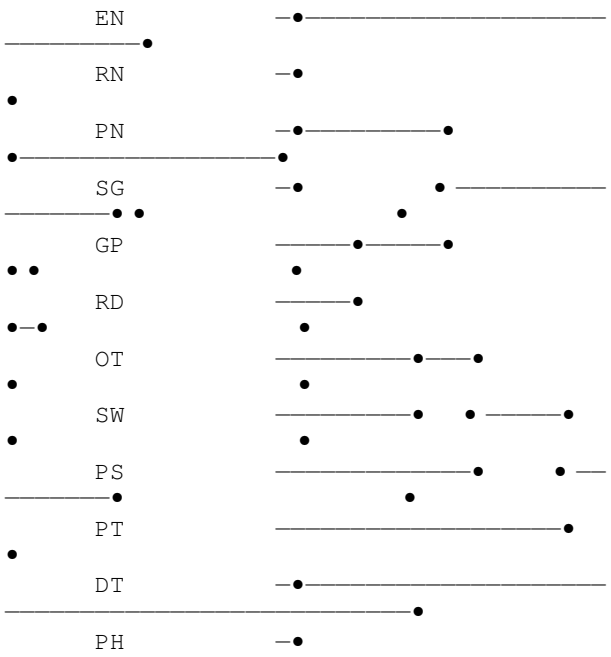


Figure 5.14: RN002: Dendogram of complete linkage hierarchical cluster solution

Clusters formed at level 13 in the single linkage solution (Figure 5.13) and at level 10 in the complete linkage solution (Figure 5.14) are {EN, RN}, {OT, SW, PT, PS}, {PN, SG, GP, RD} and {DT, PH} corresponding to the clusters identified from lowest pairwise dissimilarities. They do not, however, correspond exactly with any of the free sorts but closely approximate sort 3 (Table 5.4), the difference being that, in sort 3, RD is not included with the other medical groups.

The {DT, PH} pair are last to join the remaining groups in both solutions - the distance between them and the other groups being pronounced in the ratings data as observed in the unfolding analysis - and the non-medical professional cluster {PT, DT, PH, SW, PS, OT} in sort 1 is not identifiable in either solution.

Of the free sorts, sort 2 distinguished most finely among the groups. The {EN, RN}, {SG, PN}, {DT, PH} pairs identified there are formed early in the agglomerative process in both cluster solutions. Also, among the medical groups, the {GP, RD} pair are joined prior to joining the {SG, PN} pair in the complete linkage solution, corresponding to sort 2, but GP joins the {SG, PN} pair prior to including RD in the single linkage solution, corresponding to sorts 1 and 3. However, among the {PS, SW, OT, PT} set, the {PS, SW} and {PT, OT} pairs distinguished in

sort 2 are not formed prior to joining the others in either solution with SW and OT being joined first in both. Whilst correspondence between the freely sorted and derived clusters is generally close, differences occurring within the {PS, SW, OT, PT} set are notable.

The most obvious differences between the directly obtained and derived hierarchies are that, in the derived solutions, the nurses do not join the medical groups prior to those groups joining the {PS, SW, OT, PT} set in the complete linkage solution, and join the {PS, SW, OT, PT} set prior to joining the medical groups in the single linkage solution; and that the {DT, PH} pair do not join the non-nurse, non-medical groups prior to those sets themselves agglomerating.

In general, correspondence between the derived cluster solutions and the free sorts and directly obtained hierarchy is closer for the former than the latter, with the derived solutions failing to recover the perception of nurses being part of the 'medical team'. However, it may be recalled that, in the hierarchies task, the nurses were joined to the medical team only near the end of the process.

Summary

At the time these data were collected, a thorough analysis of the relations between directly-obtained and data-analytically-obtained results was planned. This included the extent of conformity between free interpretations of transcript and interpretations of MDS plots, between freely-formed clusters and cluster analysis solutions, between both of these and distances in MDS plots, and between interpreted MDS plots from accounted for pairwise dissimilarity judgments and MDU plots from group by attribute ratings. A further question of interest in this context was the relationship between interpretations of several 'individuals' data and their representations in solutions built on their aggregated data such as in the INDSCAL analysis reported in Chapter 6. One aspect of this was the extent to which the structural integrities expected of individual categorical schemes were observable in the results of analysis of the aggregated data, against the possibility that the presumed commonality among individual's schemes such analysis might identify was 'synthetic' and unlike few if any 'working' schemes. Most of these initiatives have since given way to other priorities and much of the data collected in this process is not further used. The data that are used are the set of pairwise dissimilarity judgments, the accounts of among-group similarities and differences, and the group by attribute ratings data. The process of pairwise dissimilarity judgment with associated accounts remains an important source of categorical scheme-relevant data that are relatively unconstrained by researcher pre-conceptions and represents the foundation of subsequent data collection and analysis processes. Ultimately, the accounts are the most important

resource for the model-building exercise but the pairwise dissimilarity judgmental process is a very effective means of obtaining them and once under way requires very little prompting. Nevertheless, the free-sort and hierarchies processes and the data they generate are directly relevant to categorization and have a number of intriguing possibilities.

Although not reported here, interpretations of the data from each of the twenty interviews were pursued in something approaching the detail of the example reported above. Whilst that example serves well to illustrate the nature of much the data and analytical processes subsequently employed and provides a suitable orientation to what follows, it was found that, in general, the correspondence between directly-obtained judgments and data analysis results was generally good. Two-dimensional MDS configurations were found to suffice for most subjects although one one-dimensional and a few three-dimensional solutions were selected as appropriate in other cases. Overall, despite that it may not be reported, this kind of detailed examination of the data upon which the model-building process is based offers insight into the results of subsequent analyses.

The next chapter reports the analysis of the aggregated pairwise dissimilarities data and the associated accounts and examines the correspondence between the results of that analysis and an analysis if the group by attribute ratings data.

Chapter 6

Analysis of the aggregated dissimilarities and their accounts

The numeric data: INDSCAL analysis

The twenty pairwise dissimilarity matrices were submitted to non-metric INDSCAL analysis with ties untied. Two, three, four and five-dimensional models were estimated (2D stress = .22, RSQ = .68; 3D stress = .16, RSQ = .72; 4D stress = .13, RSQ = .78; 5D stress = .11, RSQ = .79). Figures 6.1 and 6.2 display stress and RSQ values by number of dimensions.

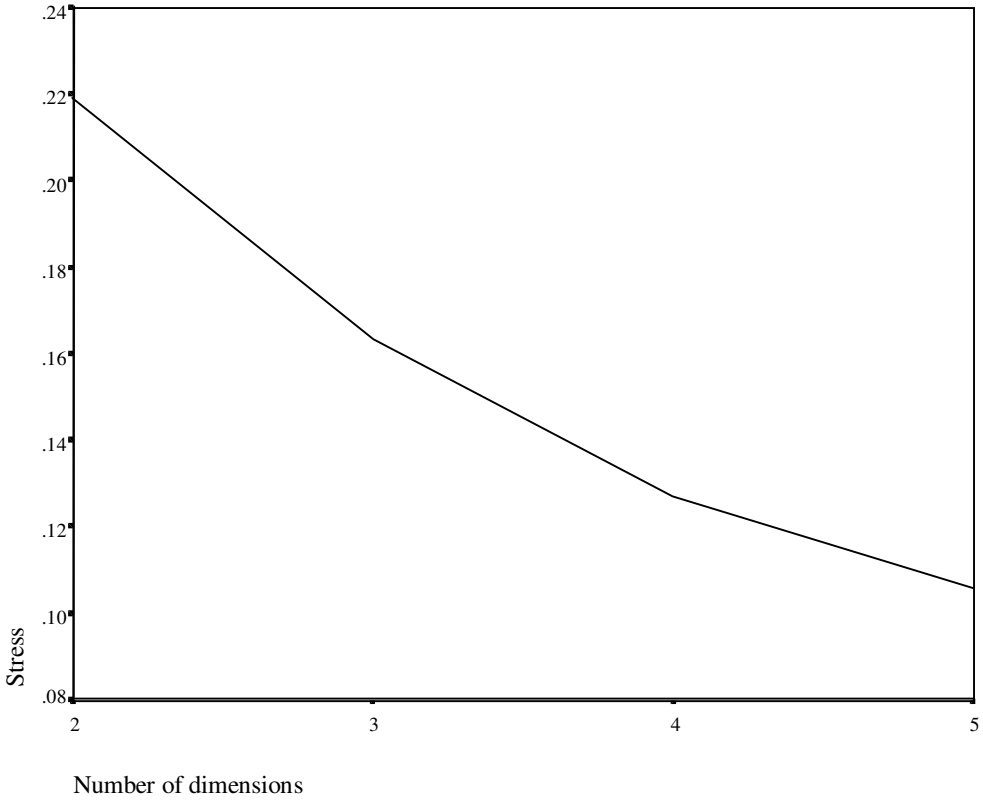


Figure 6.1: INDSCAL: Stress by number of dimensions

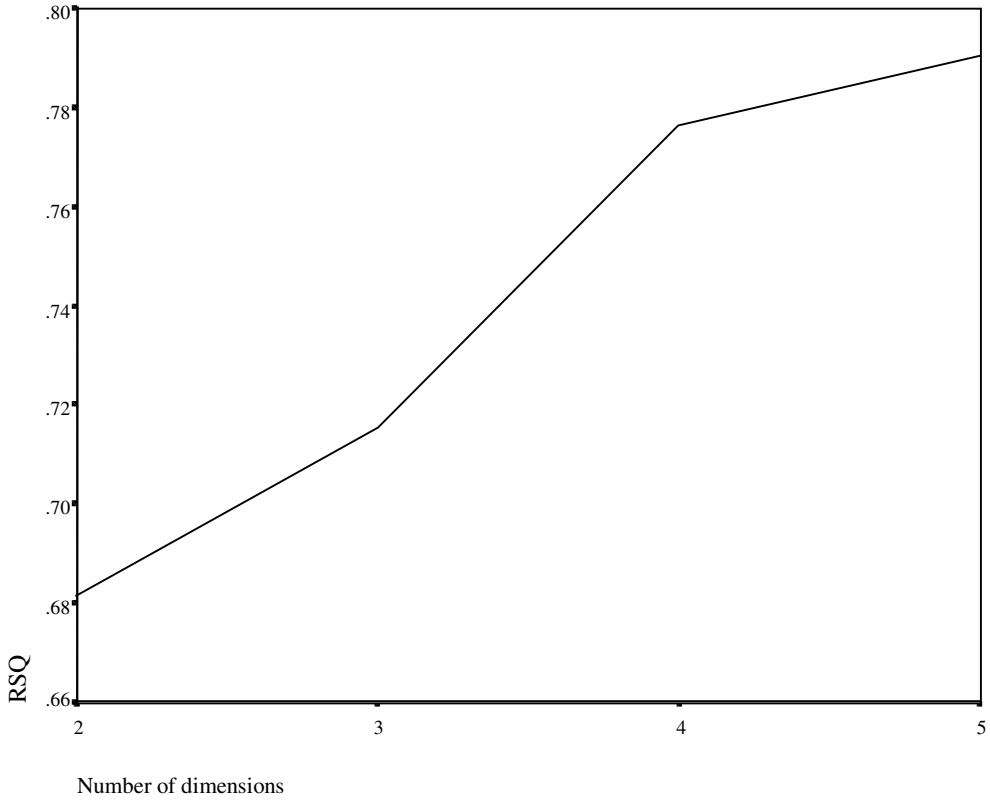


Figure 6.2: INDSCAL: RSQ by number of dimensions

Whilst from three to four dimensions the decrease in stress and increase in RSQ values is substantial, improvements in these fit statistics declines sharply from four to five dimensions. Accordingly, the four-dimensional solution was chosen for interpretation. Table 6.1 reports the group dimension coordinates of the solution and Figures 6.3 to 6.8 display the projections of the configuration onto each pair of the four dimensions.

Table 6.1: Four-dimensional group space, group dimension coordinates

	Dimension			
Group	1	2	3	4
DT	0.4017	0.0690	-1.3513	1.7678
EN	2.1010	-0.0151	0.6895	-0.2014
GP	-0.7442	-0.4986	1.1510	-0.5914
OT	0.4174	1.2521	-1.1198	-0.9605
PH	-0.4494	-1.0092	-1.1588	1.7475
PN	-1.4738	-0.6204	0.4116	-0.1767
PS	-0.3869	1.4470	1.0802	0.9393
PT	0.3036	0.7503	-1.1941	-1.3867
RD	-0.1183	-1.4419	0.9326	-0.5420
RN	1.3748	-0.5046	0.5323	-0.0085
SG	-1.4744	-1.0598	-0.9515	-1.0701
SW	0.0487	1.6314	0.9781	0.4826

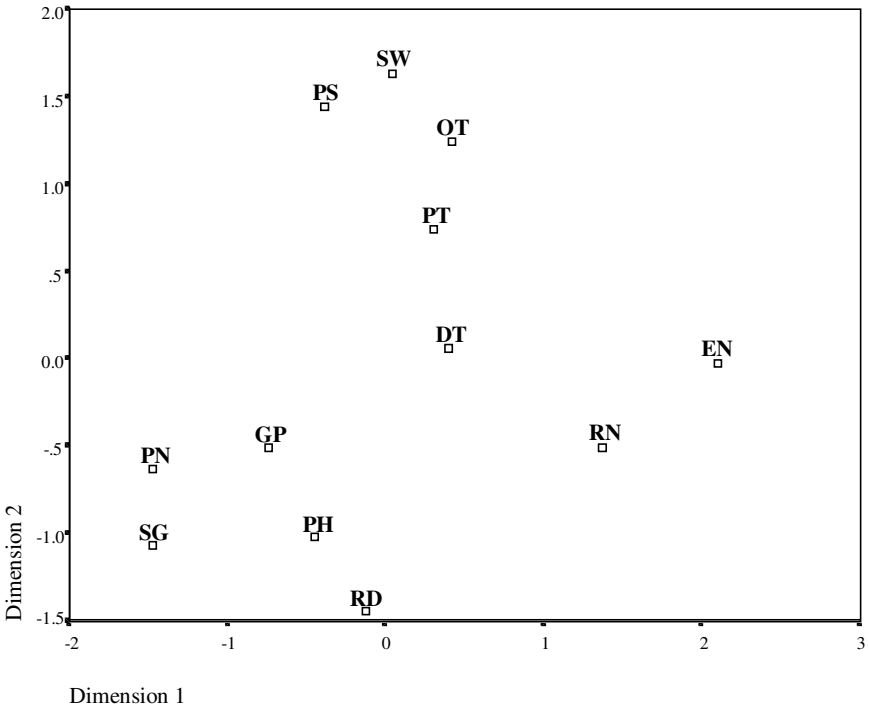


Figure 6.3: INDSCAL: Dimension 2 by dimension 1

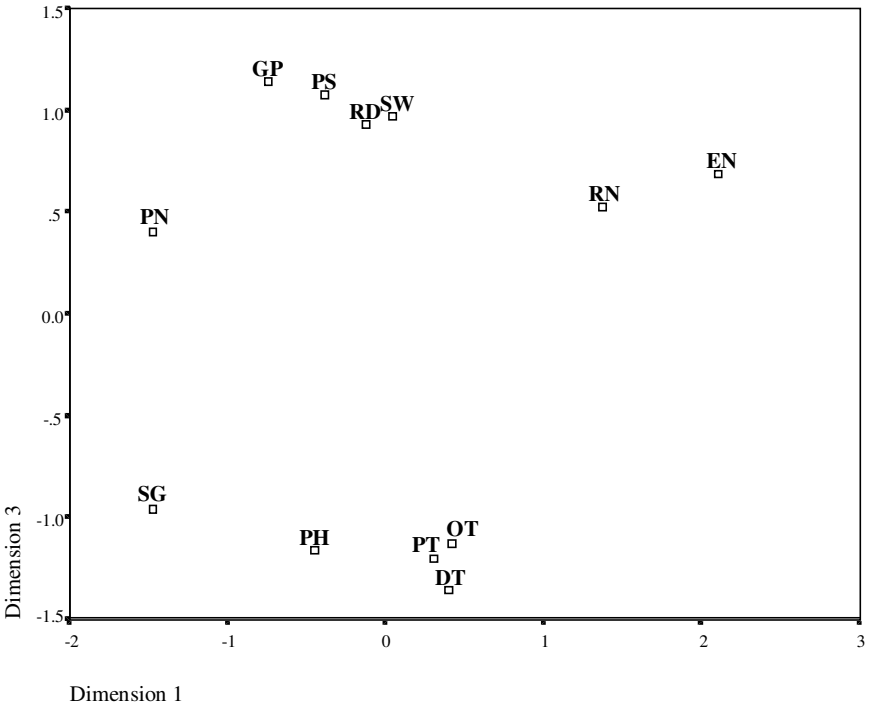


Figure 6.4: INDSCAL: Dimension 3 by dimension 1

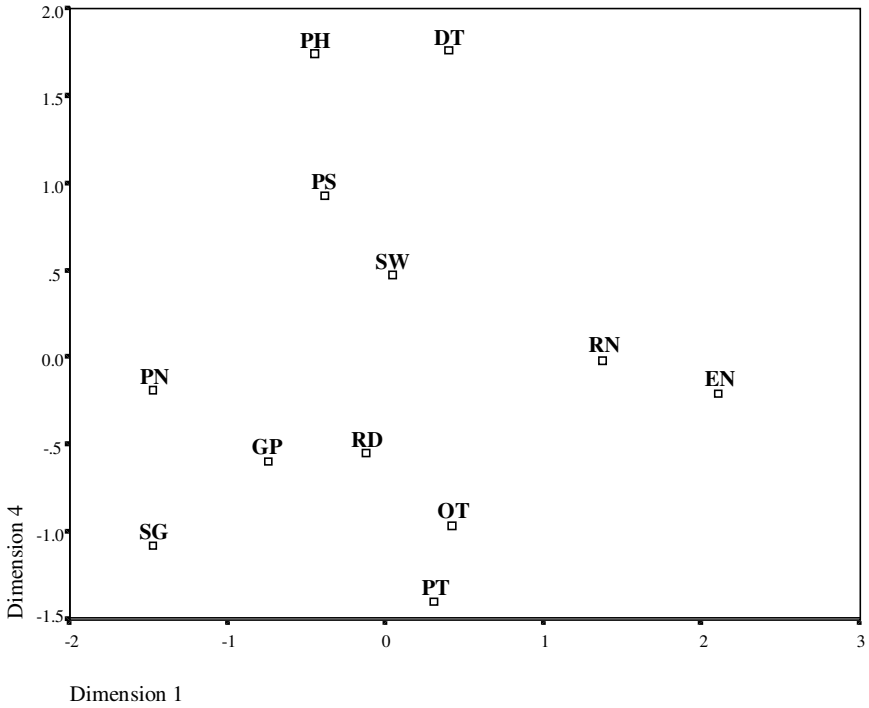


Figure 6.5: INDSCAL: Dimension 4 by dimension 1

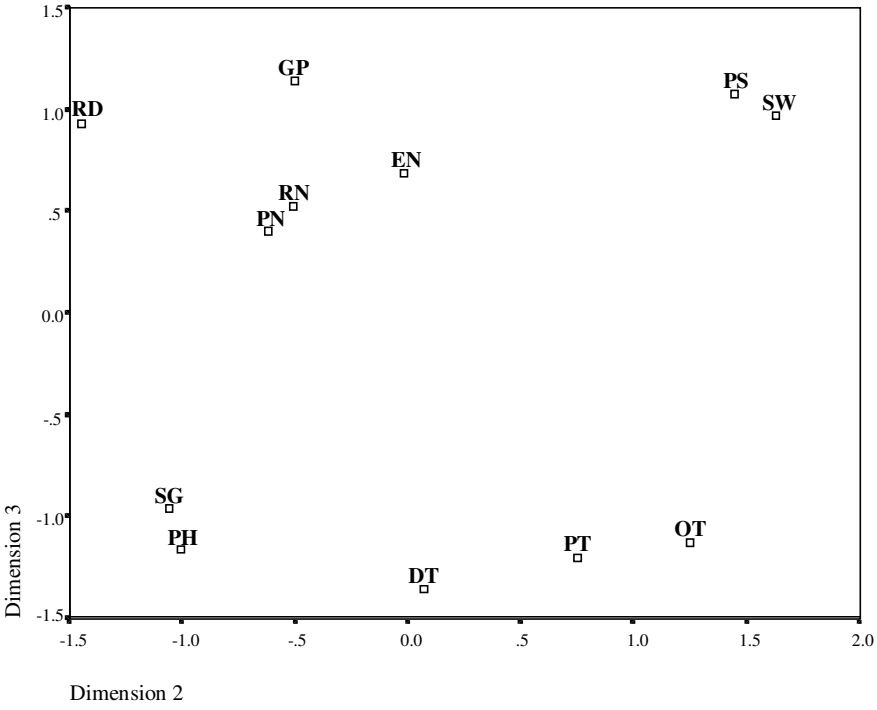


Figure 6.6: INDSCAL: Dimension 3 by dimension 2

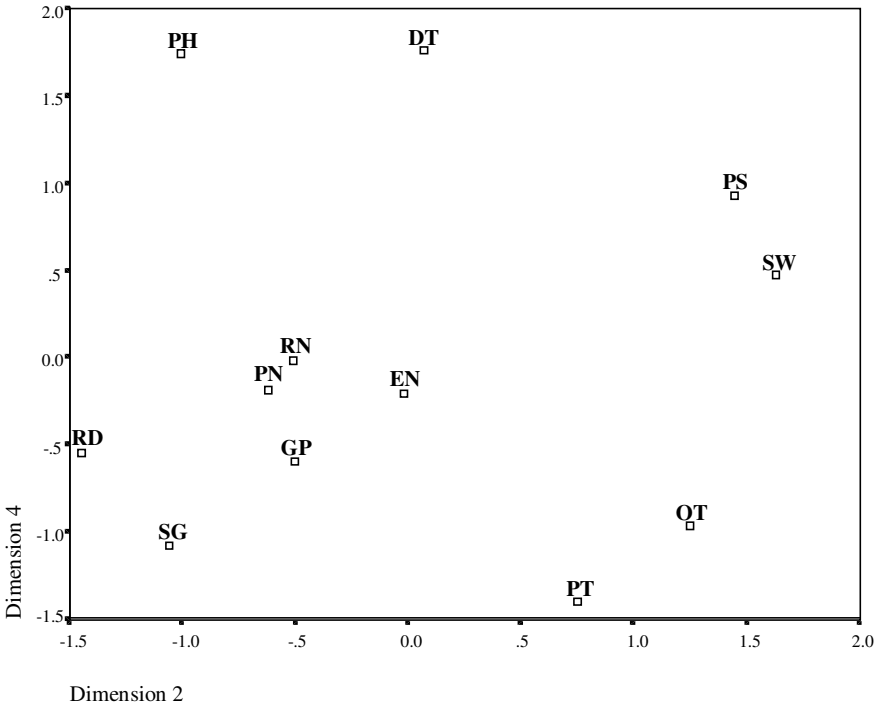


Figure 6.7: INDSCAL: Dimension 4 by dimension 2

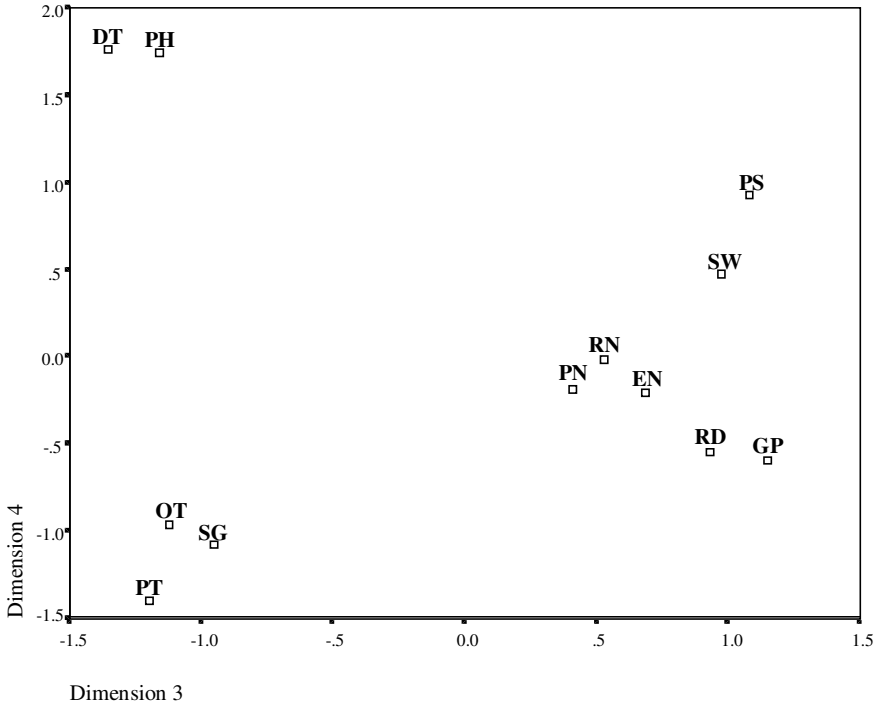


Figure 6.8: INDSCAL: Dimension 4 by dimension 3
The accounts (verbal data)

As for the analyses of individual data in Chapter 5, the essential resource for interpretation of the group space configuration are subjects' accounts of their dissimilarity judgments in which they describe the commonalities and differences between pairs of groups. However, whereas the volume of transcript for each individual was of such a size as allow its use for interpretive purposes without prior sorting or coding of its content, the total volume of transcript among the twenty interviews was too large to be so treated. For the collected transcript, it was necessary to develop a coding scheme and to apply a sorting process so that, at each point in the process of interpretation of the group space configuration, the relevant comments could be systematically and efficiently retrieved.

Minimally, for each comment describing a commonality or difference, it was necessary to identify both the pair of groups being compared and the stated or implied relation between the groups in terms of the quality or attribute invoked in the comment. With respect to a pair of groups (A-B), a comment might assign an attribute to A without clear reference to B (A_), to B without reference to A (B_), equally to A and B (A=B), to A not B (A~B), to B not A (B~A), to A more than B (A>B) or to B more than A (B>A). Each such relation between a pair of groups in terms of an attribute was referred to as the 'status' of A and B in terms of the attribute. Each of the sixty-six A-B pairs was referred to as an 'object'. 'By object' and 'by status' wer e each considered to be a 'way' of classifying comments. A further obvious way of classifying a comment is by its 'source' or the subject who made it. The individual sources, objects and statuses were considered to be 'elements' of their respective ways.

A relational database was programmed to accommodate sorting of selections from text ('comments') by the three ways, source, object and status. 'Sort' and 'select' functions were programmed to allow for retrieval of chosen sets of comments: sort options controlled the order of comments in reports with the way specified last iterating fastest; and select options specified the subset of comments reported by identifying a subset of elements within each way - 'each', 'all', 'one' or 'some'.

It was planned initially to use only these three ways, and not to specify the attribute(s) invoked by each comment: i.e. the attributes were to be left 'embedded' in the comments and retrieved only at the time of reporting and interpretation of the group space configuration. Whilst the procedure was adequate to the task of interpretation, and an interpretation made on this basis, it was decided that the interpretive process would be more transparent to or more easily followed by a reader if the comments were collected into sets according to attributes they invoked. Consequently, a fourth way, 'attribute' was programmed and the comments further classified in terms of a set of attribute elements. The set of attributes and their frequencies of reference are presented as Table 6.2.

Table 6.2: The set of attributes employed in sorting comments selected from accounts and their frequencies

Attribute	Count

advising role - other groups	11
advising role - patients	25
airy-fairy / wishy-washy	10
analytical / diagnosis / problem-solving	35
arrogant / aloof / superior / elitist	65
authority / right to decide	68
autonomous / independent / professional	38
auxiliary / peripheral	45
avaricious / self-serving	16
body / physical aspects	39
breadth of view / scope of practice	49
caring attitude / empathy	24
central to hospital / health care	25
communicate - patients	22
communicate / respect - other groups	33
counselling role / listeners	24
education / training / knowledge	152
experienced	21
gender	12
generalists / versatile / role overlap	52
hands-on / physical contact - care	41
hard-working / task oriented / busy / do-ers	38
helping attitude	4
holistic / whole person	49
intelligence / ability	15
intrinsic orientation	6
invasive / aggressive treatment	17
listen / talk - willing / do	38
manage / organise / coordinate	12
medical treatment / model	49
mind / mental - emotional aspects	49
on-going / extended contact	9
patient care - direct / general	49
patient contact	90
personal approach / style / orientation / skills	76
personal involvement / know patients well / close	55
pharmaceuticals / medicines	28
physical / biomedical science	24
power / control	26
practical	15
private practise	5
rehabilitation / adjustment	44
responsibility / importance of decisions	34
specialised / particular role	60
specialised knowledge	30
specific / narrow focus / aspect	64
status / prestige	102
teamwork / complementary	89
technical - orientation / role	23

time with patients	39
valuable role	9
well-being oriented (personal / social)	50

The program functions described above were adequate to and constituted an invaluable tool for managing the collected accounts suitably to their usage in interpretation of the group space configuration. However, it was realised that they formed the core of a more general qualitative analysis tool. These functions have since been supplemented with others, including that of generating frequency and cross-classification count matrices for inspection or statistical analysis.

The interpretive process involves selecting pairs of groups (objects) likely to be diagnostic of a dimension (see below) in turn and examining the commonalities (A=B) of some pairs (see below) and the differences (A~B, B~A, A>B, B>A) between others (the remaining objects, A_ and B_, were employed only to supplement or check interpretations based upon those already mentioned). This means that, for present purposes, a sort order of 'subject x object x attribute x status' and a series of selections of 'all subjects x one object x each attribute x one status' produced the required comments at each point in the interpretive process.

Quantity and quality: integration of the numeric and verbal data

Interpretive strategy for the INDSCAL solution

The basic strategy for interpretation of a dimension involves identifying pairs of groups that are either (i) closely adjacent on and located towards one or the other end of the dimension or (ii) widely separated on and located towards opposite ends of the dimension. Comments describing commonalities between pairs of type (i) and comments describing differences between pairs of type (ii) are likely to refer to attributes associated with the dimension. For pairs of type (i) such attributes should indicate the character of the ends of the dimension on which the pairs are located, and for pairs of type (ii), they should indicate the character of the concept or construct underlying the spread of groups across the dimension.

Many such pairs of groups might be identified of which some are likely to be more diagnostic of a dimension than others. The more diagnostic pairs of type (i) are those that are closely adjacent on the dimension under interpretation and more widely separated on the other dimensions, and the more diagnostic pairs of type (ii) are those that are widely separated on the current dimension and more closely adjacent on the others. Pairwise distances on each dimension were derived from Table 6.1 and are reported as Table 6.3. The first step in interpretation of each dimension was to select diagnostic pairs in terms of the principles outlined above by reference to Table 6.3 and Figures 6.3 to 6.8.

Table 6.3: Pairwise distances by dimension

	Pairwise distances by dimensions			
Groups	Dim 1	Dim 2	Dim 3	Dim 4
DT-EN	1.70	0.08	2.04	1.97

DT-GP	1.15	0.57	2.50	2.36
DT-OT	0.02	1.18	0.23	2.73
DT-PH	0.85	1.08	0.19	0.02
DT-PN	1.88	0.69	1.76	1.94
DT-PS	0.79	1.38	2.43	0.83
DT-PT	0.10	0.68	0.16	3.15
DT-RD	0.52	1.51	2.28	2.31
DT-RN	0.97	0.57	1.88	1.78
DT-SG	1.88	1.13	0.40	2.84
DT-SW	0.35	1.56	2.33	1.29
EN-GP	2.85	0.48	0.46	0.39
EN-OT	1.68	1.27	1.81	0.76
EN-PH	2.55	0.99	1.85	1.95
EN-PN	3.57	0.61	0.28	0.02
EN-PS	2.49	1.46	0.39	1.14
EN-PT	1.80	0.77	1.88	1.19
EN-RD	2.22	1.43	0.24	0.34
EN-RN	0.73	0.49	0.16	0.19
EN-SG	3.58	1.04	1.64	0.87
EN-SW	2.05	1.65	0.29	0.68
GP-OT	1.16	1.75	2.27	0.37
GP-PH	0.29	0.51	2.31	2.34
GP-PN	0.73	0.12	0.74	0.41
GP-PS	0.36	1.95	0.07	1.53
GP-PT	1.05	1.25	2.35	0.80
GP-RD	0.63	0.94	0.22	0.05
GP-RN	2.12	0.01	0.62	0.58
GP-SG	0.73	0.56	2.10	0.48
GP-SW	0.79	2.13	0.17	1.07
OT-PH	0.87	2.26	0.04	2.71
OT-PN	1.89	1.87	1.53	0.78
OT-PS	0.80	0.19	2.20	1.90
OT-PT	0.11	0.50	0.07	0.43
OT-RD	0.54	2.69	2.05	0.42
OT-RN	0.96	1.76	1.65	0.95
OT-SG	1.89	2.31	0.17	0.11
OT-SW	0.37	0.38	2.10	1.44
PH-PN	1.02	0.39	1.57	1.92
PH-PS	0.06	2.46	2.24	0.81
PH-PT	0.75	1.76	0.04	3.13
PH-RD	0.33	0.43	2.09	2.29
PH-RN	1.82	0.50	1.69	1.76
PH-SG	1.03	0.05	0.21	2.82
PH-SW	0.50	2.64	2.14	1.26
PN-PS	1.09	2.07	0.67	1.12
PN-RD	1.36	0.82	0.52	0.37
PN-RN	2.85	0.12	0.12	0.17
PN-SG	0.00	0.44	1.36	0.89
PN-SW	1.52	2.25	0.57	0.66
PS-PT	0.69	0.70	2.27	2.33
PS-RD	0.27	2.89	0.15	1.48

PS-RN	1.76	1.95	0.55	0.95
PS-SG	1.09	2.51	2.03	2.01
PS-SW	0.44	0.18	0.10	0.46
PT-PN	1.78	1.37	1.61	1.21
PT-RD	0.42	2.19	2.13	0.84
PT-RN	1.07	1.25	1.73	1.38
PT-SG	1.78	1.81	0.24	0.32
PT-SW	0.25	0.88	2.17	1.87
RD-RN	1.49	0.94	0.40	0.53
RD-SG	1.36	0.38	1.88	0.53
RD-SW	0.17	3.07	0.05	1.02
RN-SG	2.85	0.56	1.48	1.06
RN-SW	1.33	2.14	0.45	0.49
SG-SW	1.52	2.69	1.93	1.55

Underlying interpretation of the configuration is a conceptual model in which the attributes are represented as vectors through the origin of the space, so that an attribute increases in the direction of its vector and groups with larger orthogonal projections on a vector are identified as possessing or manifesting more of the attribute. Conceptually, this is a point-vector model differing from formal point-vector models (see Chapter 4) in the absence of formal or mathematical determination of vector lengths and directions. Although the alternative point-point model (see Chapter 4) might better represent the underlying group-attribute relations, the determinacy or precision of point-point representation of such relations is in general beyond what can be achieved in interpretation of pairwise configurational distances from verbal accounts.

Given the point-vector conceptualisation, configurational interpretation in terms of accounts amounts to informal and incomplete location of attribute vectors through the origin of the configuration: informal because attributes are not numerically associated with objects in a way that allows mathematical location of the vectors and incomplete because, although some indication of vector orientations other than parallel to a single dimension might emerge from the interpretive process, all that can be confidently discerned is which attributes appear to more strongly associated with each dimension in terms of their frequency of mention in respect of the selected dimensionally diagnostic pairs of groups. The result of this is identification of attributes whose 'vectors' are relatively 'long' in the direction of each dimension: i.e. attributes that are relatively parallel to the dimension and/or importantly associated with the configuration. In factor analysis terms, it is possible only to identify those attributes (items) with highest 'loadings' on the dimensions (factors).

Whilst, from what is said above it might be thought that interpretation of the configuration in terms of accounts can produce only limited results, this is relative to formal point-point

and point-vector models. The factor analysis analogy above provides a point of reference for the potential quality of the results: factor analysis solutions are rarely interpreted as wholes and most commonly factor by factor in terms of highest loadings (items with substantial secondary loadings are even sometimes deleted); and interpretation is commonly made in terms the semantic values of item labels without further insight into how the items were interpreted by subjects or used by them to represent their points of view. The present procedure offers at least this much with two added virtues: the 'items' are not constructed by the researcher but emerge from and in the language of subjects, and the comments drawn from accounts provide better access to subjects' understandings and representations than the wordings of questionnaire items. These comments are not meant as criticisms of factor analysis per se, which can indeed be used in sophisticated ways, but to claim for the present procedure the credibility the familiarity of factor analysis affords it, and beyond that to reiterate the primary motivation for employing the present methods: to develop descriptive models from subjects' relatively unconstrained judgments and accounts rather than to locate subjects in models defined in terms of researchers' concepts.

Interpretation of the group space configuration

The pairs of groups selected as diagnostic of each dimension and the comments describing the pairwise commonalities and differences relevant to dimensional interpretation, being selections from the contents of the database of accounts, are presented in Appendix A, Part 1. Presented below are summary interpretations of each of the four dimensions, representing the attributional commonalities or themes among dimensionally relevant comments. Arriving at these summaries is not a simple one-step process as the comments selected as relevant to interpretation of each dimension include references to attributes relevant also, sometimes more relevant, to other dimensions. This means that a general understanding of the themes associated with the spread of groups across each of the four dimensions is important to distinguishing among the attributes more and less relevant to each.

Dimension 1

Dimension one accounts for .41 of explained variance and is the largest and most 'important' of the four dimensions. The nurses, RN and EN, are separated off at the positive end of the dimension and, to a slightly lesser extent, the medical specialists, SG and PN, are separated off at the negative end. The pairwise differences employed towards interpretation all involve one or other of the nurse groups and perhaps, to some extent, refer to attributes they perceive to be relatively unique to themselves. Similarly, many of the pairwise differences examined involve SG or

PN and may tend to invoke attributes associated relatively uniquely with them. Nevertheless, it is clear that there is a core of attributes associated with the spread of all groups across the dimension which are perhaps, in the case of nurse-medical specialist contrasts, represented in a more extreme form.

The core attributes, increasing towards the negative end of the dimension are education, knowledge, status, authority and responsibility. With these are associated intelligence, an academic or analytical orientation, arrogance or aloofness, power, avariciousness and masculinity. Whilst these attributes largely account for the dimension as a whole, attributes tending to increase towards the positive (nurses') end are hands-on, physical, direct patient contact and care; spending time with, having a personal approach to and becoming personally involved with patients; having an orientation that is at once holistic and practical, and femininity.

Dimension 2

Dimension two is substantial, accounting for .26 of explained variance. The negative end of the dimension is characterised by medical model thinking and medical treatment, knowledge of pharmacology and usage of medicines and drugs; by a biomedical, scientific outlook, a clinical focus exercised largely in a hospital setting, and an orientation to disease processes and treatment of illnesses. In contrast, the positive end of the dimension is characterised by an orientation to personal and social well-being, to 'fit' to familial, wider social and physical environments and to 'coping' and living in a broader sense; by 'helping' with 'problems' and facilitating rehabilitation or adjustment after treatment rather than performing treatment itself. Broadly speaking, the dimension is based on a medical – non-medical / health-welfare distinction, with which is associated a sense that the more medically oriented groups are focused on acute or more physically critical conditions and deal more directly with the immediate reasons for people being in hospital, whereas the more welfare oriented groups have more time to listen, talk and deal more broadly with life issues that are to some extent peripheral to hospitals' main business.

Dimension 3

Dimension three is also substantial, accounting for .21 of explained variance; it is also subject to clear interpretation, although some of the attributes associated with the underlying theme are also associated with dimensions two and four. The dimension divides the groups into two categories at its extremes with, relative to

the total, small within-category variation. Groups at the positive end of the dimension share a breadth of focus and holistic orientation to the person beyond concern for (or dealing with) immediate or manifest medical or technical problems. In contrast, groups at the negative end of the dimension are narrowly focused on a relatively small aspect of persons' welfare in which they are specialised in a scientific, technical or specific way. This is a 'specific skills, knowledge and technically focused versus as a generalist, holistic, humanistic and personal' orientation. Whereas the groups at the positive end are willing, and sometimes must by virtue of their role, listen, talk and counsel, take note of and perhaps empathise with personal-emotional states or issues, spend time with and make real contact with people, develop rapport and become personally involved with them, the groups at the negative end of the dimension are specialists who are there to do or tell rather than to listen, narrowly focused on technical problems in respect of which they are in possession of scientific or other particular knowledge and skills.

Dimension 4

Dimension four is perhaps the most difficult to interpret with confidence: it explains only .13 of total explained variance and most of the pairs selected for interpretive purposes as adjacent on the dimension are also separated by small distances on other dimensions and most of those selected for interpretive purposes as separated on the dimension are also separated by large distances on other dimensions; moreover, the commonalities within and differences between the selected pairs do not identify attributes that dominate or are unique to the dimension. Nevertheless, it is apparent that that the positive end of the dimension, on which DT and PH are extreme but which also includes PS and SW, is characterised by a non-physical or non-bodily role with respect to patients; and the negative end of the dimension, on which PT, SG and OT are extreme but which includes GP, RD, EN, PN and RN, is characterised by medical or physical treatment or care involving more or less hands-on physical contact with them. The roles of groups at the positive end of the dimension are to contribute to patients' knowledge or understanding or change in their attitudes or circumstances rather than to treat or provide direct care of their physical or medical conditions. They're more likely to 'work behind the scenes' or to talk to patients or others in respect of their 'needs' or 'problems' than to deal directly with the physical or medical reasons for their being in hospital.

Extending this view of the dimension and reading from the positive to the negative end, the roles of PH and DT are entirely to advise patients or others about their dietary or pharmacological needs; the roles of PS and SW are to counsel patients in the interests of their psycho-emotional or socio-economic well-being; the roles of RN, PN, EN, RD and GP are all, whilst they involve more than treatment or care of patients' manifest or immediate medical or physical conditions, nevertheless inherently involved with and directed towards them; and the roles of OT, SG and PT are more obviously, perhaps almost exclusively, centred on the functionality of patients' bodies.

Characterisation of groups and clusters of groups in terms of their locations in the four-dimensional space

Having arrived at an interpretation of the group space configuration it is possible to characterise each of the groups located within it in terms of their positions on the four dimensions and the attributional qualities associated with them. The same process may also be applied to clusters of groups that are coherent on all or most dimensions.

Of the twelve groups, characterisation in terms of location in the configuration will be made only for registered nurses as the group of primary interest. The same process might, however, be readily applied to each group in turn.

Who or what are registered nurses in terms of the health-occupational group space?

Registered nurses are located towards the low status end of dimension one: although they're somewhat further 'up the ladder' than ENs, the distance between RNs and the next 'level' of groups, the allied health professionals, PTs, OTs, SWs and DTs, tends to exceed that between ENs and RNs. Consequently, whilst RNs are self-perceived to be more highly educated and knowledgeable, and to have more status, authority and responsibility than ENs, they consider themselves to possess less of these qualities than all other groups in the set. It is possible that identification among RNs to nursing as a whole, including loyalty to ENs, has led them to make judgments that place them closer to low status ENs than might otherwise be so, or than they might be placed by others.

The positive tone of some of the qualities attributed to nurses in their dimensional opposition to possession of high status, education, authority and responsibility, such as hands-on practicality within a humanistic, holistic, personal and caring approach, might, whatever their validity, be partly attributed to the principle of maintenance of positive self-group evaluation. While ever these qualities are integral to nurses' identities as nurses and simultaneously contrasted with the qualities of high education, knowledge, status, authority, responsibility and other

associated attributes, they may represent a social psychological barrier to further professionalisation of nursing.

Registered nurses are located towards the medical pole of dimension two, being in these terms more medically oriented than not only the clearly non-medical SW, PS and OT but more medical also than EN and DT. Indeed, they are aligned with GP on the dimension, reflecting perhaps not so much a claim to the same level of medical or pharmacological knowledge, or treatment of illness with medicines and drugs, as GPs but, on the one hand, their involvement in treatment and care of more acutely ill patients, and on the other, GPs' and to some extent PNs' involvement in life-context and welfare issues beyond the immediate medical problem. Whilst nurses may in their role as carers or by self-definition be welfare oriented, this is nevertheless in the context of care and treatment of often critically ill patients for which role considerable bio-medical and pharmacological knowledge is necessary.

Registered nurses are located towards the generalist, holistic, humanistic and personal pole of dimension three. Whilst the dimension represents them clearly as members of this category in contrast to the groups at the opposite pole, they are identified as having slightly less of these qualities than GP, PS, SW, RD and EN, and perhaps slightly more than PN. Their relative position on the dimension may be accounted for in that their responsibility for administration of drugs and managing and monitoring technical equipment and information requires their possession of specific technical knowledge and skills. As on dimension two, where RNs were described as both welfare and medically oriented, on dimension three, whilst in general they may have a breadth of focus and holistic orientation to the person beyond concern for immediate medical or technical problems, they nevertheless require the knowledge and skills to deal with them by virtue of and within the limits of their role.

As an aside on nurses' concepts of 'holistic', they appear to 'define' the term to some degree in contrast to medical model thinking, a narrow focus on illness and technical orientation, thus tending to exclude the material and bodily from its meaning in favour of the personal, mental, emotional and social. This leads among some to a representation of social workers and psychologists as epitomising holism, a view invoking the emergence of psychological conflict or dissonance through simultaneously valuing holism and feeling that its prototypical exemplars, social workers and particularly psychologists, are less than practical, 'airy-fairy' and even indulgent. Loc ating holism at the union of the physical and mental, body and mind, organism and person, as some nurses appear to do, may be more appropriate, yet to do so may carry the implicit threat of assimilating qualities of medical practitioners, a category with whom nurses find themselves in competition.

Registered nurses are located, together with GP, RD, EN and PN, in that region of dimension four in which the roles involve more than but inherently include more or less hands-on treatment or care of patients' medical or physical conditions. As closest among this set to the non-physical SW, PS, PH and DT groups, RNs are represented as, to some extent, sharing their characteristics: whilst distinguished from them in their treatment or care of the medical or physical, RNs nevertheless provide advice about health related needs for management of drugs and diet; and if they do not actually counsel in respect of, take account of and respond with sensitivity to patients' personal - emotional and socio-economic conditions.

Cluster analysis of averaged dissimilarities

Averaged similarities between each of the sixty-six pairs of groups were computed from the twenty individual dissimilarity matrices. The matrix of averaged similarities was submitted to hierarchical cluster analysis. Two agglomeration methods were employed, nearest neighbour or single linkage and furthest neighbour or complete linkage. These methods were chosen because they provide solutions that are invariant under monotonic transformation of the pairwise distances (Coxon & Davies, 1982, p. 103, p. 166) and which are thus consistent with the non-metric approach taken to obtaining the scaling solution. Dendograms representing the single and complete linkage solutions are presented as Figures 6.9 and 6.10.

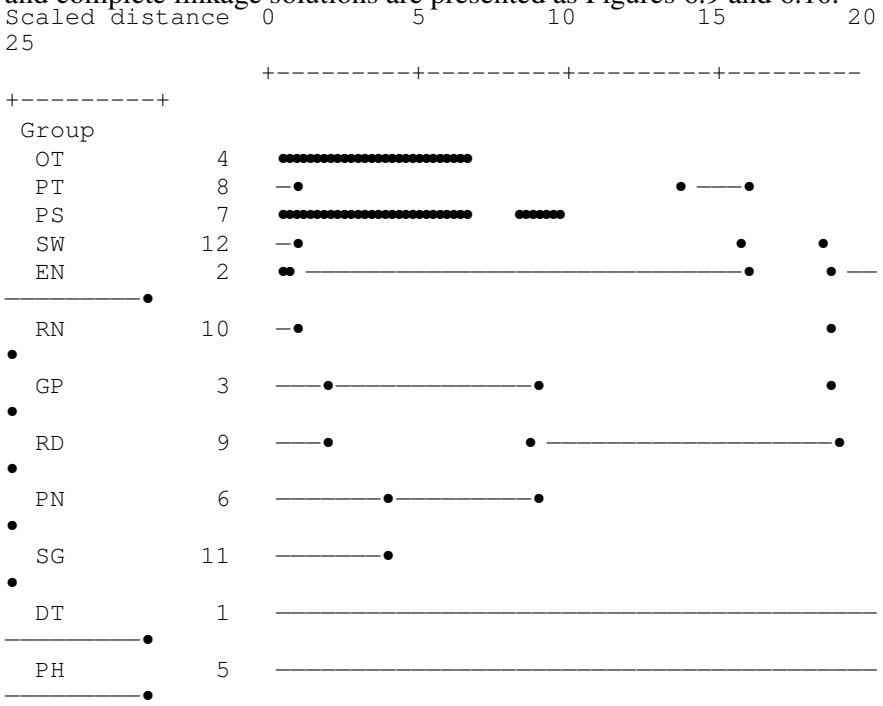
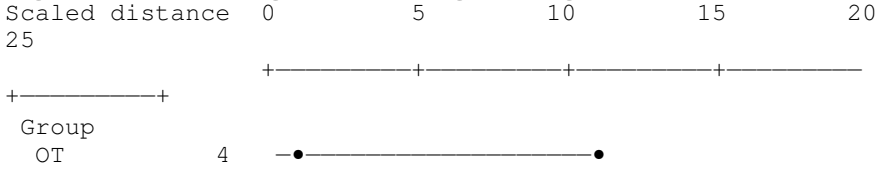


Figure 6.9: Dendogram from single linkage cluster solution



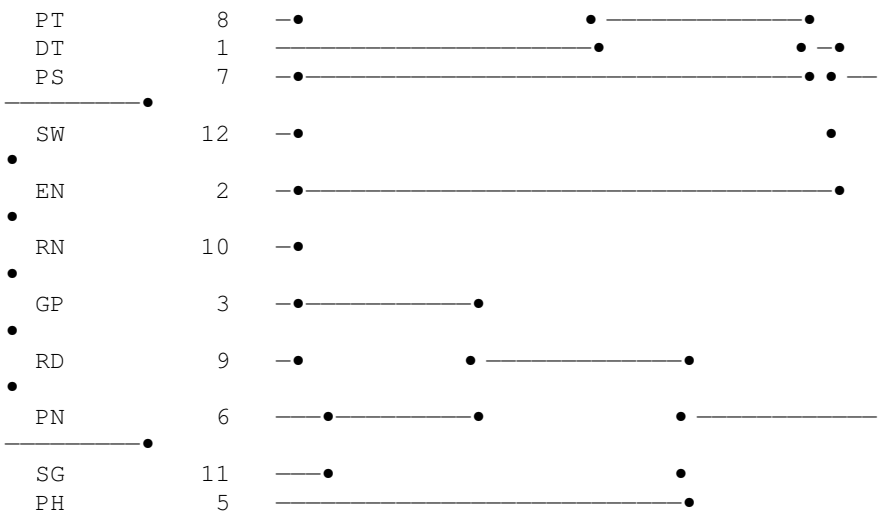


Figure 6.10: Dendogram from complete linkage cluster solution

Characteristics of clusters in terms of the health-occupational group space

The two solutions are very similar in the early stages of agglomeration: the pairs {OT, PT}, {PS, SW}, {EN, RN} and {GP, RD} are formed early, followed closely by {PN, SG} before the {GP, RD} and {PN, SG} pairs are matched to form the doctors group. From this point on, differences between the solutions centre mainly on the stages and locations at which the DT and PH join: whereas DT and PH (first DT to {OT, PT} then PH to the doctors) are included in the complete linkage structure at this stage, they are matched together and joined to the single linkage structure at the very last stage. Given these differences, the two solutions continue to coincide: {PS, SW} join {OT, PT} [(single linkage) or {OT, PT, DT}(complete linkage)], the nurses join the non-medical groups, and the doctors (including PH in the complete linkage solution) join the non-doctor groups (including DT in the single linkage solution).

Rather than attributing characteristics to the clusters in terms of the group space configuration separately for the two cluster solutions, the pair of groups treated differently by them, DT and PH, will be discussed first followed by a discussion of the commonalities that remain between the solutions: i.e. essentially of the single linkage solution.

DT and PH are closely adjacent on dimensions three and four, separated most widely on dimension two and separated to some degree on dimension one (Table 6.3; Figures 6.3 to 6.8). On dimension two, although centrally located, DT is closer to the 'welfare, helping with problems, rehabilitation, adjustment pole' and to OT and PT in particular than is PH; and PH is closer to the 'medical model thinking, medical treatment, knowledge and usage of drugs, scientific outlook' pole placing them closer to the doctors. On dimension one, DT is centrally located, again similarly to OT and PT in particular, whereas PH is closer to the

higher 'education, knowledge, status, authority, responsibility' end of the dimension, populated in the main by the doctors. These differences in their configurational locations are consistent with the complete linkage cluster solution. On the other hand, DT and PH are closely adjacent to each other and relatively isolated from the other groups at the negative end of dimension three and the positive end of dimension four (see Figure 6.8); on dimension three they are adjacent to both the {OT, PT} pair and SG; and on dimension four they are both more closely aligned with PS and SW than other groups. The isolation of the pair in the negative on dimension three, positive on dimension four region of the space indicates an unusual combination of qualities: narrowly focused on a small aspect of persons' well-being in which they are specialised in a scientific, technical or specific way, in roles that are entirely to advise rather than to treat, care for or even counsel. These features of their configurational locations are consistent with the single linkage solution.

The cluster solutions have in common early matching of the pairs {OT, PT}, {PS, SW}, {EN, RN}, {GP, RD} and {PN, SG}, joining of {GP, RD} and {PN, SG} to form the doctors group, followed by joining of {PS, SW} and {OT, PT} to form the auxiliary group, and joining of the nurses to the auxiliary group. The major cleavage in the structure is between the doctors group and the others; the major cleavage among the others is between the nurses and the auxiliaries; the major cleavage among the doctors is between the {GP, RD} pair and the specialists; and the major cleavage among the auxiliaries is between the therapists, OT and PT, and the {PS, SW} pair.

The doctors groups, although widely spread on dimension three, form a relatively coherent cluster in the group space configuration, located in the negative ends of dimensions one, two and four. To the extent that this is so, they are collectively represented as possessing or manifesting high education, knowledge, status, authority and responsibility; intelligence, an academic or analytical orientation, arrogance or aloofness, power, avariciousness and masculinity; medical model thinking, medical treatment, knowledge of pharmacology and usage of medicines and drugs, a biomedical, scientific outlook, a clinical focus, and an orientation to disease processes and treatment of illnesses; and medical or physical treatment or care involving more or less physical hands-on contact.

The {GP, RD} and {PN, SG} pairs are separated on dimension one and, although PN remains closer to the {GP, RD} pair than to SG, the {GP, RD} pair are located further towards the positive pole of dimension three than are PN and SG. Thus, GP and RD are represented as possessing less education, knowledge, status, authority and responsibility (and associated dimension one attributes) than PN and SG; and a broader focus and more holistic

orientation to the person beyond the immediate medical or technical problem than SG in particular but also than PN. Although the {PS, SW}, {OT, PT} and {EN, RN} pairs form quite tightly coherent clusters in the configuration, and the {PS, SW, OT, PT} set forms a coherent cluster on dimensions one and two, the large non-doctor group identified in the cluster analysis solution is too widely spread throughout to be considered a configurational entity: whilst the nurses may, at low levels of similarity, have more in common with the allied health professionals than with the doctors, they are in the main distinct from both.

The allied health professional set {PS, SW, OT, PT} is, as a whole, distinguished by its occupancy of the positive end of dimension two and its middling to high status in terms of its location on dimension one: as well as possessing relatively high levels of education, knowledge, status, authority and associated attributes, they are represented as oriented to personal and social well-being, and to 'fit' to and coping in wider social and physical environments; and as 'helping' with 'problems' and facilitating rehabilitation and adjustment after medical treatment rather than performing such treatment themselves.

On dimensions one and two, compared to the allied health professional groups, the nurses are represented as of relatively lower status and more medically or clinically oriented. The {PS, SW} and {OT, PT} pairs are widely separated on dimensions three and four with the nurses in each case located between them. Accordingly, the {PS, SW} and (to a lesser extent) nurses pairs are represented as more broadly focused and holistic than the {OT, PT} pair or, to put it the other way, the latter pair is represented as more narrowly focused on a relatively smaller aspect of persons' welfare and as more specialised in a scientific or technical way. In terms of their relative locations on dimension four, whilst the {OT, PT} pair are represented as occupying roles that are almost exclusively centred on patients' bodies, the {PS, SW} pair is represented as occupying a non-physical counselling role, with the nurses' roles represented as relating to both the physical and personal or social aspects.

The interview sample multivariate data

As previously described (Chapter 5), eleven of the twenty interview sample subjects returned object (groups) by attribute multivariate ratings data matrices. One of these matrices (RN002) was examined in detail in Chapter 5. This part of the present chapter reports an analysis of the aggregate of the remaining ten matrices, all of which were rated on a common (0 to 9) scale (see Chapter 5).

Design of an analytical procedure for the aggregate of the ten matrices presents a considerable challenge arising from employment of a different set of attributes for each subject, according to the specific content of that subject's accounts of his or her pairwise dissimilarity judgements. The purpose of the analysis is, however, to present a solution to this problem

and to examine the extent of conformity between a model based on aggregated pairwise dissimilarity judgments and associated aggregated accounts, and a model based on aggregated object by attribute ratings matrices. This present purpose is directed towards the broader objective of validation of the model to be derived from the questionnaire sample set of object by attribute ratings matrices.

An important difference between the structure of those and the present data is that the questionnaire sample set of matrices will employ a common set of attributes selected from the aggregated pairwise dissimilarities accounts as representative of the sample as a whole, whereas the present set of matrices employ different sets of attributes selected from the individual accounts. It is thus not possible to perform on the present aggregate of the ten individual matrices the same form of analysis as will be performed on the aggregate of the common-attribute questionnaire sample matrices. Nevertheless, as the analysis reported below demonstrates, it is possible to extract the commonality from the ten individual matrices and consequently to compare the solution so derived with the INDSCAL solution described above.

That the INDSCAL solution represents twenty subject's judgments and the aggregated object by attribute ratings matrices represent a subset of ten of them is a complicating factor in this process. Although a separate INDSCAL solution could be estimated for these ten subjects for comparison with a solution derived from their multivariate data matrices, this is not necessary if it can be established that a pairwise solution for these ten subjects would not differ importantly from the twenty subjects solution already estimated. One way to establish this is to compare the subject weights from the twenty subjects' INDSCAL solution between the ten subjects who returned multivariate data matrices and the ten subjects who did not. The INDSCAL subject weights are reported as Table 6.4.

Table 6.4: INDSCAL subject weights

		Dimension weights			
Subject	Weirdness	Dim 1	Dim 2	Dim 3	Dim 4
1	0.1783	0.5039	0.5032	0.4786	0.2301
2	0.3058	0.5290	0.4689	0.2654	0.5197
3	0.4195	0.2480	0.3639	0.7087	0.3834
4	0.1357	0.6703	0.4594	0.3159	0.3071
5	0.2319	0.3700	0.3907	0.5115	0.3669
6	0.0939	0.5804	0.4740	0.3582	0.2606
7	0.1425	0.5584	0.4269	0.2818	0.3452
8	0.3310	0.8064	0.3553	0.2925	0.1917
9	0.3807	0.3428	0.7214	0.2448	0.4311
10	0.0674	0.5962	0.4327	0.4220	0.2843
11	0.2257	0.5928	0.4978	0.4374	0.1764
12	0.1089	0.5661	0.4479	0.3295	0.2433
13	0.1846	0.4146	0.4206	0.4948	0.2770
14	0.4722	0.8864	0.2188	0.2068	0.2261
15	0.1705	0.6667	0.3459	0.4645	0.2816
16	0.1813	0.3399	0.4522	0.3435	0.2203

17	0.1800	0.4182	0.5346	0.4492	0.4110
18	0.2074	0.3373	0.5035	0.3245	0.3183
19	0.1645	0.6614	0.3550	0.4052	0.2516
20	0.2254	0.7049	0.3195	0.3093	0.3622

Subjects 1, 3, 4, 5, 6, 8, 12, 14, 15 and 16 provided the ten multivariate object by attribute ratings matrices. Multivariate analysis of variance was used to compare subject weights over the four dimensions between this set and the remainder of subjects. No significant multivariate difference was found (Wilks' Lambda = .773; F = 1.103; df = 4, 15; probability = .391). It may be that, with only ten subjects per group, failure to find significance is due to low statistical power for the significance test. However, none of the more powerful univariate tests (i.e. on the weights for each dimension taken separately), each with 1,18 degrees of freedom, was found to be significant (Dim 1, F = .396, prob. = .537; Dim 2, F = 2.311, prob. = .146; Dim 3, F = .499, prob. = .489; Dim 4, F = 3.194, prob. = .091).

Non-Linear Principal Components Analysis

Non-linear principal components analysis (PRINCALS) was employed to identify the commonality among the ten objects by attributes data matrices. In order to suit the SPSS Categories implementation of PRINCALS, the '0 to 9' data were recoded '1 to 10'. The ten objects (occupational groups) were treated as subjects (or cases) and the 304 attribute items (over the ten subjects' data) were treated as variables. Because those attributes with the greatest variance across objects discriminate most strongly among them, the 218 attributes that had standard deviations greater than or equal to 2, or ranges greater than or equal to 5, were selected for inclusion in the analysis. Attributes were treated as ordinally measured and solutions in 1 to 11 dimensions were estimated. R-squared values for these solutions are reported in Table 6.5 and plotted by number of dimensions in Figure 6.11.

Table 6.5: Non-linear principal components analysis: RSQ by number of dimensions

Dimension(s)	RSQ
1	.4695
2	.7313
3	.8473
4	.8941
5	.9394
6	.9664
7	.9838
8	.9938
9	.9980
10	.9989
11	1.0000

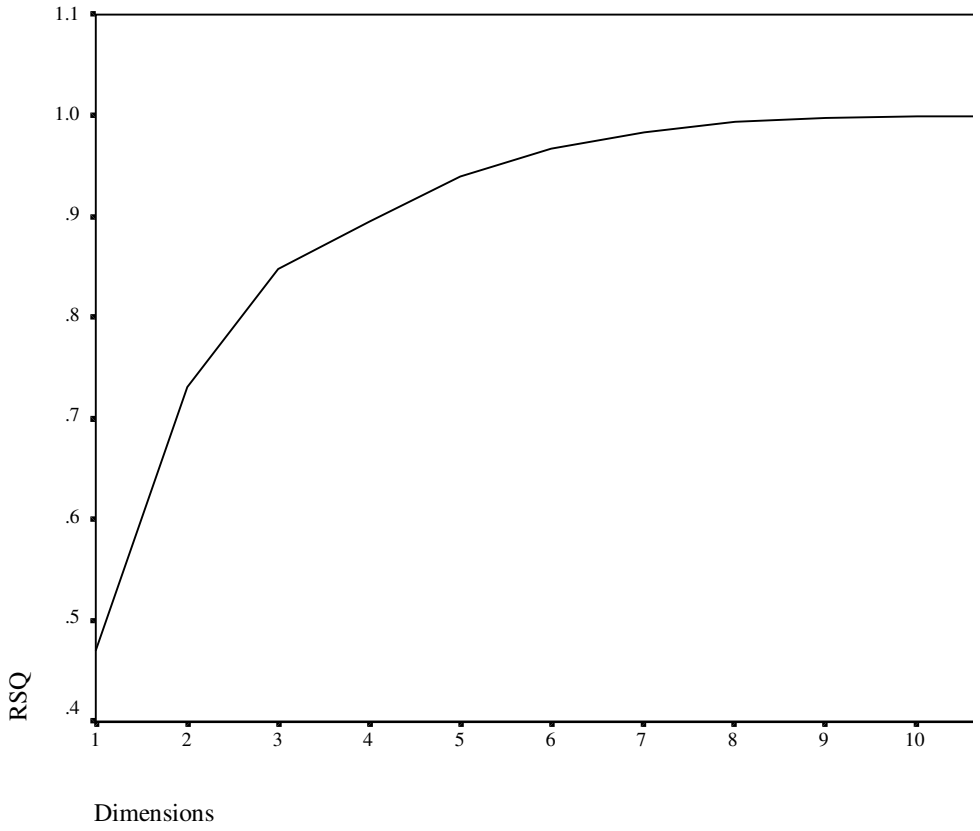


Figure 6.11: Non-linear PCA: RSQ values for solutions from 1 to 11 dimensions

Inspection of Figure 6.11 suggests a solution with a minimum of three dimensions and parsimony suggests four. Eigenvalues of the four dimensions are: Dim 1 = .352, Dim 2 = .308, Dim 3 = .164, Dim 4 = .070. Object scores (i.e. the coordinates of the twelve groups in four-dimensional space) were saved as variables and are reported in Table 6.6.

Table 6.6: PCA object scores

	Object Scores			
Object	Dim 1	Dim 2	Dim 3	Dim 4
DT	-1.27	1.14	1.24	.32
EN	1.86	1.18	1.13	-.85
GP	.72	-.92	.08	.71
OT	-.29	.64	-.95	-1.37
PH	-1.67	.22	1.64	.68
PN	-.08	-1.61	-.21	.18
PS	-.29	.60	-1.46	1.10
PT	-.28	.36	-.45	-2.10
RD	.25	-1.06	.03	-.06
RN	1.75	.22	.52	1.10
SG	-.43	-1.70	.14	-.70
SW	-.26	.93	-1.70	.99

Whilst using these scores an object configuration, analogous to the group space configuration from the INDSCAL analysis, could be produced and the configurations compared following Procrustes rotation (Gower, 1975), it is more pertinent for present purposes to establish the extent of overall correspondence between distances among groups in the two solutions. Canonical correlation analysis was employed for this purpose. The overall multivariate multiple regression between the two sets of coordinates is highly significant (Wilks' lambda = .000; approximate F = 63.01; df = 16, 12.86; probability = .000) and 91.2% of the variance in the set of MDS coordinates is accounted for by the four PCA canonical variates. Evidently, distances among objects estimated by PCA from ratings on attributes are highly similar to their distances as estimated by MDS from pairwise dissimilarity judgments, provided that the attributes on which the groups are rated are sufficiently closely related to the statements subjects make in account of their pairwise dissimilarity judgments.

However, consistency of interpretation of differences among (distances between) objects in terms of attributes between the two solutions is also important. Again, although Procrustes rotation might be used to orient the PCA object configuration to maximum conformity with the MDS configuration and loadings on the rotated components examined, that approach was not pursued here. It may be sufficient for present purposes to interpret the unrotated PRINCALS components in terms of highest attribute loadings and to observe differences among the groups on these constructs in order to make a global judgment of interpretational consistency between the two solutions.

Interpretation of the PCA dimensions

The attributes by dimensions loadings matrix is large and less than convenient as a basis for dimensional interpretation. The full matrix is presented in Appendix A, Part 2 and four sorted sub-matrices of the highest attribute-dimension loadings for each of the four dimensions are presented below as Tables 6.7 – 6.10.

Component 1

Table 6.7: Non-linear PCA: Highest attribute-dimension 1 loadings in ascending order

Code	Attribute	Dim 1
V602	focus on one aspect	-.910
V1615	work from knowledge base and leave care to others	-.884
V1515	independent - don' t have anyone to answer to	-.881
V817	specialised knowledge	-.872
V429	narrow or technical role	-.868
V101	specialists / focus on one area	-.814
V614	specialists with particular, focused skills	-.813
V807	freedom in how they work	-.811
V815	autonomy in their practice	-.811
V1511	focus on own job and not interested beyond that	-.807
V808	focus on a particular aspect	-.764

V312	focus on particular aspects / problems / areas	-.759
V123	part of the non-medical team	-.758
V1604	focus on a small area or section	-.741
V813	high standing as health professionals	-.732
V818	high social standing / class / prestige	-.732
V831	mainly middle class backgrounds	-.732
V503	limited scope of practice	-.714
V402	arrogant, 'superior' or 'stuck-up'	-.713
V1519	too busy to spend much time with patients	-.713
V320	interested in people's feelings / emotions	.703
V502	large overall impact on patient wellbeing	.716
V508	concerned with patients' medical wellbeing	.716
V826	interested in medical wellbeing	.718
V332	respond to wide range of types of events	.724
V507	concerned with patients' physical wellbeing	.726
V304	caring attitude	.730
V327	close to patients mentally / emotionally / spiritually	.731
V313	have 'human' skills	.733
V1625	deal with the totality of the patient	.735
V1226	spend a lot of time with each patient	.743
V1421	work 'hands-on'	.749
V608	central role in health-care delivery	.772
V325	holistic approach	.775
V627	oriented to promoting wellness	.776
V419	close contact with patients	.781
V820	work hands-on	.785
V102	generalists / wide variety of problems	.798
V112	obliging and communicative people	.801
V816	follow instructions / procedures initiated by others	.801
V329	team-workers	.822
V109	become personally close to patients	.823
V812	communicate / share knowledge with other groups	.831
V620	interested in social wellbeing	.837
V832	interested in people as people / overall person	.839
V819	generalists with a wide variety of duties	.840
V1510	communicate well with other groups	.846
V616	people-oriented	.857
V1516	their work is part of the nurses' role	.858
V615	holistic orientation	.859
V621	interested in personal wellbeing	.868
V1517	personally involved	.873
V822	interested in physical wellbeing	.881
V428	know and understand patients	.885
V314	have talking and listening skills	.898
V409	spend a lot of time with patients	.904
V408	closely involved with patients	.907
V1526	good rapport	.907
V309	deal with 'nitty-gritty' matters	.911
V1518	spend a lot of time with patients	.917
V821	interact closely with patients	.925
V1521	interested in mental and social aspects	.930
V333	face-to-face contact time with patients	.932

Component 1 represents a contrast between those attributes with negative and those with positive loadings.

The set of attributes with negative loadings refer to narrowness of focus, focus on a particular aspect, specialised knowledge and a specialised role, autonomy in practice, and status and prestige. The set of attributes with positive loadings refer to spending time with, talking and listening to, establishing rapport with, coming to know and understand and becoming closely involved with patients; having an holistic approach to them, working hands-on with them and taking an interest in their personal, mental and social aspects; and being generalists who communicate with both patients and other groups. The groups with the largest negative scores on the component are PH and DT (and to some extent SG) and those with the highest positive scores are EN and RN, and also GP.

Component 2

Table 6.8: Non-linear PCA: Highest attribute-dimension 2 loadings in ascending order

Code	Attribute	Dim 2
V104	mainly males	-.976
V1414	lot of influence on care / treatment decisions	-.976
V801	mainly male	-.973
V633	decision-making power	-.962
V405	focused mainly on disease processes	-.954
V630	physical (incl. chem) / biological sciences	-.939
V1504	' talk down' to patients	-.935
V520	focus is ' cure'	-.934
V1520	high position in health hierarchy	-.922
V612	high level of academic education	-.921
V322	interested in people' s medical conditions	-.913
V607	high standing in health hierarchy	-.911
V623	practice based on own discipline and research tradition	-.910
V634	high prestige / status	-.900
V604	well established professional organisation	-.896
V331	use invasive treatments	-.893
V1624	high status in health system	-.884
V315	materialistic	-.869
V521	a lot of theoretical knowledge	-.867
V513	clever	-.864
V305	high-brow knowledge / interests	-.861
V804	think of themselves as an elite group	-.858
V1513	' I know everything' attitude	-.857
V116	work is vital - serious or life-threatening problems	-.856
V528	highly trained	-.855
V601	technical / scientific orientation	-.853
V512	intelligent	-.851
V324	arrogant / self-opinionated	-.843
V117	high level of academic achievement	-.830
V1424	high status in health hierarchy	-.829
V330	diagnostic skills	-.828
V610	high level of responsibility	-.827
V626	focus on correction of disorder	-.824
V631	independent practitioners	-.815

V802	high level of responsibility	-.815
V811	high level of learning / education	-.811
V515	clinical or analytical approach	-.804
V328	technical - mechanical skills / knowledge	-.784
V805	broadly based knowledge	-.771
V414	narrowly focused in their approach	-.769
V1222	concerned with medical welfare	-.756
V303	concerned with politics of health setting	-.755
V1408	high level of responsibility	-.751
V316	powerful / influential	-.744
V1623	mostly concerned with immediate medical condition	-.733
V1412	dogmatic with other groups	-.718
V1506	there to tell rather than to listen	-.715
V1201	highly trained	-.708
V524	broad range of responsibilities	-.705
V1219	roles overlap or crossover with other groups	.740
V1418	accept advice / share information	.766
V624	practice dependent on knowledge generated by others	.792
V118	secondary to primary medical treatment	.896
V105	mainly females	.929

Whilst there are both large negative and large positive attribute loadings on component 2, the dimension is largely defined in terms of the negative loading attributes. The dimension identifies a technical or scientific orientation based in the physical or biological sciences, a clinical or analytical focus on disease processes, correction of disorder, 'cure' and medical condition; high levels of intelligence, education, (academic) knowledge and training, status and prestige, decision-making power, influence and authority, and responsibility; a tendency to elitism, arrogance, self-importance and dogmatism; and masculinity.

The groups with the largest negative scores on the component are the doctors (SG and PN in particular, but also RD and GP), and the groups with the largest positive scores are EN, DT and SW but also OT and PS. Apparently, SG and PN are the most 'doctor-like' and EN, DT and SW the least.

Component 3

Table 6.9: Non-linear PCA: Highest attribute-dimension 3 loadings in ascending order

Code	Attribute	Dim 3
V1405	social science oriented	-.771
V103	treat main or ' root' problems	-.768
V1611	help people find solutions to their problems	-.759
V1618	help people adjust to their daily lives	-.700
V318	interested in the way people think	-.693
V827	accepting / tolerant	-.678
V824	interested in mental wellbeing	-.670
V1622	work to improve patients' personal or social wellbeing	-.663
V825	interested in social wellbeing	-.657

V320	interested in people' s feelings / emotions	-.654
V111	have a lot of patient contact	-.651
V506	concerned with patients' social wellbeing	-.651
V509	concerned with patients' personal wellbeing	-.651
V823	interested in emotional wellbeing	-.648
V1417	empathetic in their approach	-.648
V1420	direct contact / relate closely	-.648
V1223	concerned with mental or emotional welfare	-.647
V319	interested in people' s social circumstances	-.646
V501	direct patient contact	-.646
V1621	work to improve patients' mental or emotional state	-.646
V510	involved with patients as people	-.644
V1501	care, support, look-after, nurture	-.644
V1502	personal style with patients	-.644
V1505	there to listen to patients	-.644
V1512	take interest in patients as whole people	-.644
V505	concerned with patients' mental wellbeing	-.641
V1503	relate ' on a level' with patients	-.636
V323	people-oriented / humanistic	-.635
V327	close to patients mentally / emotionally / spiritually	-.629
V519	spend time talking to patients	-.622
V1224	concerned with personal or social welfare	-.619
V1430	lot of variety in their work	-.608
V1525	oriented to ' fixing' things	-.608
V1603	prefer not to deal with people much	.635
V119	concerned with physical needs	.640
V619	interested in physical wellbeing (structure)	.714
V603	share knowledge / collaborate	.747
V613	broad educational base	.792
V1428	work towards physical welfare	.793
V617	interested in medical wellbeing (organism)	.823

As for component 2, component 3 is largely defined in terms of its negative loading attributes. These attributes refer to involvement with, interest in or concern for patients' personal, mental, emotional and social wellbeing or welfare; to helping people find solutions to their 'problems' and with adjustment to their daily lives; to a humanistic, empathetic, accepting approach to 'people as people'; and to making direct contact with people in a 'person to person', listening and talking manner. This is contrasted (positive loadings) with preferring not to deal with people (as people) much, and focusing more on their physicality.

The groups with the largest negative scores on the component are SW, PS and OT, and the groups with the largest positive scores are PH, DT and EN.

Component 4

Table 6.10: Non-linear PCA: Highest attribute-dimension 4 loadings in ascending order

Code	Attribute	Dim 4
V1427	practical bent	-.662
V1421	work ' hands-on'	-.581

V110	work closely with patients physically	-.567
V1506	there to tell rather than to listen	-.555
V121	central role in hospital context	-.545
V321	interested in people' s physical conditions	-.539
V119	concerned with physical needs	-.530
V1522	interested in physical aspects	-.527
V833	technical or clinical role	-.510
V311	narrow therapeutic focus	-.509
V829	work to routines	-.491
V1230	peripheral to the main work of medical treatment	-.475
V619	interested in physical wellbeing (structure)	-.469
V624	practice dependent on knowledge generated by others	-.420
V820	work hands-on	-.420
V115	concerned with diagnosis or assessment	.401
V1231	peripheral to the main work of patient care	.409
V511	limited or narrow therapeutic focus	.414
V806	adjunct to main work of hospital	.418
V304	caring attitude	.428
V1614	willing to listen to patients	.429
V827	accepting / tolerant	.435
V824	interested in mental wellbeing	.443
V1405	social science oriented	.455
V803	broad range of responsibilities	.482
V318	interested in the way people think	.501
V317	interested in patients as people	.518
V120	concerned with personal or emotional needs	.521
V1415	like working with people	.530
V1407	make critical or vital decisions	.562
V809	tend to be patient people	.640
V629	biological / social sciences	.659
V628	social sciences / humanities	.664
V1423	advisory role	.785

Component 4 accounts for a relatively small proportion of variance and appears, in terms of themes among attributes, to be less conceptually coherent than the first three components. Nevertheless, the negative loading attributes refer to working in a practical, routine, hands-on manner with patients' in the interests of their physical condition or wellbeing: this is direct physical care or treatment in contrast to care or treatment via medicines or other means ('peripheral to the main work of medical treatment'). Coherence among the positive loading attributes is more difficult to identify.

The groups with the largest negative scores on the component are PT (in particular), OT, EN and SG, and the groups with the largest positive scores are RN, PS and SW, and also GP and PH.

Who are registered nurses from the perspective of the PCA solution?

The similarity between the ways registered nurses are characterised according to the INDSCAL and PCA

solutions provides an indication of the extent of interpretational conformity between them.

In the PCA solution, registered nurses have large positive scores on dimensions one and four and small positive scores on dimensions two and three (Table 6.6). Consequently, whilst registered nurses score near the means over groups on dimensions two and three, they are largely distinguished by their differences from the other groups on dimensions one and four. Dimension one accounts for about five times the variance of dimension four and is subject to greater interpretational clarity.

In terms of dimension one attributes, RNs are distinguished from most other groups (although ENs and to a lesser extent GPs are similar to them in this respect) by, more than most groups, spending time with, talking and listening to, establishing rapport with, coming to know and understand and becoming closely involved with patients; having an holistic approach to them, working hands-on with them and taking an interest in their personal, mental and social aspects; and being generalists who communicate with both patients and other groups. In terms of the negative-loading attributes, they also possess less than most groups of narrowness of focus, focus on a particular aspect, specialised knowledge and a specialised role, autonomy in practice, and status and prestige. To the extent that dimension four attributes support a reliable description, RNs are like PSs and SWs in being less involved than many groups (PT, OT and EN in particular) in direct physical care and more involved in care or treatment via medicines or other means. Their relatively small positive loading on dimension 3 indicates, however, that they differ from PSs and SWs in being more focused on patients' physical needs, medical condition and physical wellbeing and being relatively less involved with their personal, mental, emotional and social wellbeing and adjustment. Their small positive score on dimension two indicates that they are 'average' among groups on the attributes that serve primarily to distinguish the doctors from the auxiliary groups locating them between the two.

In general terms, this description accords well with the description of registered nurses drawn from the INDSCAL solution.

Summary

The INDSCAL solution modelling the set of pairwise dissimilarities matrices and its interpretation from sorted and selected comments from accounts appears to be very satisfactory from a purely descriptive point of view. The extent of commonality among subjects in terms of their dissimilarity estimates is quite high as indicated by the .78 RSQ statistic for the solution. Moreover, sufficient commonality was observed among

subject's accounts to support reasonably confident interpretation of among-group similarities and differences, although an independent observer would need to assess that him- or her- self by careful examination of the sorted and selected accounts in the Appendix. This sort of approach to building models of attribute by category structures may serve many useful purposes, which may be extended beyond the form of its employment here. For example, a solution might be interpreted in qualitatively different terms for different groups of perceivers by separately selecting and comparing their accounts. Although little was made of the solution's subject weights in this application, they might be used, perhaps in conjunction with separate interpretations from accounts, to compare perceivers from different social groups or from the same social groups under different judgmental conditions.

This sort of data collection process and modelling is, however, limited in other respects. In particular, these are two: the processes of data collection and interpretation of solutions are time-consuming and expensive and tend to limit the sizes and representativeness of samples, and the category by attribute relations – the primary focus of categorization research – are informally or externally established. External association of attributional differences with perceived dissimilarities among categories has, apart from a sense of indeterminacy, two limitations in a research context: it does not allow for detailed examination of structure or conceptual coherence among attributes, nor does it produce variables describing among attribute or object by attribute relations that may be related to pragmatically or theoretically important variables external to the measurement model itself. Although the data-collection process employed here might perhaps with little loss be simplified, or with ingenuity, instantiated in a self-report instrument to reach larger, more representative samples, the results of the process do not lend themselves to employment of the solution obtained for application or research purposes beyond one-off description.

Nevertheless, dissimilarity judgments (and, although little used here, sorts and hierarchical sorts) together with associated accounts are clearly directly relevant to natural categorization and an invaluable means of collection and interpretation of attributional statements that may be used as a basis upon which to develop sets of perceiver by category - relevant rating scale items. Whilst one might be tempted to dispense with modelling the dissimilarity judgments and interpreting the configuration and to 'harvest' the attributional comments directly, more complex models subsequently built will be more clearly interpretable once a sense of the associations among attributes and the distinctions differences in terms of them serve to effect among categories are gained. Observation of how attributes are combined to make certain kinds of distinctions among categories is part of a process of learning what subjects mean when they use them. Obtaining such solutions 'along the way' also has the potential to indicate the approximately appropriate dimensionality of

subsequently obtained solutions and provide a point of reference against which their possible degeneracy might be judged.

From the point of view of moving beyond dissimilarity judgments and accounts to rating-scale data, it is reassuring that distances among categories in INDSCAL configurations representing pairwise dissimilarity judgments and in PCA object spaces from ratings of categories on suitably selected and worded attribute scales may correspond to the extent of .92 shared variance as observed here. PCA was used for this purpose in this context rather than MDU because the latter would have produced an essentially uninterpretable configuration representing distances among over two hundred points: such a configuration might be subject to some sort of interpretation in two (rather largely-displayed) dimensions but not in three or four as seems appropriate. Moreover, attempts to continue data analysis in the MDS tradition by applying MDU and WMDU models to the ratings scale data described in Chapter 7 resulted in less than useful or degenerate solutions. An extension of PCA, three-mode PCA (see Chapter 7), however, produced a highly satisfactory solution. Not only MDS-type models but also the non-metric approach employed thus far was abandoned there because, to date, optimal scaling routines have not been included three-mode PCA algorithms. The failure of the non-metric WMDU analyses is also suggestive that optimal scaling may be associated with solution degeneracies in large multi-modal data sets.

Chapter 7

Analysis of the three-mode data I: the research instrument, the sample, the data and initial approaches to analysis

The purposes of the research reported in this and the next two Chapters include (a) to collect data from a broader, more representative sample of Australian registered nurses than it was possible to access through the interview process reported previously and (b) to fit a model in which the relations among attributes, among groups and between attributes and groups are formally (i.e. from measures according to a mathematical model) rather than informally established. The data collection process was to have a sample of registered nurses each rate on a ten-point scale (0-9) the extent to which each of a set of attributes applies to each of the twelve groups. The data generated are three mode with three distinct sources of variation: among objects (groups), among attributes and among perceivers (subjects / nurses). The data analysis objective is to fit a model to these three modes of data variation simultaneously: i.e. to fit a model that represents the observed data as a product of subject by object by attribute interaction.

The present chapter describes the research instrument, the sample, the data and initial approaches to its analysis. It reports PCA and MDU analyses of the data reduced to two modes by averaging over subjects and a WMDU analysis of the three-mode data. Although WMDU may appear to be the most 'natural' three-mode model to fit to the data in the sense of consistency with the MDS and MDU analyses reported previously, the results were less than satisfactory (see below). Accordingly, a more general model in the PCA tradition, three-mode PCA (3PCA) (Kroonenberg, 1983; Tucker, 1964) was fit and found to yield very

satisfactory results. The 3PCA analysis is reported in Chapters 8 and 9. Chapter 8 provides an introduction to the analysis and a component by component interpretation of the solution. However, interpretations of this sort tend to reify constructs following directions through which the component spaces are viewed or which are associated with particular sets of rotations. An alternative approach to interpretation through examination of joint plots (e.g. Kroonenberg, 1983; Veldscholte, Kroonenberg & Antonides, in press) focuses attention more on joint (attribute by group) relationship spaces as wholes and tends less to encourage reification of constructs associated with particular rotations. In the absence of reasons to favour a particular description, the solution might better be conceived of as a 'map' to a social cognitive domain to be read in different ways for different purposes. The joint plot approach to interpretation is consonant with this orientation. Chapter 9 reports an interpretation from joint plots and summarises the analysis as a whole.

The research instrument

A set of forty four attributes perceived to categorize together and distinguish among the twelve groups was gleaned from the accounts of the twenty interview subjects of their perceived similarities and differences among the sixty six pairs of the twelve groups. The set of attributes, together with identifying numbers and codes, is reported in Table 7.1. Selection of these attributes was made prior to development of the software described in Chapter 6 and there used to interpret the INDSCAL configuration modelling the set of twenty between-group pairwise dissimilarity matrices. Whilst they do not correspond exactly to the set of attributes identified in that process and reported in Table 6.2, there is considerable correspondence between the two sets. The instrument was formatted as a matrix with attributes as rows and groups as columns with the cells being filled by subjects with their ratings (0-9) of the extent to which each attribute applies to each group.

Table 7.1: List of attributes on which 60 subjects rated the 12 groups

#	Code	Attribute
1	eduintel	Education / intelligence
2	status	Status / prestige
3	authrty	Authority / decision-making power / right to decide
4	power	Power / ability to direct or control others
5	rspnsbty	Responsibility / importance or potential impact of decisions / actions
6	arrognce	Arrogant / self-important / aloof / elitist
7	males	Males
8	scientfc	Scientific orientation / attitude
9	humanstc	People oriented / humanistic
10	analytcl	Analytical / like to work things out / solve problems / diagnose
11	practcl	Practical - action or task / oriented / doers
12	genrlsts	Generalists with knowledge / skills that overlap / crossover with other groups
13	speclizd	Specialized knowledge / experts in an area
14	narrow	Narrow speciality / focus on a specific area or aspect
15	variety	Deal with a wide variety of people / problems / situations
16	infothng	Deal with information / things / material rather than directly with people

17	rootprob	Investigate / delve-into / deal with underlying causes or root problems
18	auxilary	Auxiliary / peripheral to main treatment / care process
19	central	Central / pivotal / focal role in health care process
20	manage	Administer / coordinate / organise / manage
21	cooprtve	Approachable /cooperative / liaise / share knowledge with others
22	hardwork	Hard-working
23	medtrt	Involved in medical treatment / have a medical / clinical orientation
24	phystrt	Involved in physical treatment (versus or as well as physical well-being or care)
25	mentemot	Involved with patients' mental-emotional well-being / needs or problems
26	soclwb	Involved with patients' social well-being / needs or problems
27	perswb	Involved with patients' personal or everyday well-being / needs or problems
28	physwb	Involved with patients physical well-being / needs or problems
29	advise	Advise / inform / educate patients
30	disease	Oriented to illness / disease / disorder
31	problems	Deal with ' problems' or ' needs' other than or as well as immediate medical ones
32	perstyle	Have a personal approach to or style with patients
33	tecstyle	Have a technical approach to patients or their illnesses / problems
34	broadvw	Have a broad view of or approach to a person
35	holistic	Have a holistic approach / treat patients as ' whole persons' / in ' totality'
36	empathy	Have a caring attitude / are empathetic / compassionate / tolerant / accepting
37	timewp	Spend time with patients
38	rapport	Develop rapport with patients / communicate well / have good ' people skills'
39	listen	Willing to listen to patients' points of view / concerns
40	closetop	Get close to patients / know patients well
41	handson	Provide direct / hands-on / physical patient care
42	contact	Have face-to-face / one-to-one patient contact
43	longterm	Maintain long-term relationships with patients
44	athome	See / are concerned with / patients or their lives in the community / at home

Demographic data were also collected from each subject both to provide a basis for description of the sample and as potentially accounting to some degree for subject variability. Whilst accounting for subject variability is not an important objective of this research, modelling it and demonstrating processes by which variables external to the three mode data itself may be related to it is. There are likely many psychological and social variables with greater potential to account for subject variability than those measured here and exploration of such relationships might be the subject or further research. Demographic data were collected on gender, age, years of experience, training (tertiary or hospital system, both or hospital system with tertiary training in progress) and whether or not a nurse had specialised.

The sample and response

The sample was recruited through advertisements in The Australian Nursing Journal and in Bedside Manners, a newsletter circulated among registered nurses undertaking continuing and further education through the Centre for Professional Development in Health Sciences at Southern Cross University.

Perhaps due to the amount of time and effort involved in completing the questionnaire, a process requiring 528 ratings as well as the demographic

data, only sixty completed instruments were returned. This naturally raises the questions of the influence of self-selection and of the adequacy of the sample size. There are two aspects to be considered in response to these concerns: the representativeness of the sample and the adequacy of the sample size to reliable model estimation. The first of these resolves to a question of what population the sample obtained is actually representative of. Whilst there is little guidance in this, the research is primarily concerned with examination of an integrated data collection and analysis process and secondarily with description of a specified population. It remains that the sample does represent some population – perhaps a highly motivated sub-set of the population of Australian registered nurses who recognised the questionnaire as an opportunity to express their interests – and the data collected remain appropriate to the primary objective of the research. Among possible ways of representatively sampling a specified population using these methods must be considered reduction of the burden imposed on potential respondents through limiting the number of attributes on which they are required to rate the groups.

In respect of the adequacy of the sample size to reliable model estimation, the data collected from sixty subjects here is relatively large in volume and highly structured. Judgment of sample size adequacy is in any case conditional upon both the model employed and the fit of model to data and may be adequately assessed only subsequently to model estimation. However, sample size adequacy is generally judged in the context of statistical inference or of the reliability of sample statistics as estimates of population parameters: i.e., of the expected variation among samples from the same population. The models employed here derive more from the psychometric or data-analytic tradition in which descriptive or measurement objectives take precedence over tests of significance.

In the present context, variability among repeated samples from the same population is of less interest than variability among alternative models on the same sample. The utility of statistical inferential results is in any case dependent upon the prior conditions of sample representativeness and measurement adequacy: the variation within the obtained sample is used to estimate the variation among potentially repeated samples from the same population on the assumption of representativeness; and measurement determines what it is that among-sample variability is estimated of. Present interest focuses on the ability of three-mode measurement models to yield non-degenerate estimates of three-mode structure that summarise the interaction of three-sources of variability in generation of a categorical scheme.

Sample demographics

The sample consisted of 54 females and six males. Minimum and maximum ages were 25 and 60 years, and minimum and maximum years of experience were three and 39. Eighteen subjects were hospital trained only, 11 were tertiary trained only, 18 had completed hospital training and were completing tertiary

training, and thirteen had completed both hospital and tertiary training. Forty three nurses had specialised and 17 had not.

Descriptive statistics of group by attribute ratings

Means, standard deviations, and minimum and maximum values for each attribute by each group (summarised over subjects) are reported in Table 7.2. Considerable variation is observed on each of the three modes. Taking the subject mode over which the data are summarised, the ranges of scale points employed by subjects within each attribute by group cell are generally wide given the expectation of reasonable consensus among a coherent social group commenting on a situation of which most have considerable experience. The within-cell standard deviations in Table 7.2 are a measure of consensus allowing observation of variation in consensus about groups across attributes, attributes across groups and as a function of attribute by group interaction. A formal analysis of consensus in terms of attribute by group standard deviations is possible by means of PCA or MDS but is not pursued here. This is after all an aspect of variability on the subject mode which is subsequently modelled as part of the analysis of three-mode interaction. The approach taken here is to assume that consensus in this context is potentially multivariate: that there may be several ways or dimensions on which relative prototypicality might be defined or that each subject might be described in terms of his or her prototypicality profile over a set of distinct subject dimensions or perspectives.

Table 7.2: Means, sample sizes, standard deviations and minimum and maximum ratings for each attribute by each group (summarised over subjects)

		Group											
Attribute	Statistic	DT	EN	GP	OT	PH	PN	PS	PT	RD	RN	SG	SW
education / intelligence	mean	6.42	5.15	7.97	6.63	7.73	8.46	7.36	7.00	7.41	7.14	8.36	6.59
	n	59	59	59	59	59	59	58	59	59	59	59	59
	s.d.	1.56	1.39	0.93	1.30	0.98	1.02	1.27	1.22	1.08	1.01	1.06	1.29
	min.	2	2	5	3	4	2	3	3	4	5	2	3
	max.	9	9	9	9	9	9	9	9	9	9	9	9
status / prestige	mean	5.05	3.46	7.69	5.41	6.88	8.51	6.76	6.22	6.81	5.93	8.58	5.53
	n	59	59	59	59	59	59	58	59	59	59	59	59
	s.d.	1.65	1.58	1.36	1.73	1.25	1.01	1.42	1.43	1.27	1.51	1.05	1.51
	min.	1	0	2	1	2	2	4	2	4	2	2	2
	max.	9	7	9	9	9	9	9	9	9	9	9	9
authority / right to decide	mean	5.35	2.9	7.97	5.55	6.73	8.58	6.58	6.08	6.97	6	8.67	5.47
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.46	1.76	1.25	1.88	1.64	1.05	1.62	1.62	1.25	1.57	0.99	1.97
	min.	0	0	2	0	1	2	2	0	4	2	2	0
	max.	9	8	9	9	9	9	9	9	9	9	9	9
power / ability to control or direct	mean	4.8	2.68	7.53	4.88	5.9	8.52	6.34	5.7	6.75	6.15	8.65	5.3
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.19	1.9	1.46	2.15	2.16	0.77	1.79	1.91	1.45	1.67	0.63	2.08

	min.	0	0	3	0	1	6	2	0	1	2	6	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
responsibility	mean	5.19	3.8	7.97	5.38	7.2	8.63	6.8	6.28	7.73	7.55	8.73	6
	n	59	59	60	60	60	60	59	60	60	60	60	60
	s.d.	2.35	2.08	1.45	2.19	1.84	0.66	1.85	2.03	1.29	1.44	0.58	2.1
	min.	0	0	2	0	1	7	1	0	5	3	7	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
arrogant / aloof / elitist	mean	3.45	1.9	6.53	4.17	4.72	7.72	5.81	4.48	6.43	3.85	8.32	4.73
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.82	1.96	1.98	2.71	2.78	1.64	2.37	2.74	1.9	2.07	1.17	2.57
	min.	0	0	2	0	0	3	1	0	1	0	4	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
males	mean	2.54	2.52	6.98	2.79	6.41	7.95	5.84	4.59	6.2	3.52	8.16	3.55
	n	56	56	56	56	56	56	55	56	56	56	56	56
	s.d.	1.98	1.58	1.41	2.05	1.52	1.05	1.71	1.55	1.38	1.69	0.99	1.72
	min.	0	0	4	0	3	5	2	1	3	1	5	0
	max.	9	8	9	9	9	9	9	9	9	9	9	9
scientific	mean	5.02	2.52	7.08	4.32	7.83	8.17	5.24	5.78	7.42	5.67	8.05	3.17
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.41	1.72	1.43	2.25	1.44	1.06	2.34	2.15	1.37	1.8	1.21	2.23
	min.	0	0	2	0	2	4	0	0	3	0	4	0
	max.	9	8	9	9	9	9	9	9	9	9	9	9
people oriented / humanistic	mean	5.78	7.98	6.18	7.12	4.60	5.00	7.24	6.93	5.60	8.10	4.43	7.60
	n	60	59	60	60	60	60	59	60	60	60	60	60
	s.d.	2.23	1.03	2.18	1.64	2.51	2.6	1.82	1.54	1.81	1.12	2.6	1.72
	min.	0	5	0	0	0	0	1	1	1	4	0	2
	max.	9	9	9	9	9	9	9	9	9	9	9	9
analytical / diagnose	mean	5.52	3.60	7.23	6.27	6.12	8.27	7.51	6.52	7.67	7.20	7.97	6.17
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.25	2.14	1.65	2.07	2.44	1.02	1.52	1.93	1.13	1.49	1.09	2.16
	min.	0	0	0	0	0	5	2	0	5	0	5	1
	max.	9	9	9	9	9	9	9	9	9	9	9	9
practical / doers	mean	5.25	8.25	5.22	6.98	5.22	4.58	4.54	7.05	5.97	7.87	6.73	5.14
	n	60	60	60	60	60	60	59	60	60	60	60	59
	s.d.	2.37	0.97	2.37	1.94	2.71	2.44	2.17	2.12	1.9	1.53	2.26	2.42
	min.	0	4	0	0	0	0	0	0	2	1	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
generalists / knowledge & skills crossover	mean	3.65	5.75	7.17	5.23	4.13	5.20	4.68	5.3	6.10	7.85	4.12	5.35
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.43	2.61	1.98	2.33	2.63	2.66	2.42	2.11	2.01	1.44	2.7	2.5
	min.	0	0	1	0	0	0	0	0	2	3	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
specialized / experts in an aspect	mean	8.10	4.17	5.73	7.52	8.37	8.28	7.98	7.68	5.63	7.18	8.57	6.82
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	1.42	2.47	2.2	1.95	1.34	1.14	1.14	1.64	2.27	1.64	0.93	2.25
	min.	0	0	0	0	0	3	4	0	0	3	3	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
narrow focus	mean	8.05	3.10	3.95	7.12	7.88	6.70	7.51	7.20	4.60	4.08	7.90	6.02
	n	60	60	60	59	60	60	59	60	60	60	60	60

	s.d.	1.59	2.34	2.49	1.97	1.75	2.57	1.71	2.06	2.49	1.99	1.97	2.55
	min.	0	0	0	1	2	0	1	0	0	0	1	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
variety	mean	5.92	7.75	8.50	6.95	5.70	7.23	7.53	7.08	8.02	8.33	6.77	8.00
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.57	1.89	1.03	1.93	2.83	1.86	1.48	1.6	1.5	1.43	2.05	1.3
	min.	0	1	2	2	0	2	4	3	3	1	2	3
	max.	9	9	9	9	9	9	9	9	9	9	9	9
information / things	mean	4.10	1.88	3.05	3.22	6.92	4.42	2.97	2.98	3.25	2.88	4.43	3.07
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.96	1.77	2.32	2.41	2.13	2.77	2.41	2.46	2.25	2.42	2.71	2.46
	min.	0	0	0	0	1	0	0	0	0	0	0	0
	max.	9	7	9	9	9	9	9	9	9	9	9	9
root problems	mean	5.02	3.5	6.23	5.1	3.42	6.97	7.44	5.95	6.43	6.78	5.88	6.98
	n	60	60	60	60	59	60	59	60	60	60	60	60
	s.d.	2.37	2.27	2.29	2.31	2.36	2.04	1.78	2	1.98	1.62	2.59	1.95
	min.	0	0	0	0	0	2	2	1	0	0	1	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
auxiliary	mean	6.27	4.38	3.33	6.07	5.3	3.43	5.49	5.18	3.72	3.88	3.22	5.38
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.55	2.93	2.6	2.26	2.61	2.78	2.37	2.53	2.8	3	2.71	2.53
	min.	0	0	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
central role	mean	4.07	5.6	6.87	4.22	4.57	7.17	5.1	5.28	6.75	7.7	7.12	4.62
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.37	2.89	2.21	2.22	2.47	1.78	2.25	2.38	2.1	1.66	1.97	2.35
	min.	0	0	0	0	0	3	1	0	2	2	2	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
administer / manage	mean	3.03	3.12	5.58	4.05	3.78	5.92	4.49	4.72	5.77	7.87	5.8	5.12
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.5	2.48	2.71	2.51	2.52	2.45	2.33	2.18	2.27	1.28	2.21	2.53
	min.	0	0	0	0	0	0	0	0	0	3	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
cooperative	mean	5.9	7	5.97	6.2	6.17	4.95	5.44	6.32	6.35	7.92	4.46	6.43
	n	60	60	60	60	60	60	59	60	60	60	59	60
	s.d.	2.65	1.9	2.15	2.32	2.31	2.24	2.41	2.18	1.86	1.17	2.35	2.45
	min.	0	0	0	0	0	0	0	0	0	3	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
hard-working	mean	5.18	8.18	7.27	6.37	6.5	6.92	6.24	7.2	8.03	8.32	7.38	6.25
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.17	1.03	2.07	2.02	1.72	2.03	2.09	1.39	1.3	0.89	1.45	2.21
	min.	0	5	0	0	2	1	0	2	4	5	2	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
medical treatment	mean	4.78	5.43	8.1	4.7	6.55	8.47	4.95	5.9	8.47	7.87	8.15	3.22
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.62	2.27	1.65	2.48	2.13	0.93	2.94	2.25	0.7	1.36	1.48	2.21
	min.	0	0	2	0	1	4	0	1	6	0	2	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
physical treatment	mean	3.58	7.71	6.32	6.19	3.19	5.78	2.95	7.63	6.69	8.02	6.97	2.76

	n	59	59	59	59	59	59	58	59	59	59	59	59
	s.d.	2.69	1.78	2.51	2.71	2.92	2.97	2.56	1.99	2.15	1.29	2.41	2.73
	min.	0	2	0	0	0	0	0	0	1	4	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
mental / emotional problems	mean	2.67	7.35	6.32	5.18	2.35	4.6	8.22	4.15	5.15	7.85	3.13	7.85
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.27	1.81	2.27	2.36	2.22	2.71	1.49	2.34	2.34	1.53	2.31	1.71
	min.	0	1	1	0	0	0	1	0	0	1	0	1
	max.	8	9	9	9	8	9	9	9	9	9	8	9
social problems	mean	3.08	6.82	5.68	5.30	1.77	3.62	7.24	3.68	4.4	7.43	2.58	8.35
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.5	1.99	2.43	2.55	1.84	2.47	2.1	2.23	2.51	1.73	2.03	1.36
	min.	0	1	1	0	0	0	0	0	0	1	0	2
	max.	8	9	9	9	8	8	9	9	9	9	7	9
personal problems	mean	3.8	8.18	5.5	5.97	2.05	3.43	6.2	4.37	4	8.1	2.87	6.88
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.51	0.97	2.45	2.76	2.05	2.22	2.37	2.4	2.37	1.26	2.05	2.34
	min.	0	5	0	0	0	0	0	0	0	3	0	0
	max.	9	9	9	9	7	8	9	9	8	9	8	9
physical problems	mean	5.25	8.12	6.92	6.40	2.82	5.90	3.88	6.40	6.23	8.18	5.65	3.97
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.59	1.06	2.2	2.71	2.72	2.48	2.27	2.48	2.26	1.1	2.61	2.6
	min.	0	5	0	0	0	0	0	0	0	5	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
advise / inform	mean	7.47	6.13	6.73	7.22	5.87	5.65	5.98	7.03	6.20	8.23	5.00	6.15
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	1.95	2.21	2.15	1.93	2.86	2.35	2.52	1.95	1.69	1.21	2.39	2.15
	min.	2	0	1	1	0	1	0	1	2	3	1	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
illness / disorder	mean	4.67	5.29	7.31	4.74	6.28	7.66	5.28	5.48	7.38	6.26	7.62	3.41
	n	58	58	58	58	58	58	57	58	58	58	58	58
	s.d.	2.89	2.48	2.15	2.65	2.43	2.16	2.83	2.53	2.26	2.31	2.18	2.61
	min.	0	0	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	8
non-med problems	mean	4.47	6.71	5.2	6.2	2.98	3.56	6.69	5.31	4.53	7.71	2.8	7.46
	n	59	59	59	59	59	59	58	59	59	59	59	59
	s.d.	2.78	2.14	2.54	2.45	2.56	2.62	2.24	2.25	2.51	1.75	2.39	2.02
	min.	0	0	0	0	0	0	0	1	0	0	0	1
	max.	9	9	9	9	9	9	9	9	9	9	8	9
personal approach	mean	6.13	8.03	6.88	7.23	4.4	5.33	7.1	6.92	6.12	7.98	4.43	7.37
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.21	0.99	1.88	1.42	2.69	2.27	2.26	1.83	1.8	1.13	2.42	2.2
	min.	0	5	0	3	0	0	0	0	0	3	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
technical approach	mean	5.35	3.63	6.02	5.68	7.13	7.4	4.46	6.28	6.87	4.95	8	3.58
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.31	2.24	2	2.15	1.83	1.75	2.69	2.03	2.03	2.35	1.4	2.59
	min.	0	0	2	1	0	2	0	1	0	0	2	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9

broad view	mean	4.27	6.48	6.12	5.62	3.62	5.02	6.80	5.27	5.03	7.35	3.95	7.03
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.5	2.17	2.31	2.61	2.63	2.65	2.26	2.37	2.38	2.01	2.66	2.39
	min.	0	0	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
holistic approach	mean	4.48	7.10	5.73	5.78	3.07	4.45	6.71	5.47	5.00	7.68	3.48	7.10
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.49	1.94	2.37	2.51	2.5	2.57	2.07	2.13	2.13	1.7	2.33	2.07
	min.	0	0	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	8	9
caring / empathetic	mean	5.13	7.82	5.87	6.53	4.15	4.75	6.8	6.27	5.55	7.87	4.00	7.23
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.44	1.33	2.17	1.68	2.35	2.02	2.12	1.91	1.57	1.27	2.3	1.95
	min.	0	4	0	1	0	1	0	0	3	4	0	1
	max.	9	9	9	9	8	9	9	9	9	9	8	9
spend time	mean	4.47	8.07	5.20	6.03	2.48	3.88	6.49	6.18	4.77	7.65	3.33	6.87
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.82	1.54	2.54	2.22	2.11	2.22	2.6	2.3	1.99	1.87	2.15	2.09
	min.	0	1	0	1	0	0	0	1	0	1	0	1
	max.	9	9	9	9	9	9	9	9	9	9	9	9
rapport / people skills	mean	5.28	7.85	6.02	6.47	3.57	4.68	7.17	6.68	5.67	8.05	3.8	7.18
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.43	1.42	2.41	1.95	2.49	2.4	2.17	1.87	1.97	1.42	2.28	2.09
	min.	0	2	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
willing to listen	mean	5.43	7.50	6.20	6.55	4.40	5.02	7.36	6.17	5.70	7.75	4.22	7.47
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.31	1.96	2.22	2	2.73	2.4	2.3	2.2	2.06	1.67	2.29	1.94
	min.	0	1	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
close to patients	mean	3.57	8.05	6.18	5.67	2.77	4.17	6.78	5.77	4.65	7.90	3.20	7.02
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.23	1.51	2.42	2.09	2.29	2.4	2.47	2.24	2.28	1.73	2.33	2
	min.	0	2	0	1	0	0	0	0	0	0	0	1
	max.	9	9	9	9	9	9	9	9	9	9	9	9
hands-on care	mean	1.72	8.72	4.83	5.32	1.58	2.92	2.68	7.37	4.72	8.47	4.43	2.03
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.03	0.52	2.75	2.6	2.1	2.52	2.86	1.84	2.72	0.95	3.12	2.39
	min.	0	7	0	0	0	0	0	1	0	3	0	0
	max.	8	9	9	9	9	9	9	9	9	9	9	9
one-to-one / face-to-face contact	mean	7.03	8.28	7.63	7.63	3.87	6.57	7.81	7.90	7.27	8.22	6.20	8.05
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.27	1.63	2.06	1.46	3.03	2.68	2.14	1.65	2.16	1.65	2.75	1.44
	min.	1	0	0	4	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9
long-term relationships	mean	3.17	5.77	7.48	4.4	2.87	4.33	6.12	4.75	2.60	5.40	2.73	5.78
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.73	2.65	2.14	2.5	2.74	2.58	2.39	2.52	2.14	2.62	2.34	2.55
	min.	0	0	0	0	0	0	0	0	0	0	0	0

	max.	9	9	9	9	9	9	9	9	9	9	9	9
community / at home	mean	4.20	5.12	6.85	6.35	3.15	3.85	6.07	5.17	2.68	6.32	2.50	7.20
	n	60	60	60	60	60	60	59	60	60	60	60	60
	s.d.	2.87	2.72	2.15	2.50	2.83	2.82	2.48	2.39	2.27	2.31	2.18	2.23
	min.	0	0	1	0	0	0	0	0	0	0	0	1
	max.	9	9	9	9	9	9	9	9	9	9	9	9
Total	mean	4.86	5.76	6.39	5.75	4.84	5.96	6.11	5.95	5.89	6.98	5.71	5.85
	n	262	262	263	262	262	263	258	263	263	263	262	262
	s.d.	2.75	2.87	2.42	2.46	2.96	2.78	2.56	2.34	2.42	2.22	2.98	2.71
	min.	0	0	0	0	0	0	0	0	0	0	0	0
	max.	9	9	9	9	9	9	9	9	9	9	9	9

Introduction to analysis

The most direct and, on the face of it, straight-forward and appealing three-mode model that might be fit to these data is weighted multidimensional unfolding (WMDU). However, unfolding models have been found often to degenerate, converge on local minima or produce uninformative solutions, such as when all of the attribute (ideal) points lie outside the configuration of groups (Borg & Groenen, 1997, Chapters 14,15; Jackson, 1991, pp. 211-214). An attempt to fit such a model (reported below) resulted in a solution of indefinite fidelity. An alternative family of models that may be both more general and offer more reliable estimation is three-mode factor analysis (see Law, Snyder, Hattie, & McDonald, 1984). One such model is three-mode principal components analysis (3PCA) first formulated by Tucker (1964) and subsequently further developed as TUCKALS by Kroonenberg and De Leeuw (1980)(see Kroonenberg, 1983, 1994). A restricted version of this model with a number of desirable properties, such as non-arbitrary (intrinsic) axis orientation, known as PARAFAC has been well developed by Harshman (e.g. Harshman & Lundy, 1984a, 1994).

The analyses reported in this Chapter include both PCA and MDU models with a view to their subsequent comparison. Prior to fitting the three-mode extensions, 3PCA and WMDU, two-mode PCA and MDU models are fitted to the matrix of mean (over subjects) attribute by object ratings. The intention is to exemplify the basic principles of the two approaches and to provide relatively straight-forward models of the group by attribute structure. This structure may be of central interest to some readers who may find it more accessible when not embedded in the three-mode models. Beyond this utilitarian concern, these models provide an initial approach to the data to be elaborated in the three-mode models: i.e. although there is no simple mapping of attribute by object relationships embedded within a three-mode solution and as obtained in a two-mode solution by collapsing over the third mode, these two-mode results are of interest in their own right and productive of a 'feeling' for the structure of the data.

Two-mode (group by attribute) models

PCA

PCA on the correlation matrix of the mean group by attribute ratings found 5 components among the 44 attributes with eigenvalues greater than one among them accounting for 95.07 % of total variance. Although there is a drop-off in eigenvalues after the third component, the fourth component accounts for .04 of variance and may be descriptively useful. The first four components among them account for 92.2% of total variance and a minimum of 71.1% (communality) of any attribute ('maintain long-term relationships with patients'). Varimax rotation was used to aid interpretation. Eigenvalues and variance explained for the first 11 components, and variance explained by the four rotated components are reported in Table 7.3. The rotated component loading matrix is presented as Table 7.4 and the group component scores are reported in Table 7.5.

Table 7.3: PCA: Eigenvalues and variance explained (four components retained)

	Extraction eigenvalues			Rotation sums of squared loadings		
Component	Eigenvalue	% Variance	Cum. %	Total	% Variance	Cum. %
1	23.38	53.14	53.14	17.97	40.84	40.84
2	10.31	23.44	76.58	12.55	28.53	69.37
3	5.05	11.48	88.06	7.79	17.71	87.08
4	1.81	4.12	92.18	2.24	5.10	92.18
5	1.27	2.89	95.07			
6	0.84	1.91	96.98			
7	0.65	1.47	98.45			
8	0.27	0.62	99.07			
9	0.25	0.58	99.65			
10	0.11	0.26	99.91			
11	0.04	0.09	100.00			

Table 7.4: PCA: Rotated component loading matrix

	Component			
Attribute	1	2	3	4
broadvw	0.98	-0.04	0.12	0.05
soclwb	0.98	-0.11	0.02	-0.05
mentemot	0.96	0.01	0.10	-0.14
holistic	0.95	-0.21	0.18	0.12
listen	0.93	-0.30	0.10	0.13
closetop	0.92	-0.23	0.28	0.02
problems	0.92	-0.30	0.05	0.23
rapport	0.89	-0.32	0.22	0.19
persnlwb	0.88	-0.32	0.26	0.07
empathy	0.88	-0.37	0.23	0.16
perstyle	0.86	-0.38	0.23	0.20
timewp	0.86	-0.38	0.26	0.14
humanstc	0.86	-0.42	0.15	0.24
athome	0.85	-0.13	-0.16	0.21
longterm	0.83	0.02	0.02	-0.15

contact	0.83	-0.14	0.25	0.15
variety	0.80	0.31	0.43	-0.18
tecstyle	-0.79	0.57	0.14	0.02
infothng	-0.78	0.19	-0.36	0.01
cooprtve	0.46	-0.45	0.44	0.35
analytcl	-0.08	0.96	-0.09	0.12
power	-0.26	0.96	-0.04	-0.07
rspnsbty	-0.24	0.95	0.07	-0.04
authrty	-0.34	0.92	-0.11	-0.06
status	-0.34	0.92	-0.10	-0.13
eduintel	-0.36	0.91	-0.11	-0.04
arrognce	-0.26	0.89	-0.12	-0.26
males	-0.38	0.81	-0.01	-0.41
manage	0.28	0.78	0.39	0.25
scientfc	-0.61	0.75	0.09	-0.05
rootprob	0.53	0.73	-0.20	0.16
central	0.09	0.70	0.66	-0.12
disease	-0.42	0.68	0.50	-0.25
medtrt	-0.34	0.67	0.61	-0.11
auxilary	0.02	-0.64	-0.63	0.39
phystrt	0.02	0.08	0.93	0.15
hardwork	0.18	0.18	0.90	-0.17
physclwb	0.29	-0.07	0.86	0.16
handson	0.31	-0.20	0.85	0.19
practcl	0.09	-0.42	0.77	0.26
narrow	-0.54	0.08	-0.71	0.29
genrlsts	0.61	0.26	0.64	0.11
speclizd	-0.46	0.37	-0.56	0.46
advise	0.33	-0.25	0.21	0.78

Table 7.5: PCA: Group component scores

	Component			
Group	1	2	3	4
DT	-0.89	-1.10	-0.97	0.94
EN	0.54	-2.08	1.43	-1.54
GP	0.63	0.97	0.45	-0.84
OT	0.03	-0.73	-0.23	1.09
PH	-1.74	-0.44	-0.66	-0.29
PN	-0.43	1.37	-0.12	-0.43
PS	1.19	0.45	-1.51	-0.39
PT	-0.21	-0.25	0.38	1.12
RD	-0.35	0.48	0.91	-0.58
RN	1.07	0.57	1.40	1.84
SG	-1.26	1.02	0.34	-0.49
SW	1.41	-0.26	-1.41	-0.43

Interpretation of the rotated components

The loadings in Table 7.4 are correlation coefficients between the rotated components and the measured

variables. As such the relative strengths of component – variable relations and the substantive meanings of the components are better indicated by their squares. All components manifest some very high loadings (.98 > *l* > .78; .96 > explained variation >.71) so that loadings as small as about .6 (.36 explained variation) represent relatively less important references for interpretation.

Component 1

Whilst the relatively large set of variables on which component one loads highly are clearly closely related in the sense that they are used to describe and distinguish among the groups in very similar ways (although there are potentially meaningful differences in their secondary loading patterns), they might be categorized on conceptual grounds as an initial approach to interpretation:

have a broad view of or approach to a person
have a holistic approach / treat patients as whole persons / 'in totality'
deal with a wide variety of people / problems / situations
generalists with knowledge / skills that overlap / crossover with other groups
involved with patients' social well being / needs or problems
involved with patients' mental -emotional well being / needs or problems
involved with patients' personal or everyday well being / needs or problems
deal with problems or needs other than or as well as immediate medical ones
willing to listen to patients' points of view / concerns
develop rapport with patients / communicate well / have good 'people skills'
have face-to-face / one-to-one patient contact
get close to patients / know patients well
spend time with patients
have a caring attitude / are empathetic / compassionate / tolerant / accepting
have a personal approach to or style with patients
(do not) have a technical approach to patients' or their illnesses / problems
people oriented / humanistic
(do not) deal with information / things / material rather than directly with people
(do not) have a scientific orientation / attitude
maintain long term relationships with patients
see / are concerned with patients or their lives in the community / at home.

High scores on this component (Table 7.5) describe groups whose members have a broad,

holistic approach and the generalist skills to deal with varied demands; they are involved with patients' mental-emotional, personal-everyday, social and other non-medical needs or problems; spend time in close contact with patients listening to them, developing rapport and getting close to them; have a caring attitude and a personal rather than a technical approach; are people-oriented and humanistic rather than scientific and deal directly with people rather than with information and things; and maintain relationships that extend outside the time and place of the immediate medical treatment situation. For short this component is named 'humanistic care and involvement'. Usage of the term is intended to invoke the co-presence of the entire set of attributes listed above.

The three groups with the highest scores on the component are (in descending order) SW, PS and RN. GP and EN have positive scores of smaller magnitude.

The three groups with the lowest scores on the component are (in descending order of 'lowness') PH, SG and DT. PN and RD have negative scores of smaller magnitude.

PT on the negative side and OT on the positive side are located close to the component mean.

As this last comment indicates, these scores are relative to the component mean. In terms of raw scores, the lowest scoring group (PH) has a mean over the items listed above (after reverse coding negatively loaded items) of 3.21 and the highest scoring group (SW) has a raw score mean of 7.00.

Component 2

The set of items on which component two loads most highly may be conceptually categorized as follows:

education / intelligence
scientific orientation / attitude
analytical / like to work things out / solve problems / diagnose
power / ability to control or direct others
status / prestige
arrogant / self-important / aloof / elitist
responsibility / importance or potential impact of decisions / actions
authority / decision-making power / right to decide
investigate / delve into /deal with underlying causes or root problems

oriented to illness / disease / disorder
involved in medical treatment / have a medical / clinical orientation
central / pivotal / focal role in health care process
administer / coordinate / organize / manage
(not) auxilary / peripheral to main treatment / care process
males

High scores on this component describe groups whose members have high levels of technical, scientific education which they employ in diagnosis and treatment of organic disorder; they have high levels of responsibility and authority; play a central, management role in the health care process; have high status, prestige and power; and tend to be arrogant or aloof and male. The component represents a conjunction of what they know and do, the responsibility and authority this involves, the status and power afforded it, and who they tend to be in gender or sexual stereotypical terms. For short this component is named 'scientific treatment'.

The three groups with the highest scores on the component are PN, SG and GP followed by RN, RD and PS, with PS scoring just above the component mean..

The three groups with the lowest scores on the component are EN, DT and OT followed by PH, SW and PT, with SW and PT scoring just below the component mean.

Component 3

Groups with high scores on this component are hard-working, involved in practical, hands-on physical treatment in the interests of physical well being, play a central rather than auxiliary role and are generalists rather than specialised. For short this component is named 'hands-on physical care'.

The three groups with highest scores on this component are EN, RN and RD followed by GP, PT and SG.

The four groups with lowest scores on the component are PS, SW, DT and PH followed by OT and PN.

Component 4

This component is dominated by the item 'advise / inform / educate patients'. This role tends to be associated with specialisation, cooperativeness, an auxiliary function and females. For short this component is named 'advise'.

RN has the highest score on this component followed by PT, DT and OT also with reasonably substantial positive scores.

EN has the lowest score on the component followed by GP, then RD, SG, SW, PN, PS and PH with relatively small negative scores.

Relations among attributes, among groups and between attributes and groups

This analysis was performed on the matrix of correlations among attributes. The loadings in Table 7.4 are direction cosines defining the orientation of each attribute vector through the origin of the four dimensional component space and the group component scores are the coordinates of each of the groups on each of the components. The overall result is a point-vector model of the variance structure of the group by attribute ratings: relationships among the attributes are represented as the angles among their vectors, with the vectors of attributes serving to distinguish among the groups most similarly being separated by the smallest angles; the relationships among the groups are represented by their interpoint Euclidean distances with groups treated most similarly by the attributes being separated by the smallest distances; and the relationships between the attributes and the groups are represented by the orthogonal projections of the group points onto the attribute vectors with groups manifesting most (least) of an attribute being located furthest from the origin in the positive (negative) direction of the attribute vector.

In basic terms, rotation reorients the dimensions of the space to 'simplify' the relationship between the dimensions and the attribute vectors. What this simplification amounts to and the constraints placed upon it depend upon the rotation method chosen. In the present case (Varimax rotation) the major constraint is maintenance of orthogonality among the dimensions and the simplification involved is, as far as possible, to produce (actually 'find') a mix of vect ors that are either closely parallel or nearly orthogonal to each component, minimising the number of vectors in the mid-range of angles. The objective is to produce dimensions that are closely parallel to a clear sub-set of attribute vectors so that their natures as complex abstractive attributes are identifiable as the commonality among the set of attributes whose vectors are most closely parallel to each. It might be hoped, in the interests of interpretability of the components, that attribute vectors are in general closely aligned with one and only one dimension but this is

achieved to varying degrees depending upon the structure of the data. In the present case there are a number of attributes with substantial secondary loadings. In view of this point-vector plots of each pair of the first three rotated dimensions (Figures 7.1, 7.2 and 7.3) are presented to provide a more complete 'picture' of the solution than achieved by the dimension by dimension interpretation offered above, although that interpretation offers a more than adequate summary of the dominant relations. Interpretation might be pursued further by characterising the groups in terms of their profiles across the four abstractive attributes named above. Cluster analysis on Euclidean distances defined in terms of group component score profiles would offer insight into the hierarchical similarity structure among the groups.

The attribute vectors shown in Figures 7.1 – 7.3 are scaled so that their lengths are proportional to the proportions of variance that the pairs of components plotted explain of the attributes. This is achieved by multiplying the loadings of each attribute on each dimension by (twice) the square root of their sums of squares. Plotting these transformed loadings on the two dimensions as vector 'destinations' gives an hypotenuse with length equal to (twice) the sum of squared loadings or (twice) the proportion of variance explained. In order to simplify the Figures, no vector is shown on a plot if the proportion of variance explained of it by the two plotted dimensions is less than .50. Some vector labels have been moved somewhat to avoid overwriting, and although all vector 'destinations' are plotted, most vectors are not drawn. In the case of point-vector models, reading these plots may be avoided if the kind of dimension by dimension interpretation offered above is considered adequate. Alternatively, rotation may be avoided if such plots are produced. However, in the case of point-point models such as MDU or of MDS models in general the results are designed to be spatially represented and otherwise offer little insight into the data. In view of their almost universal spatial representation, MDS plots are rarely rotated and when they are it is generally to simplify comparison between configurations rather than to simplify interpretation of a single solution. It should be noted that metric MDS on Euclidean distance matrices derived from profiles of the elements of one mode over the other is identical to PCA on the correlation matrix (Cox & Cox, 1994, pp. 34, 35) but that output is usually limited to estimates of fit (e.g. RSQ), component scores and corresponding scatterplots.

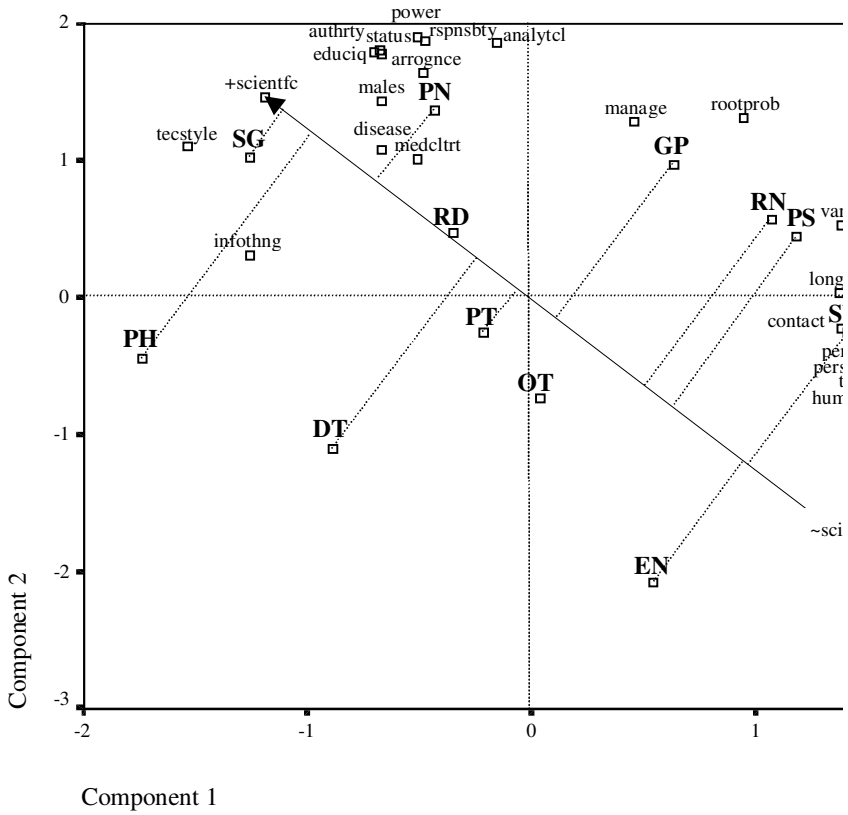


Figure 7.I: PCA: point (group) – vector (attribute) plot of component 2 by component 1

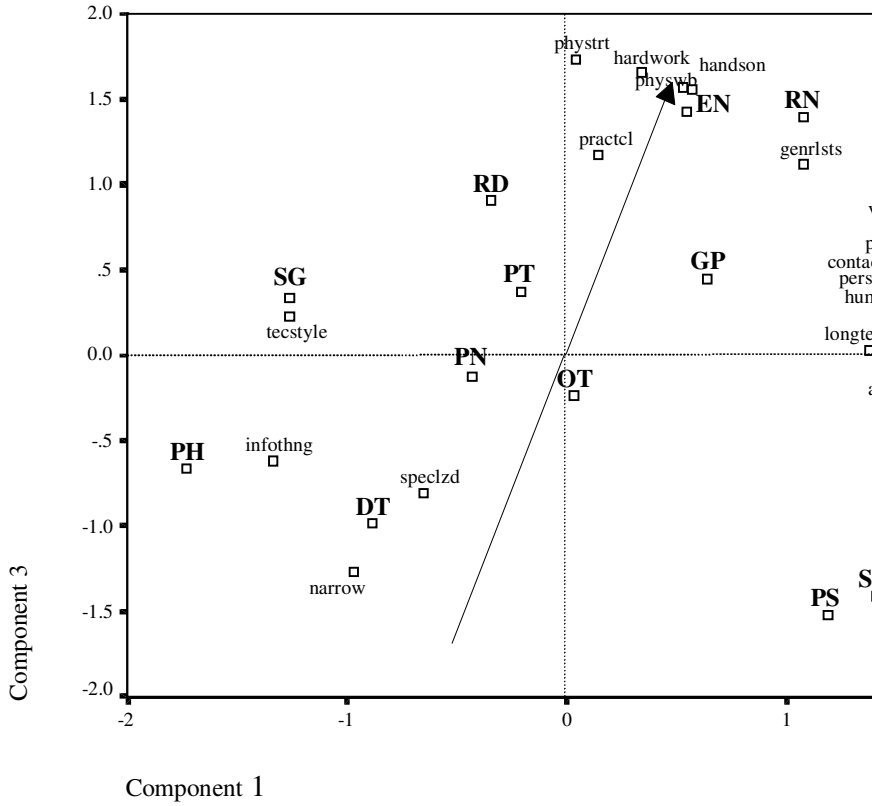


Figure 7.2: PCA: Point – vector plot of component 3 by component 1

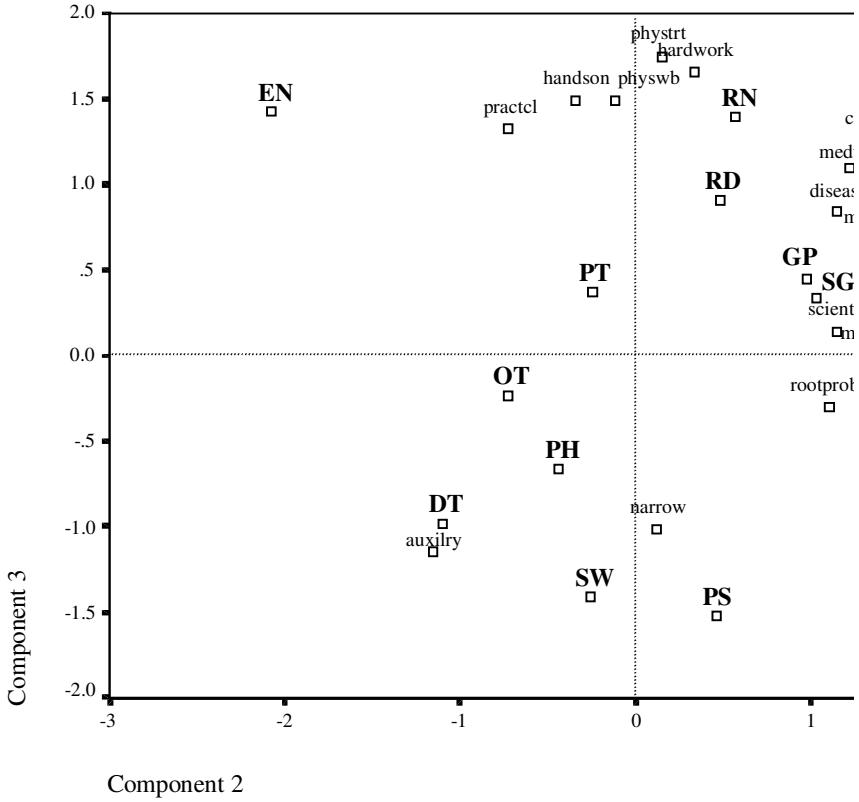


Figure 7.3: PCA: Point – vector plot of component 3 by component 2

In reading these figures it needs be recognised that they are each a plane through a four-dimensional space (a projection onto a surface of the 'box') and that each is conditional upon the others. This places considerable demands on geometric imagination even if the fourth dimension is ignored. For present purposes, however, and as the 'price' of summarisation, each may be viewed 'as if' independent of the others. The extent of distortion involved increases from Figure 7.1 to Figure 7.3 with decreasing proportions of variance explained by successive components.

In general terms, the similarities among groups are represented by their interpoint distances, with groups rated more similarly over the attributes being located more adjacently in the space, and similarities among the attributes are represented by the angles among their vectors, with vectors of attributes serving to distinguish more similarly among groups being separated by smaller angles. The relative extent to which each attribute is judged to apply to the groups is represented by the

orthogonal projections of the group points onto the attribute vectors, which pass through the origin from their negative to positive directions. Because attribute means were removed in computing the correlation matrix on which the analysis was performed, groups whose orthogonal projections onto an attribute vector in its positive (negative) direction from the origin are represented according to the model as being judged to manifest above (below) average levels of the attribute.

The projections of the group points onto the 'scientific' attribute vector are displayed in Figure 7.1 showing that, according to the model, the extent to which the groups are judged to have a 'scientific orientation / attitude' are, in decreasing order, SG, PH, PN, RD, DT, PT (above the mean), GP, OT, RN, PS, EN and SW (below the mean). Depending the researcher's or reader's interest, a great deal of information may be extracted from the plots in this way. For example, points of potential interest involve the 'males', 'administer / coordinate / organise /manage' and 'investigate / delve into / deal with underlying causes or root problems' vectors. The attribute 'males' may represent the approximately-judged proportions of males in each group (or it may represent something more akin to masculinity). According to the solution, EN is the group in which females (or perhaps, femininity) are judged to be most strongly represented. The set of attributes whose vectors are more closely parallel to the 'males' vector are associated with the more male dominated groups (and in the negative sense with the more female dominated groups), and the set of attributes more closely parallel to the negative projection of the vector (the 'females' vector) are associated with the more female dominated groups (and in the opposite sense with the more male dominated groups). Depending upon interpretation, these sets of attributes may serve not only to distinguish among the groups in particular ways but also to define masculinity and femininity in this context.

The particular interest in the 'manage' and 'rootprob' vectors is that they lie between the scientific / male and humanistic / female axes, and are judged to apply most strongly to GP, RN, PS, SW and PN. Further interpretation of these and other relationships represented in the Figures 7.1 – 7.3 is left to the reader.

MDU

Metric MDU with row conditionality was performed on the reverse-coded (dissimilarities) matrix of mean attribute by group ratings to estimate two and three-dimensional solutions (2-D stress = .244, RSQ = .944; 3-D stress = .226, RSQ = .952).

Metric rather than non-metric MDU was chosen empirically because the high RSQ values obtained with that option leave little room for non-metric transformation to improve fit. Indeed, the freedom to monotonically transform response scales may sometimes allow MDU to suppress meaningful variation in order to improve fit, as may have occurred in the three-mode WMDU model subsequently reported (see below). In a metric analysis conditionality refers to conditionality of origin: the data are (at best) interval rather than ratio and an additive constant needs to be estimated to identify an origin for each attribute scale. Specifying row rather than matrix conditionality amounts to estimation of additive constants separately for each attribute scale (for each nurse) rather than estimation of a single additive constant for all attributes. Young (Young & Hamer, 1987, pp. 60-63, p. 89) is definite that data of this sort should invariably be treated as attribute conditional. As an aside, the additive constant problem disappears in a PCA analysis on a square correlation (or covariance) matrix because attribute scores are analysed relative to their means, but re-appears if components are obtained directly by singular value decomposition of a rectangular (raw or 'pre-processed') data matrix (see e.g. Harshman & Lundy, 1984b).

The two-dimensional solution is chosen for interpretation because reduction in RSQ between the two- and three-dimensional solutions is modest and because interpretation of the interpoint distances among sixty-six (44 attributes + 12 groups) points in three-dimensional Euclidean space is a formidable task. The coordinates of the attributes and the groups in two-dimensional 'joint' space are reported in Table 7.6 and the configuration is plotted as Figure 7.4. The model fits distances between the group and attribute points so that points representing groups manifesting more of an attribute are located more closely to the attribute point, with all group and attribute points being fitted simultaneously. Generally this means that similarities among attributes in terms of their profiles across groups are represented by their interpoint distances with smaller distances representing greater similarity; and similarities among groups in terms of the extent to which they manifest attributes are represented by their interpoint distances with smaller distances representing more similar attribute profiles.

Table 7.6: MDU: Attribute and group coordinates in two-dimensional joint space

Attribute	Dimension 1	Dimension 2
Eduintel	1.10	0.16
Status	1.46	0.14
Authrity	1.49	0.17
Power	1.48	0.04
Rspnsbty	1.17	-0.05
Arrognce	1.74	0.06

Males	1.77	-0.08
Scientfc	1.72	0.07
Humnistc	-1.20	-0.09
Analytcl	0.79	0.09
Practicl	-1.14	-0.60
Genrlsts	-0.70	-0.70
Speclzd	0.96	0.81
Narrow	1.03	1.15
Variety	-0.46	-0.46
Infothng	2.06	0.97
Rootprob	0.14	0.02
Auxilary	-0.72	2.12
Central	0.27	-0.62
Manage	0.20	-0.13
Cooprtve	-0.67	-0.04
Hardwork	-0.18	-0.60
Medtreat	0.99	-0.71
Phystrt	-0.42	-0.86
Mentemot	-0.71	-0.26
Soclwb	-0.98	-0.25
Perswb	-1.16	-0.28
Physwb	-0.69	-0.72
Advise	-0.36	0.12
Disease	1.06	-0.55
Problems	-0.98	-0.05
Perstyle	-0.80	-0.08
Techstyl	1.48	0.16
Broadvw	-0.54	-0.11
Holistic	-0.77	-0.14
Empathy	-0.79	-0.07
Timewp	-0.96	-0.15
rapport	-0.78	-0.08
listen	-0.71	-0.03
closetop	-0.85	-0.21
handson	-0.98	-0.75
contact	-0.63	-0.18
longterm	-0.39	-0.04
athome	-0.54	0.11
Group		
DT	-0.58	2.43
EN	-2.27	-0.95
GP	0.50	-1.89
OT	-1.28	1.64
PH	1.26	2.07
PN	1.69	-1.21
PS	-0.55	1.87
PT	-0.84	1.64
RD	0.73	-1.93
RN	-0.89	-1.41

SG	1.84	-1.21
SW	-1.40	1.67

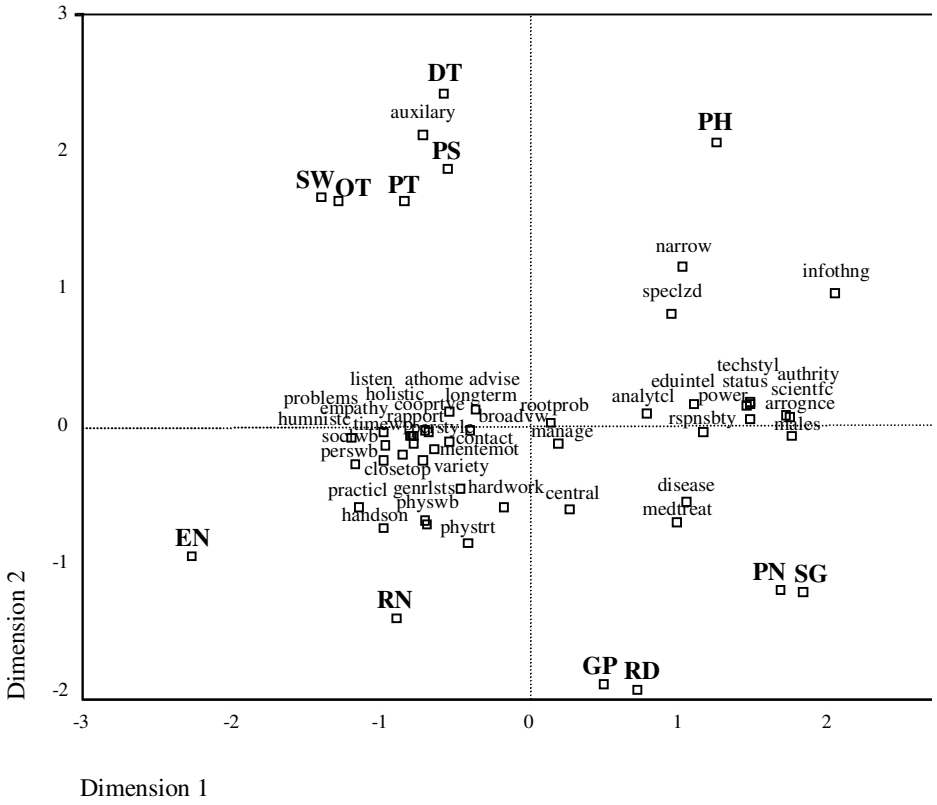


Figure 7.4: MDU: Point – point (group – attribute) plot of dimension 2 by dimension 1

The set of attributes on which PCA dimension two loaded most highly ('scientific treatment') are relatively closely adjacent and located towards the positive pole of MDU dimension one, and near the origin of dimension two. The groups closest to this cluster of attribute points are PN, SG, GP, RD, and PH. Relative to the PCA solution, RN and PS rate less highly and PH rates more highly on these attributes.

The set of attributes on which PCA dimension one loaded most highly ('humanistic care and involvement') are ge nerally located towards the negative pole of MDU dimension one. Whilst the 'centre of gravity' of these points is not easily located visually, RN and EN are most closely adjacent to it with GP, RD and SW, OT, PT and PS at 'middling' distances, and PN, SG, PH and DT most distant. Relative to the PCA solution, RN and EN rate more highly and SW and PS rate more lowly on these attributes.

The set of attributes on which PCA dimension three loaded most highly ('hands-on physical care') are located towards the negative poles of MDU dimensions one and two. RN, EN, GP

and RD are the groups most closely adjacent to this set of attributes, representing a somewhat higher rating in these terms of GP and of RN relative to EN than indicated by the PCA solution.

Although the MDU configuration is most appropriately interpreted in terms of distances rather than dimensions, it appears that MDU dimension one represents a contrast between PCA dimensions one and two: the more scientifically trained, medical-treatment oriented groups are located towards the positive pole and the more humanistic, involvement-oriented groups are located towards the negative pole. Whilst MDU dimension two serves reasonably well to represent PCA dimension three, it clearly distinguishes between those groups more directly involved in the central concerns of the hospital - medical treatment and physical care - and those playing less central (if still essential), more auxiliary roles. The four quadrants of the space contain PH as scientific, treatment oriented but auxiliary; the doctors groups distinguished into the specialists and the generalists; the nurses, somewhat separated; and the more humanistic, involvement-oriented auxiliary groups. RN is closer to all groups in quadrants two (doctors) and three (nurses) than to any group in quadrants one or four, and is nearly as close to GP and RD as to EN. This solution represents RN as more similar overall to the generalist doctors groups (GP and RD) than to any other group except EN.

Comment on the two two-mode models

The two two-mode solutions, the point-vector PCA and the point-point MDU solution, may be considered alternative and equally legitimate summaries of the mean attribute by group ratings. Choosing between them may, as much as anything, be a matter of preference. PCA seems more amenable to dimensional as opposed to configurational interpretation. To the extent that this is so, PCA may offer a more accessible representation than MDU for solutions in three or more dimensions. However, a two-dimensional MDU configuration (should a solution in two dimensions be acceptable) may represent a more accessible result than the corresponding PCA solution, depending upon one's preference for interpreting distances or vectors.

Both the PCA and MDU solutions presented are highly successful in parsimoniously representing the two-mode, object by attribute, structure: the PCA solution accounted for .92 of total variance in four dimensions and the MDU solution accounted for .94 of total variance in two dimensions. These extraordinary (in social science terms) results are in large part due to suppression of the considerable variation on the subject mode. From this perspective, the challenge for the three-mode analyses that follow is to model as much systematic variation among subjects as possible and so to approach as closely as

possible the overall levels of fit obtained in the two-mode analyses.

Introduction to the three-mode analyses

As a mean confounds sub-sample differences in summarisation of a bi- (or multi-) modal distribution, yielding a number that is unlike the scores in either sub-group, these two-mode solutions may not be similar to solutions for any particular sub-sample identified in the three-mode analyses. This observation may apply more to the three-mode PCA solution than to the three-mode WMDU solution because the latter represents subject variability as stretchings and shrinkings of the dimensions of a common space (diagonal weighting of the third mode elements) which may be more like the two-mode configuration than is identifiable in the separate components for each of the three modes obtained from the three-mode PCA analysis. In the kind of analysis employed, TUCKALS3 (Kroonenberg, 1983), the number of dimensions for each of the first two modes (attributes and groups) may differ whereas, in three-mode WMDU, the common (among subjects) space is a joint (attributes and groups) space. A further difference between the TUCKALS3 and WMDU models is that TUCKALS3 finds subject components (prototypical subject dimensions), thus reducing the dimensionality the third mode, whereas WMDU makes third mode estimates (dimension weights) for each subject. TUCKALS2 (Kroonenberg, 1983) is a 3PCA model that does not reduce third mode dimensionality but may extract different numbers of components for each of the first two modes, and PARAFAC (Harshman & Lundy, 1984a) estimates a joint space for the first two modes and represents subject variablity by the dimensional stretching and shrinking device (diagonal third-mode weights) employed in WMDU, making PARAFAC the closest 3PCA model to WMDU. Indeed, under specific data pre-processing conditions, WMDU and PARAFAC are identical with the exception that PARAFAC is a point-vector and WMDU a point-point model. From these considerations, TUCKALS2 may be seen to be the most general three-mode model, followed by TUCKALS3, PARAFAC and WMDU.

Three-mode models

WMDU

An attempt to fit a metric, row-conditional WMDU model to the reverse-coded 60 (subjects) x 44 (attributes) x 12 (groups) three-mode data matrix failed when the algorithm internally generated a singular matrix and terminated. Non-metric (ordinal, ties untied) row conditional WMDU models did, however, arrive at solutions. Row conditional non-metric WMDU models estimate for each subject both an additive constant for each row (attribute) and a monotonic transformation of the response scale in order to maximise fit to the model. It is a reasonable assumption that subjects will vary in their usage of the attribute response scales with idiosyncratic origins and patterns of non-linear response: some may take the zero scale point seriously and produce data

with approximately 'true' zeros whilst others may use the full extent of the scale to represent the variation among the groups; and some may avoid extremes making response distances larger towards the ends than near the middle of a scale whilst some may emphasise among group differences willingly employing the full extent of the scale in an approximately linear fashion. These considerations may apply with less force to data averaged over subjects because the averaging process may homogenise these response style differences.

As previously mentioned, fitting a (non-metric, row conditional) WMDU model to the data produced a solution of indefinite fidelity. The reasons for this judgment will become more apparent as the models are described in detail but essentially they amount to this: that, as iterations proceed, the points are forced into increasingly compact regions of the space suppressing what we have reason to expect are meaningful differences among them. Whilst this effect might possibly be due to the freedom to estimate the origin and non-metrically transform each of 2640 rows to maximise fit, it is possible that the result describes the strongest or core structure underlying the data. Consequently, the solution is described at two stages of its development over iterations: (i) after 10 iterations in which a reasonable amount of among attribute variation remains and (ii) at full convergence (change in s-stress [Young & Hamer, 1987] < .001).

Fit statistics for the analyses are: after 10 iterations, 2-D stress = .339, RSQ = .889, 3-D stress = .270, RSQ = .931; and at convergence, 2-D stress = .026, RSQ = .999, 3-D stress = .063, RSQ = .996. There is evidently something awry, as indicated not least by the better fit achieved in two than three dimensions. Indeed, a solution in one dimension (replicated MDU rather than weighted MDU) had stress = .105 and RSQ = .989. Because doubts about the reliability of the model do not justify a high level of interpretational effort, the two dimensional solution is chosen for interpretation.

The joint space configuration after ten iterations is plotted as Figure 7.5. A representation of the full convergence configuration is superimposed. As described below, in the full-convergence solution, the group points were compressed into two tight clusters, indicated by C1 (SG, PN, GP, RD, RN, EN, PT) and C2 (DT, OT, PH, PS, SW), and the attribute points were compressed into a near-straight line, indicated by AA'.

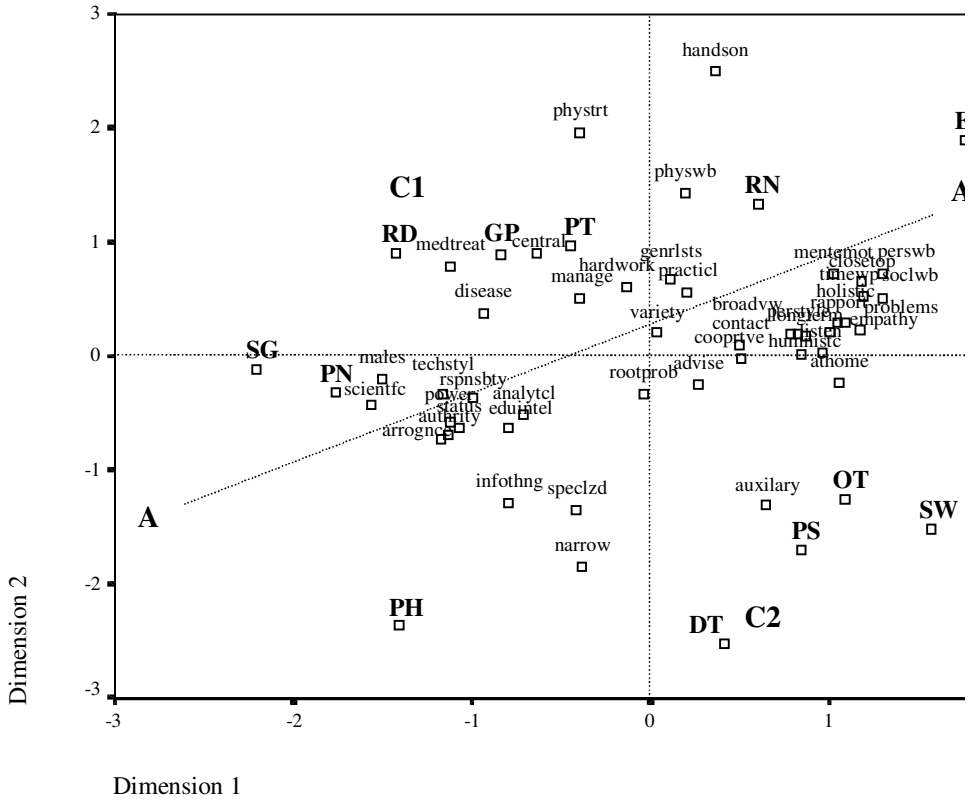


Figure 7.5: WMDU: Joint space configuration dimension 2 by dimension 1

In general terms the ten iteration solution is quite similar to the two-mode MDU solution: both axes have been reflected, the configuration rotated somewhat and there is more variation among the attributes. One important difference is the location of PT: relative to the two-mode solution, the PT point has been diagonally reflected to locate PT between GP and RN rather than among the non-PH auxiliary groups. Either position seems, post-hoc, to be reasonable: briefly, PT's are considered to be both relatively practical, involved in physical treatment and so on, tending to locate them on the doctors/nurses side of the origin, and to share a number of attributes with the auxiliary groups. It is pertinent to recall, in interpreting MDU solutions, that the model fits distances between group and attribute points and does not directly fit distances among either group or attribute points.

Beyond these differences in the two-mode MDU and three-mode WMDU joint space solutions, the fundamental difference between the WMDU and MDU models is that WMDU estimates dimension weights for each subject that indicate the importance (emphasis) individuals place on the two dimensions relative to the common joint space. An individual space may be derived from the common joint space by multiplying the common space

point coordinates on each dimension by the square roots of the subject's dimension weights so that the geometric effect is to stretch or shrink each of the axes of the common space to yield an individual space.

A one dimensional solution?

The full convergence solution is essentially one dimensional representing the differences between two clusters of groups in terms of a linear order among attributes. The one dimensional solution is plotted as Figure 7.6.

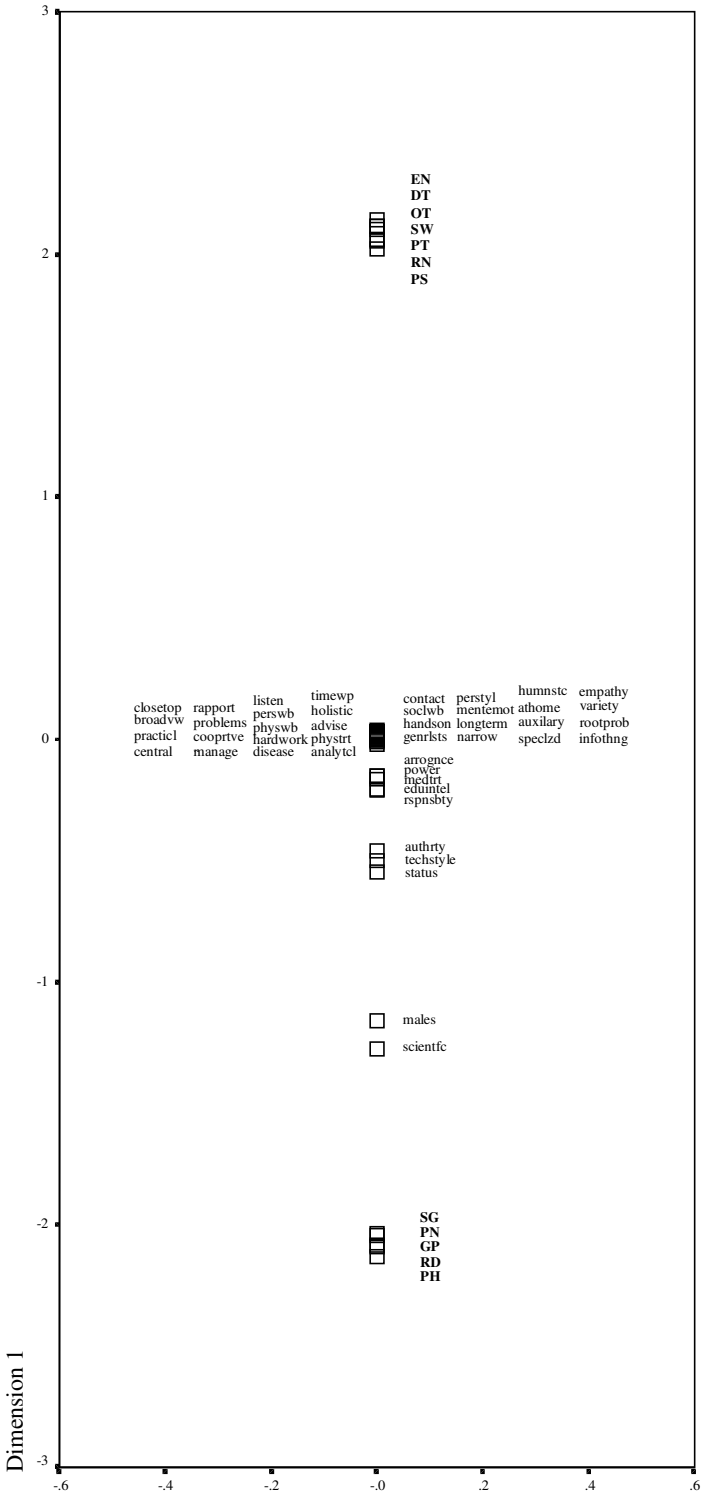


Figure 7.6: WMDU: Joint space configuration for one dimensional solution

Two points of interest are the difference between the two clusters of groups formed in the full-convergence two-dimensional solution and those formed in the one-dimensional solution, and the relative importance the one-dimensional solution affords the scientific males / humanistic females attributional contrast. The one-dimensional solution is essentially an emphasis on the first dimension of the ten-iteration two-dimensional solution highlighting the possible centrality of the scientific males / humanistic females contrast, whereas the full-convergence two-dimensional solution is more an emphasis on the medical treatment / physical care-oriented, more central roles, associated with the doctors and nurses (and PT, in this case), versus more narrowly specialised auxiliary roles.

Comment on WMDU

The WMDU solutions each appear to have both extracted and suppressed meaningful variation, and the somewhat arbitrary process of choosing among them, or of interpreting them severally for what each might convey, is disconcerting. There may be one or both of two reasons for this: that non-metric transformation of each of the 2640 rows allows too much freedom for the algorithm to suppress some whilst emphasising other variation, and that the model is not sufficiently general to adequately represent the structure of the data. Accordingly, a more general, metric model, three-mode PCA, was fit to the data as described in Chapter 8.

Chapter 8

Analysis of the three-mode data II: three-mode principal component analysis

The three-mode principal component analysis reported in this Chapter was performed with the advice and assistance of Dr Henk A.L. Kiers from the Heymans Institute at the University of Groningen and of Dr Pieter M. Kroonenberg from the Department of Education at Leiden University. Dr Kiers responded to a call for advice placed on the Albert Gifi list-server (albert-gifi@julia.stat.ucla.edu) on analysis options in view of dissatisfaction with the results of WMDU. He suggested investigation of three-mode PCA, provided an introduction to the literature, clarified a number of issues and has generally played the role of mentor through this inquiry. Dr Kroonenberg has developed a commercially available suite of programs for analysis of three-way data (3WAYPACK; Kroonenberg, 1983, 1996), offered advice and provided annotated output from a 'trial run' on the data which, doubtless due to his experience and insight into three-mode problems, has turned out, after subsequent experimentation, to be the 'optimal' solution reported. Dr Kiers has written his own programs for three-way analyses which run in MATLAB software (Matlab Inc., 1994), has developed special rotation procedures to

identify 'simple structure' among the components of each of the three modes and the core matrix simultaneously (e.g. Kiers, 1992, 1997, in press), and tests of the stability of three-mode solutions (Kiers & van Mechelen, in press). Analyses have been performed both by Dr Kiers using his programs and with 3WAYPACK. Responsibility for the solution chosen and the manner in which it is reported belong, however, with the author.

Preprocessing considerations for the subjects by attributes by groups data

These data were collected in what may be considered to be a context within a context: i.e. the context of the health occupations within the context of society considered more generally. Some attributes are likely to invoke reference to the broader context more strongly than others: for example, in making judgments about the intelligences of the set of groups, a subject may consider the mid-point of the scale to represent average intelligence in society and perhaps rate all the health-occupational groups at or above this level, so that, from the point of view of representing differences among the health-occupational groups, the mid-point of the scale may be considered to be the 'true' zero-point of the attribute; the same subject, in making judgments in respect of an attribute that appears to be relevant only within the health-occupational context, may use the zero-point of the scale to describe the group considered to manifest least of the attribute so that, from the point of view of representing differences among the groups, the scale-zero point may be considered to be the 'true' zero-point of the attribute. For this subject, the set of attribute ratings do not have the same 'true' zero points: his or her data, then, should be considered to be attribute-conditional and there is no utility in modelling the differences in attribute origins because they are essentially uninterpretable (at least without strong theoretical guidance or reference to data outside of the three-mode set itself). This indicates analysing, for each subject, the groups in their deviations from each attribute mean or, in other words, fibre-centring over groups. It should be noted in passing that this operation will column-centre the component matrix for the groups so that a group with the average score on a component will have a zero loading on the component and the other groups will be represented relative to it as having higher (positive) or lower (negative) loadings. Indeed, as this applies to all components, a group with an average score on all components will be located at the centroid of the multidimensional group configuration.

The ranges of scale points available to subjects to distinguish among groups in terms of attributes might vary with their zero points: a subject who used only the values 5 or above to distinguish among groups in terms of their intelligence has only five scale points to make these distinctions, whereas the same subject may have used the full ten scale points to distinguish among groups in terms of another attribute. In this case (for this subject), the second attribute (distinguishing among groups in terms of their deviations from its mean) will have more influence on the solution than the first: it will be responsible for more of the

separation among groups than the first. Consequently, equalising the influence of attributes by (slab)rescaling over the attribute mode might be considered. However, if it is a reasonable hypothesis that the 'true' zero points of the attribute scales (over groups) reflect the relative salience of the within-health occupations / broader society superordinates (or contexts), then those attributes more exclusively relevant to within-health occupation comparisons are likely to be those with more influence on the final form of the model, *provided* these relativities are not standardised out. It does seem worthwhile to interpret these differences in health-occupation salience or influence among attributes: i.e., to identify the relative influences of the attributes or the relative contributions they make to health-occupational discrimination and to allow the more influential among them to have the greater 'say' in the final model of among-group distinctions. A decision not to rescale attributes might also be made by reference to considerations that are largely independent of the relative salience hypothesis: it is reasonable to assume that subjects will use more of the scale to distinguish among the groups for attributes they consider to be more important or relevant to this purpose and it would seem obtuse to ignore the information they thereby offer about the attributional grounds of their judgments of group dissimilarities.

Similar considerations apply to rescaling to equally weight subjects: whilst it may be in some sense democratic to equalise the influence of subjects on the form of the model, it is entirely possible that subjects who express shared distinctions with greater clarity or emphasis may be more influential in forming or leading the development of within(nurses)-group norms. Moreover, should it be desired to relate external variables to the strength or clarity with which nurses make shared distinctions, then the vector of loadings on the component describing what they share offers a convenient variable for the relevant analysis.

With respect to centring, removal of uninterpretable attribute means by fibre-centring over groups is probably the most important preprocessing step to be taken. However, fibre-centring over attributes may also be desirable. Fibre-centring over attributes means analysing, for each subject, each attribute in deviation from its mean over groups. For each subject, raw-data group means over attributes will vary: i.e., some groups will have higher overall scores on the set of attributes than others. Interpreting differences in these means would amount to describing why some groups are judged to manifest more of the attributes more strongly than others. Such a description might take such a form as: there are more attributes in the set that allow nurses to describe *themselves* (perhaps positively), and groups with higher overall means on the attributes are described as more like nurses by nurses. Indeed, as shown in Table 7.2, the mean over all subjects and all attributes is higher for registered nurses than any other group, followed by the groups located most closely to them (GP, PS) in Figure 7.1 which displays the two strongest components from the two-mode PCA solution. Whilst,

therefore, there may be a basis for interpretation of group means, it is somewhat speculative (in the absence of data measuring the self(nurse)-referentiality of attributes) and is dependent upon the numeric balance of self(nurse)-to other-referential attributes in the set. This sort of interpretation is not only speculative and dependent on the judgment of the researcher about how many of which kinds of attributes to measure, but it is also tangential to the main purpose of the analysis: to model the relative extent to which each attribute is judged to apply to each group by each nurse. Fibre-centring over attributes, then, removes means which, if not uninterpretable, are for present purposes unintended.

The question of whether to centre over groups (remove attribute means) or to centre over both groups and attributes (remove both attribute and group means) could, despite these considerations, depend upon the extent to which this double-centring increases the noise-to-signal ratio of the data or the fit of the alternative solutions. This is important because the greater the proportion of variation not modeled (error variation) the less reliable is the solution describing the proportion that is modeled (explained variation). However, because solutions obtained for single- and double-centred data (not shown) differ trivially in terms of overall fit, a solution based on double-centred data is reported.

As Veldscholte, Kroonenberg and Antonides (in press, p. 6) show in their report of an analysis with similar objectives on similar data, double-centring has an attractive interpretation: what is modeled is, for the set of nurses, the interaction (a multiplicative term) between the groups and the attributes so that the solution describes the relative positions of the groups on the attributes and the relative positions of the attributes on the groups irrespective of the mean values of the attributes and the mean values of the groups (i.e. after adjustment for attribute and group 'main' effects). A separate analysis of this kind might be performed on the data from each subject or indeed might have been performed, instead of ordinary PCA on the mean (over subjects) groups by attributes data (shown transposed) in Table 7.2. The present objective is, however, to model rather than to suppress subject variability on perceived group by attribute interaction, or on their judgments of the 'similarities' of the groups and the attributes.

Selecting a solution

A large number of different solutions may be obtained for the same (preprocessed) data. If, for example, it is considered reasonable that there may be between one and six meaningful components on each of the three modes, then a large proportion of six cubed (216) solutions (those for which the product of the numbers of components on any two modes exceeds the number of components on the third) might be compared and selected from. Moreover, because the components on each of the three modes may be arbitrarily rotated (provided that the core matrix is appropriately counter-rotated), an infinity of different descriptions may be made of the same solution. Although the purposes of the research and the researcher's judgment of the relative utilities of the solutions and descriptions is appropriately and inevitably involved, it is clearly

desirable that empirical criteria be marshalled to guide the selection process.

Fit of data to model, parsimony of description and stability over arbitrary sub-samples are three empirical indicators of solution optimality.

Fit might be considered in absolute or relative terms both for solutions as wholes and within modes. Broadly, the overall objective of analysis is to partition the total variation among the data into more important/structural and less important/random parts, or to separate signal from noise. Extracting as many components as elements within modes would yield a 'solution' with perfect fit and represent the data as 'fully' structured but would achieve no more than its re-description. It is difficult to judge prior to analysis how much variation is to be considered signal and how much noise or to estimate an appropriate absolute level of fit for a solution as a whole.

However, on data preprocessed in the same way, solutions of different dimensionality might usefully be evaluated in terms of their relative fit. Given the sequential orthogonal variance-maximising nature of PCA, some point of diminishing returns in overall fit with increasing overall dimensionality might be identified, as might modes on which increasing component numbers yields the greatest marginal increases in overall fit. Alternatively, solutions of the same dimensionality on differently preprocessed data might also be compared for insight into preprocessing effects and perhaps influence preprocessing decisions, although priority in such decisions should probably be afforded to substantive considerations and the implications for interpretation.

Kroonenberg (1983, chap. 4) shows that the standard partitioning of sums of squares,

SS(total) = SS(fit) + SS(residual)

holds both for solutions as wholes and for each element within each mode at convergence of the alternating least squares algorithm (Kroonenberg & De Leeuw, 1980) employed in the TUCKALS programs.

SS(fit) may be further partitioned in a number of ways. The squares of the elements of the core array, i.e., the squares of the singular values are proportional to the variance explained by the corresponding combinations of the components on the three modes (p. 35; as the eigenvalues in ordinary PCA are proportional to the variance explained by the corresponding components), and because the components on each mode are different ways of partitioning the same variation, the fitted sum of squares may be partitioned among the components on each mode in proportion to the sum of squares of the singular values in the corresponding 'slices' of the core array.

Whilst the result that the total variance of each element may be partitioned into fitted and residual parts is useful in analysis of the relative contributions of elements to the overall solution, that fit may be partitioned among the components of a mode is useful in deciding when extraction of further components on the mode contributes little to overall fit.

It is pertinent to recognise that because a component accounts for only a small portion of the variance within the set of variables analysed is not necessarily a good indication that it does not relate in a substantively important sense to some variable(s) external to the set.
Accordingly, fit statistics, however employed, need to be balanced against parsimony and utility in selecting a solution.
The parsimony of a solution might be considered in terms of the sum of the numbers of the components on the three modes (A+B+C), although their product (AxBxC), being the number of elements in the core array, may better indicate the magnitude of the interpretive burden. However, reducing component numbers may confound otherwise potentially clear and distinct constructs making interpretation conceptually more difficult and the solution less useful.
Solutions that differ markedly over suitably-sized and randomly selected sub-samples may be considered to be unstable. If a solution is intended to support a reliable description of the whole sample or be used as a basis for inference to the population from which the sample was a random selection, then unstable solutions are clearly unacceptable. Stability, then, should be considered to be a basic condition of solution selection.
Any or all of the three modes, however, might be considered to be random or fixed factors and a decision needs to be made as from which mode(s) sub-samples are to be drawn for stability tests.
Each of the three modes of the present data might, in some sense, be considered to be a random factor. This applies most obviously to the subject mode which, if not an entirely random selection from the population of Australian registered nurses, constitutes a set of entities that are, in the first instance, indistinguishable - at least they are not distinguished by design. Whilst the entities on the group mode were deliberately chosen (see Chapter 5), they nevertheless represent only one of a relatively large number of sets that might have been chosen from a potentially large list of health occupations; and the set of attributes might have been different depending on decisions made following the analysis reported in Chapter 6.
Although jackknife or bootstrap re-sampling procedures might in principle be applied to stability analysis, a more straightforward approach is to compare solutions obtained on randomly-split halves of the sample (Harshman & Lundy, 1984a; Kiers & van Mechelen, in press). Leaving the details of the comparative process temporarily aside, if the number of solutions compared is large relative to sub-sample size, there is a danger of selecting a solution that happens to capitalise on the commonality of the particular sub-samples (albeit randomly) chosen. Caution needs to be exercised, therefore, in sifting through a set of solutions selecting the most stable unless the sub-samples are large relative to the number of solutions filtered or unless different splits are tested. Kiers and van Mechelen also warn that "…using stability as a comparative criterion will lead to choosing overly simple models in cases of small sample sizes, and overly complex models in cases of large sample sizes", and proposes that stability should be used as a

"conjunctive" criterion instead: "…a description chosen should only be maintained if it is reasonably stable over trivial changes in the data."

Three-mode PCA (TUCKALS 3) analysis of the (60) nurses by (44) attributes by (12) groups data.

A number of solutions of differing dimensionality were obtained for the double-centred (over attributes and groups), unstandardised data: namely, the 27 solutions for all combinations of between two and four components on each mode. These solutions were examined for overall standardised fit (SS(fit) / SS(total)) and for marginal increases in fit attributable to components on each mode. Overall standardised fit statistics for the 27 solutions are reported in Table 8.1.

Table 8.1: Standardised fit statistics for the 27 solutions with between 2 and 4 components on each mode

Numbers of components			Sums and products of A,B,C		Standard. Fit
Attributes (A)	Groups (B)	Nurses (C)	A+B+C	AxBxC	SS(fit) / SS(tot)
2	2	2	6	8	.380
2	2	3	7	12	.385
2	2	4	8	16	.387
2	3	2	7	12	.385
2	3	3	8	18	.390
2	3	4	9	24	.395
2	4	2	8	16	.386
2	4	3	9	24	.395
2	4	4	10	32	.400
3	2	2	7	12	.384
3	2	3	8	18	.392
3	2	4	9	24	.399
3	3	2	8	18	.433
3	3	3	9	27	.440
3	3	4	10	36	.446
3	4	2	9	24	.436
3	4	3	10	36	.445
3	4	4	11	48	.451
4	2	2	8	16	.387
4	2	3	9	24	.395
4	2	4	10	32	.403
4	3	2	9	24	.438
4	3	3	10	36	.448
4	3	4	11	48	.456
4	4	2	10	32	.449
4	4	3	11	48	.458
4	4	4	12	64	.465

Selecting a solution from Table 8.1 on the balance of fit and parsimony might be approached in a number of ways, such as to arrange the table in order of increasing sums of component numbers (A+B+C), within that of increasing products of component numbers (AxBxC) and within that of decreasing fit. A solution with relatively good fit might then be selected from towards the top of the table or from among the more parsimonious solutions.

An alternative approach is as follows: the solution with the best fit with two attribute components is 2x4x4 with fit = .400; the solution with the best fit with three attribute components is 3x4x4 with fit = .451; and the solution with the best fit with four attribute components is 4x4x4 with fit = .465. Whilst the marginal increase in fit in selecting three over two attribute components appears worthwhile, the marginal increase in fit in selecting four over three components does not.

From among solutions with three attribute components, the solution with the best fit with two group components is 3x2x4 with fit = .339; the solution with the best fit with three group components is 3x3x4 with fit = .446; and the solution with the best fit with four group components is 3x4x4 with fit = .451. Again, whilst the marginal increase in fit in selecting three over two components appears worthwhile, the marginal increase in fit in selecting four over three components does not.

From solutions with three attribute and three group components, the solutions with two, three and four nurse components have fit = .433, .440 and .446 respectively. There is evidently little to be gained in terms of fit in increasing dimensionality beyond two nurse components. In terms of the balance of fit and parsimony, then, the 3x3x2 solution appears optimal.

Following this process with different orders of components (A, B, C) leads to the same conclusions. Kroonenberg (pers. comm.) advises that a fit of .433 is "quite reasonable given the kind of data".

A number of other matters need to be considered, however, in selecting a solution: it is convenient to have equal numbers of attribute and group components so that they may be embedded in the same space as joint plots ('biplots'; one for each nurse component; Chapter 9), offering an interpretive alternative to rotation and reification; that components may account for only small proportions of within-set variance implies neither that they are not substantively meaningful nor that they may not relate well to variables external to the set (this relates to the utility of the solution, which can only be judged subsequently to detailed examination); and the solution should be stable over arbitrary splits of the data.

The 3x3x2 solution is highly stable as the results of the tests proposed by Kiers and van Mechelen (in press) and provided by Kiers indicate. Congruence coefficients (phi statistics measuring the proportionality of columns) between the components of split-half (odd and even numbered nurses in return-mail order) solutions for the attribute, group and nurse modes are reported in Table 8.2 and the core matrices for the two splits are reported in Table 8.3. These results are for the unrotated solution as described below.

Table 8.2: Congruence coefficients (phi's) between components in split halves

Attributes (phi's between components in splits)				Groups (phi's between components in splits)			
	A1	A2	A3		G1	G2	G3
A1	0.989	0.004	-0.001	G1	0.999	0.001	-0.001

A2	0.005	0.983	0.021	G2	0.001	0.996	0.000
A3	-0.001	0.020	0.944	G3	-0.001	-0.000	0.987
Nurses (phi's between components in each split and the appropriate part of whole sample)							
Split 1				Split 2			
	N1	N2			N1	N2	
N1	1.000	0.094		N1	1.000	-0.095	
N2	0.092	0.979		N2	-0.094	0.985	

Table 8.3: Core elements of split-half solutions

Split 1	A1B1	A2B1	A3B1	A1B2	A2B2	A3B2	A1B3	A2B3	A3B3
N1	-20.309	0.273	-0.291	0.542	10.083	-1.456	0.124	-1.940	-8.466
N2	0.848	-1.134	0.392	3.654	1.051	-0.415	2.678	-0.245	-0.257
Split 2	A1B1	A2B1	A3B1	A1B2	A2B2	A3B2	A1B3	A2B3	A3B3
N1	-19.962	0.670	-0.593	0.244	10.823	-1.572	0.128	-1.663	-8.587
N2	1.030	-0.250	-0.974	3.916	1.349	-1.595	1.105	0.538	-0.946

Total, fitted and residual sums of squares are 139186, 60335 and 78851, with the ratio of fitted to total sums of squares (standardised fit) being .4335. Sums of squares are subsequently reported scaled by 10^{-2} for compactness.

The primary results are the component matrices for the attribute (A), group (B) and nurse (C) modes, and the three-way core array describing the relations among the attribute, group and nurse components.

Secondary results are total, fitted and residual sums of squares for each element of each mode and the proportions of variance accounted for by each component of each mode (standardised component weights). Component weights are equal to the sums of squares of the elements of the corresponding slices of the core array and standardised component weights are obtained by division by total sums of squares.

Components are reported scaled to unit length. Taking the components of the attribute mode, for example, and in terms of the notation for PCA employed in Chapter 4, these are either the **u**-vectors from decomposition of the data matrix **X** in which columns are attributes and rows are group by nurse combinations or the vectors of $\mathbf{y}_*$-scores from decomposition of **X'** in which the rows are attributes and the columns are group by nurse combinations. In the three-mode context, unit length components are typically conceived of as scores rather than loadings where the latter expression is reserved for components scaled so that the sums of squared elements equal the corresponding eigenvalues, or **v**-vectors (Kroonenberg, 1983).

The component matrices and core array reported are for the unrotated solution. The unrotated solution was chosen primarily because the core array has a relatively simple structure (see below, Table 8.7) which tends to be made more complex by counter rotation with rotation of the attribute, group and/or nurse components; a reasonably satisfactory interpretation is possible in terms of the unrotated components (see below); and, for purposes of interpretation of the component spaces as wholes, it is convenient to retain the greater proportions of explained

variance in the earlier components because then their contributions to interpretation are less dependent on the contributions of later components.

Attribute components

The unit length attribute component scores and standardised component weights, together with the total and residual sums of squares and standardised fit values of each attribute are reported in Table 8.4. The first attribute component accounts for .301 of total variance, almost four times the proportion accounted for by the second (.080) and almost six times the proportion accounted for by the third (.052).

Table 8.4: Unit length attribute components and sums of squares

	Unit length components			Sums of squares		
Attribute	1	2	3	Total	Residual	Fit
eduintel	0.130	0.060	-0.004	12.177	4.670	0.616
status	0.188	0.051	-0.099	23.809	8.051	0.662
authrty	0.203	0.054	-0.105	29.105	10.727	0.631
power	0.197	0.029	-0.151	30.010	11.976	0.601
rspnsbty	0.170	-0.003	-0.141	24.815	11.237	0.547
arrognce	0.226	0.056	-0.204	49.570	24.880	0.498
males	0.249	0.003	-0.197	47.273	18.460	0.609
scientfc	0.263	-0.053	0.005	42.823	13.488	0.685
humanstc	-0.148	0.063	0.078	22.853	12.816	0.439
analytcl	0.129	0.060	-0.102	23.410	15.233	0.349
practcl	-0.044	-0.166	0.278	30.029	20.576	0.315
genrlsts	-0.045	-0.122	-0.063	28.166	25.378	0.099
speclizd	0.134	0.223	0.212	32.212	15.920	0.506
narrow	0.165	0.345	0.348	58.923	25.465	0.568
variety	-0.027	-0.021	-0.101	15.992	14.899	0.068
infothng	0.178	0.148	0.230	49.467	29.889	0.396
rootprob	0.017	0.123	-0.176	27.765	23.738	0.145
auxilary	-0.014	0.272	0.336	52.926	36.489	0.311
central	0.078	-0.184	-0.119	25.673	18.326	0.286
manage	0.051	-0.074	-0.136	30.422	27.390	0.100
cooprtv	-0.064	-0.009	0.152	21.533	18.167	0.156
hardwork	0.008	-0.142	0.036	13.589	11.196	0.176
medtrt	0.175	-0.257	-0.055	39.309	18.935	0.518
phystrt	0.006	-0.412	0.159	45.785	24.946	0.455
mentemot	-0.185	0.066	-0.282	34.613	14.061	0.594
soclwb	-0.204	0.108	-0.228	37.806	15.291	0.596
perswb	-0.215	0.004	-0.042	38.438	18.871	0.509
physwb	-0.053	-0.276	0.110	33.432	22.851	0.316

advise	-0.044	0.031	0.191	18.407	14.867	0.192
disease	0.166	-0.154	-0.011	36.260	21.986	0.394
problems	-0.190	0.105	-0.007	36.881	20.558	0.443
perstyle	-0.131	0.030	0.057	19.269	11.681	0.394
tecstyle	0.218	-0.044	0.163	43.410	21.412	0.507
broadvw	-0.118	0.068	-0.084	24.373	17.467	0.283
holistic	-0.158	0.047	-0.046	23.976	13.161	0.451
empathy	-0.145	0.035	0.040	20.609	11.498	0.442
timewp	-0.193	0.006	0.031	28.935	13.174	0.545
rapport	-0.164	0.029	0.024	22.290	10.896	0.511
listen	-0.135	0.070	0.012	18.539	10.305	0.444
closetop	-0.190	-0.007	-0.087	27.643	11.986	0.566
handson	-0.137	-0.422	0.196	55.492	24.942	0.551
contact	-0.106	0.010	0.001	23.533	18.812	0.201
longterm	-0.105	0.073	-0.162	35.319	28.255	0.200
athome	-0.136	0.176	-0.054	35.001	23.585	0.326
Total	0.000	0.000	0.000	1391.860	788.511	0.433
Std. weight	0.302	0.081	0.052			

The individual attribute total sums of squares and fit values are subject to useful interpretation.

Attributes with relatively small total sums of squares are those on which more nurses rate more groups closer to the attribute mean or in respect of which there is greater consensus among nurses that more groups are similar. Although such attributes may serve well to distinguish one or a few groups from the remainder, or distinguish a few nurses from others, they are less diagnostic in general of differences among groups and nurses. Opposite conclusions apply to attributes with relatively large sums of squares: these are attributes in respect of which there are relatively larger differences among groups and nurses and which are potentially more diagnostic of those differences.

Attributes that are relatively better and worse fit are those whose variation over groups and nurses is better and worse accounted for by the solution.

Consequently, attributes with relatively large variation and relatively good fit are those that are more diagnostic of differences among groups and nurses: their relatively large variation is relatively well-expressed in the solution. Attributes with relatively large variation and relatively poor fit are those whose relatively large variation is not well-expressed in the solution or is largely 'noise' or residual: this is more like confusion than systematic disagreement. Attributes with relatively small variation and relatively good fit are those in respect of which there is a relatively high level of consensus

among nurses that most groups are similar and for which the commonalities among groups and nurses are well-expressed in the solution: the variation on these attributes is systematic but not generally very diagnostic of differences among groups and nurses. Attributes with relatively small variation and relatively poor fit are those in respect of which there is a relatively high level of consensus among nurses that most groups are similar but for which their variation is not well-expressed in the solution or is largely error or residual.

Attributes with above median variation and above median fit (in decreasing order of fit) are:

scientific orientation / attitude
males
power / ability to direct or control others
involved with patients' social well-being / needs or problems
involved with patients' mental-emotional well-being / needs or problems
narrow specialty / focus on a specific area or aspect
provide direct / hands-on / physical patient care
involved in medical treatment / have a medical / clinical orientation
involved with patients personal well-being / needs or problems
have a technical approach to patients or their illnesses / problems
specialized knowledge / experts in an area
arrogant / self-important / aloof / elitist
involved in physical treatment (versus or as well as physical well-being or care)

Attributes with above median variation and below median fit (in reverse order of fit) are:

administer coordinate / organize / manage
maintain long-term relationships with patients
auxiliary / peripheral to main treatment / care process
practical - action or task-oriented / doers
involved with patients' physical well-being / needs or problems
see / are concerned with / patients or their lives in the community / at home
oriented to illness / disease / disorder
deal with information / things / material rather than directly with people
deal with problems or needs other than or as well as immediate medical ones

Attributes with below median variation and above median fit (in order of fit) are:

status / prestige
authority / decision-making power / right to decide
education / intelligence
get close to patients / know patients well
responsibility / importance or potential impact of decisions / actions
spend time with patients
develop rapport with patients / communicate well / have good 'people skills'
have a holistic approach / treat patients as 'whole persons' / in 'totality'
willing to listen to patients' points of view / concerns

Attributes with below median variation and below median fit (in reverse order of fit) are:
deal with a wide variety of people / problems / situations
generalists with knowledge / skills that overlap / crossover with other groups
investigate / delve-into / deal with underlying causes or root problems
approachable / cooperative / liaise / share knowledge with others
hard-working
advise / inform / educate patients
have face-to-face / one-to-one / patient contact
have a broad view of or approach to a person
central / pivotal / focal role in health care process
analytical / like to work things out / solve problems / diagnose
have a personal approach to or style with patients
people-oriented / humanistic
have a caring attitude / are empathetic / compassionate / tolerant / accepting

Interpretation of attribute components

The attribute component scores are plotted pairwise in Figures 8.1 to 8.3. Although the joint plots displaying the relations among groups and attributes reported in Chapter 9 are the principal focus for interpretation of the solution, the attribute components are subject to relatively clear description as 'complex abstract attributes' provided that patterns of secondary scores are kept in mind. However, the weight of component one relative to components two and three make this a less important consideration in its interpretation than theirs.

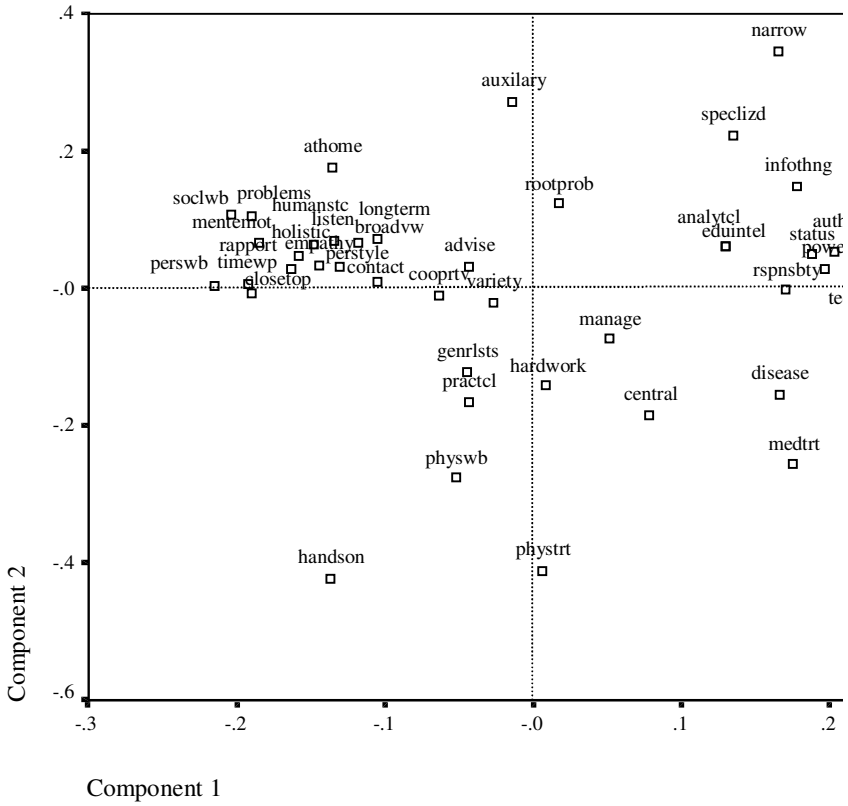


Figure 8.1: Attribute component 2 by component 1

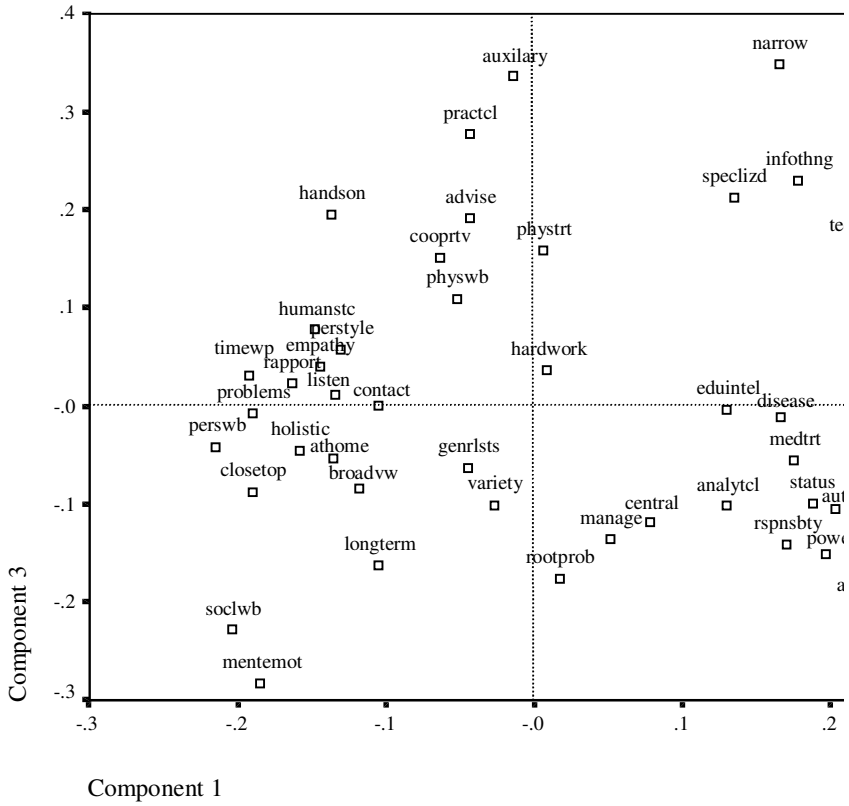


Figure 8.2: Attribute component 3 by component 1

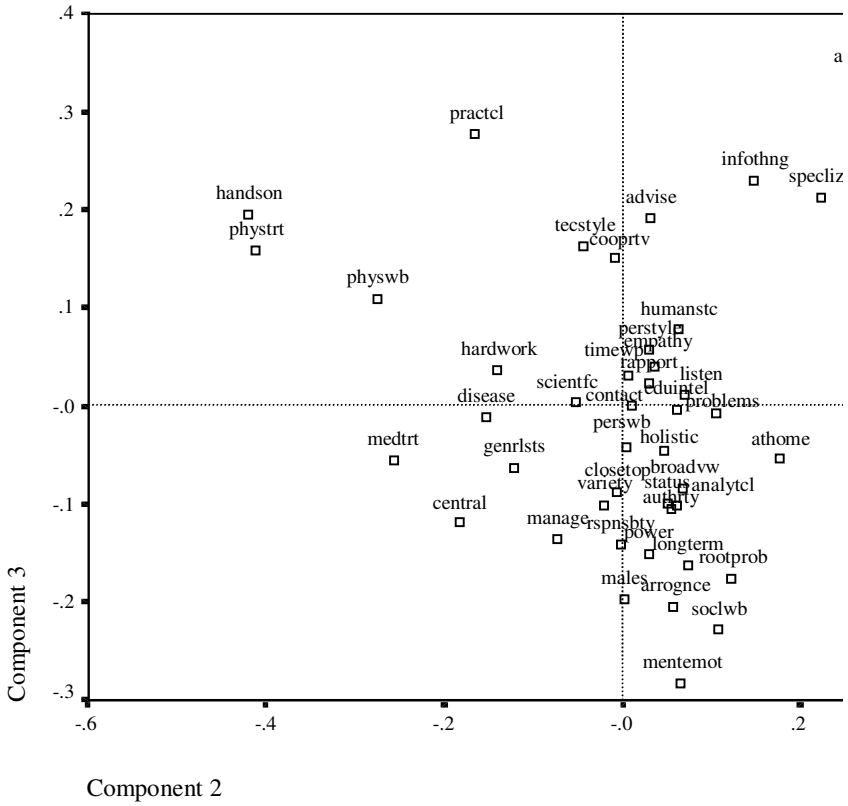


Figure 8.3: Attribute component 3 by component 2

Attribute component 1

This component represents a contrast between two sets of attributes, those with substantial positive and those with substantial negative scores. What these attributes are may be extracted from Table 8.4 or more conveniently from Figures 8.1 and 8.2. The set of attributes with relatively high scores on the positive pole of this component may be conceptually categorized as follows:

scientific orientation / attitude
education / intelligence
analytical / like to work things out / diagnose
status / prestige
power / ability to direct or control others
arrogant / self-important / aloof / elitist
authority / decision-making power / right to decide
responsibility / importance or potential impact of decisions / actions
oriented to illness / disease / disorder
involved in medical treatment / have a medical / clinical orientation
narrow specialty / focus on a specific area
specialized knowledge / experts in an area

males

This pole of the component bears a striking resemblance to the second component from the two-mode PCA of the averaged group by attribute ratings and to the positive pole of dimension one of the MDU analysis of the same data (Chapter 7), and might be similarly characterised.

Members of groups scoring highly (in the positive direction) on this component are (relative to the average group) highly educated and intelligent with an analytical, technical orientation which they employ in diagnosis and treatment of organic disorder; their knowledge is expert and specialised, and focused in a specific area; they have high levels of authority and responsibility, status, prestige and power; and tend to be arrogant or aloof and male.

The set of attributes with relatively low scores (high in the negative direction) on this component may be conceptually categorized as follows:

involved with patients social well-being / needs or problems
involved with patients mental-emotional well-being / needs or problems
involved with patients personal or everyday well-being / needs or problems
deal with problems or needs other than or as well as immediate medical ones
have a holistic approach / treat patients as 'whole persons' / in 'totality'
have a broad view of or approach to a person
people oriented / humanistic
have a personal approach to or style with patients
have a caring attitude / are empathetic / compassionate / tolerant / accepting
spend time with patients
develop rapport with patients / communicate well / have good 'people skills'
get close to patients / know patients well
have face-to-face / one-to-one patient contact
provide direct / hands-on / physical patient care
maintain long-term relationships with patients
see / are concerned with / patients in their lives in the community / at home
(females - not measured but included here in view of the binary nature of the attribute)

This pole of the component strongly resembles the first component from the two-mode PCA solution and to the negative pole of dimension one of the

two-mode MDU solution (Chapter 7), and may be characterised as follows:

Members of groups scoring highly in the negative direction on this component are people-oriented and humanistic with a broad, holistic view of patients whom they approach with a personal style and a caring, empathetic attitude; they are involved with patients' mental-emotional, personal-everyday, social and other non-medical needs and problems; spend time in one-to-one, hands-on contact with them listening to them, developing rapport and getting close to them; maintain relationships that extend outside the time and place of the immediate medical situation, and by contrast with the positive pole of the dimension, tend to be female.

This component represents the strongest contrast in the data and, although a complex amalgam, is comprehensible, as a whole, unrotated. Although the ability of purely empirical procedures to identify 'real' or 'natural' latent variables is contestable, this component represents a fundamental attributional contrast in terms of which most nurses perceptions of the most salient distinctions among groups may be summarised.

Attribute component 2

The attribute components are conditional upon each other: i.e., each describes variation (most importantly, for present purposes, among groups) over and above that described by the other components. Although attribute component one is accordingly conditional upon attributes two and three, the relative weights of the components suggest that it is more important from an interpretive perspective to consider the conditionality of the latter two components on component one than vice-versa. In the present case, the attributes with larger scores on component two appear to describe qualitatively different contrasts on either side of component one.

Attributes with relatively large scores on component two and which are relatively central (have scores nearer zero) on component one might be considered to describe the commonality between these qualitatively different contrasts.

Towards the positive pole these are,

auxiliary / peripheral to main treatment / care process

investigate / delve-into / deal with underlying causes or root problems
and towards the negative pole they are,
involved in physical treatment (versus or as well as physical well-being or care)
involved with patients' physical well-being needs or problems
(and, to some extent)
hard-working,
practical - action or task-oriented / doers
generalists with knowledge / skills that overlap / crossover with other groups

In general terms, then, attribute component two contrasts auxiliary roles that tend to involve investigating or dealing with underlying or root problems with roles that (in a more direct, hard-working, practical way) provide physical treatment and care.

Near the 'humanistic' (negative) pole of dimension one, this is a contrast between,
see / are concerned with patients or their lives in the community / at home
involved with patients' social well-being / needs or problems
deal with problems or needs other than or as well as immediate medical ones
and,
provide direct / hands-on / physical patient care

Near the 'scientific' (positive) pole of dimension one this is a contrast between,
narrow specialty / focus on a specific area or aspect
specialized knowledge / experts in an area,
deal with information / things / material rather than directly with people
and,
involved in medical treatment / have a medical / clinical orientation
oriented to illness / disease / disorder
central / pivotal / focal role in health care process.

Attribute component 3

Attributes with relatively large scores on component three and which are relatively central on component one might be considered, as for component two, to describe the commonality between two qualitatively different contrasts occurring on either side of component one.

Towards the positive pole these are,
auxiliary / peripheral to main treatment / care process
practical - action or task-oriented / doers
advise / inform / educate patients

involved in physical treatment (versus or as well as physical well-being or care)
and towards the negative pole, they are
investigate / delve-into / deal with underlying causes or root problems
In general terms, then, attribute component three contrasts auxiliary roles that provide practical advice and physical treatment with roles that deal with underlying causes or root problems.
Near the 'humanistic' (negative) pole of dimension one, this is a contrast between,
provide direct / hands-on / physical patient care
and,
involved with patients' mental-emotional well-being / needs or problems
involved with patients' social well-being / needs or problems
maintain long-term relationships with patients
Near the 'scientific' (positive) pole of dimension one, the contrast is between,
narrow specialty / focus on a specific area or aspect
specialized knowledge / experts in an area,
deal with information / things / material rather than directly with people
have a technical approach to patients or their illnesses / problems
and,
arrogant / self-important / aloof / elitist
males
power / ability to direct or control others
responsibility / importance or potential impact of decisions / actions
administer / coordinate / administer / manage
central / pivotal / focal role in health care process
analytical / like to work things out / solve problems / diagnose
status / prestige.
Whilst there is considerable overlap between the lists of attributes importantly involved in this contrast and in that represented by attribute component two, they are combined (weighted) in different ways and, as subsequent discussion shows, distinguish differently among the groups.

Group components

The unit length group components and standardised component weights, together with the total and residual sums of squares and standardised fit values of each group are reported in Table 8.5. The first group component accounts for .289 of total variance, about three times the proportion accounted for by the second

(.090) and about five times the proportion accounted for by the third (.055).

Table 8.5: Unit length group components and sums of squares

	Unit length components			Sums of squares		
Group	1	2	3	Total	Residual	Fit
DT	-0.011	0.351	0.387	109.366	82.578	0.245
EN	0.493	-0.392	0.200	196.075	76.130	0.612
GP	-0.064	-0.252	-0.403	85.823	63.899	0.255
OT	0.188	0.155	0.290	86.066	62.424	0.275
PH	-0.372	0.243	0.270	147.791	79.325	0.463
PN	-0.376	-0.084	-0.256	117.729	55.056	0.532
PS	0.139	0.418	-0.388	107.890	66.781	0.381
PT	0.051	-0.045	0.360	67.190	56.040	0.166
RD	-0.162	-0.297	-0.080	77.645	55.496	0.285
RN	0.271	-0.342	-0.054	103.746	59.317	0.428
SG	-0.469	-0.157	0.042	156.005	64.380	0.587
SW	0.311	0.403	-0.366	136.537	67.084	0.509
Total	0.000	0.000	0.000	1391.862	788.511	0.433
Std. weight	0.289	0.090	0.055			

Groups with above median variation and above median fit, or in respect of which there is a relatively systematic (according to the solution) pattern of judgments among nurses that they are relatively distant from the means of many attributes, are (in order of fit) EN, SG, PN, SW, and PH. Judgments in respect of these groups, standing at the extremes of important contrasts, are more influential on the overall form of the solution.

DT has above median variation and below median fit, indicating that it is judged to be different from many other groups on many attributes but in ways that are not well expressed in the solution.

RN has below median variation and above median fit, indicating that it is judged to be similar to many other groups on many attributes in ways that are well represented in the solution.

Groups with below median variation and below median fit, indicating that they are judged to be similar to many groups but in ways that are less well expressed in the solution, are (in reverse order of fit) PT, GP, OT, RD, and PS. PT in particular has very low variation and very poor fit.

Interpretation of group components

The group component scores are plotted pairwise in Figures 8.4 to 8.6.

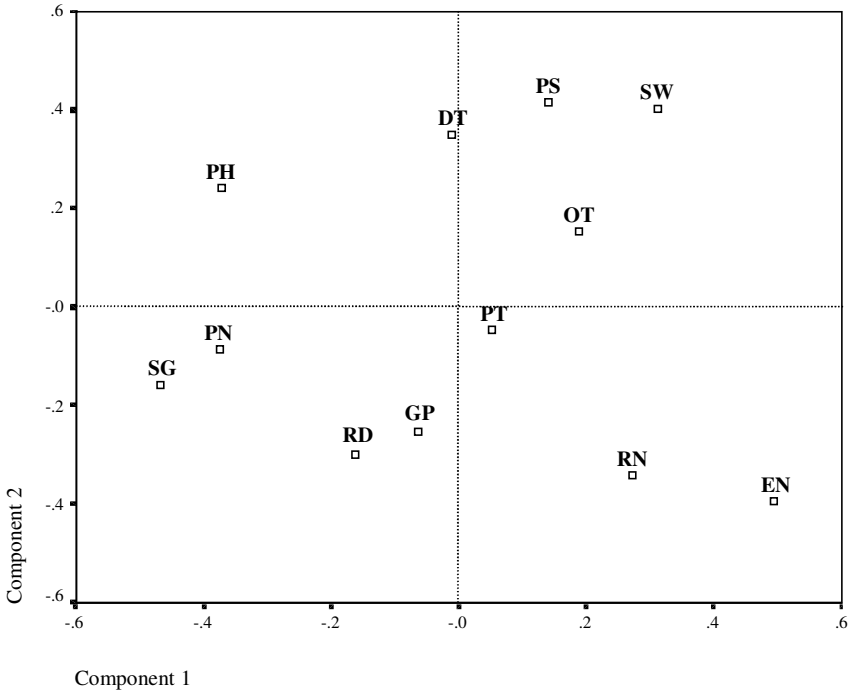


Figure 8.4: Group component 2 by component 1

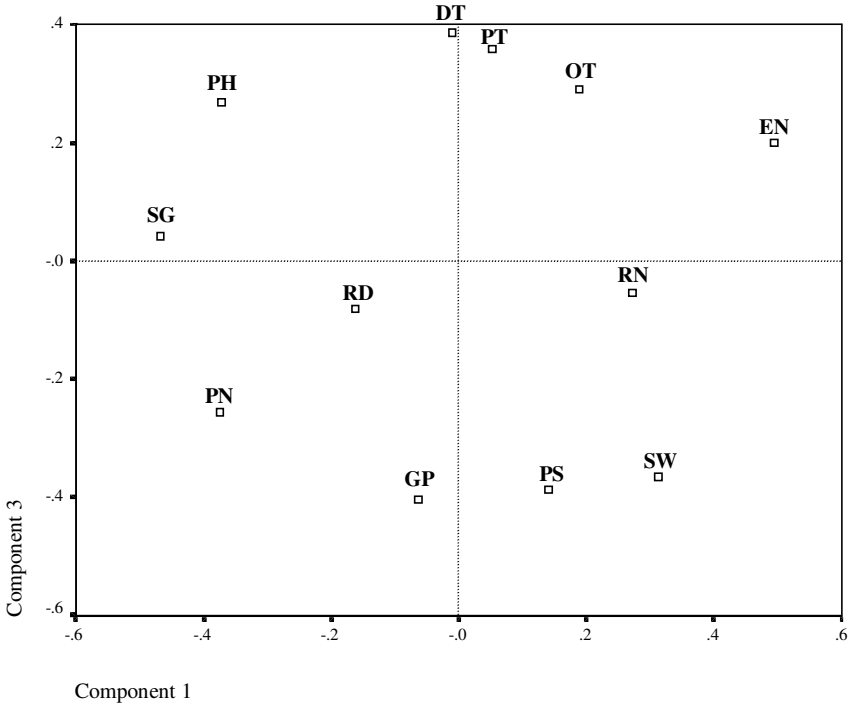


Figure 8.5: Group component 3 by component 1

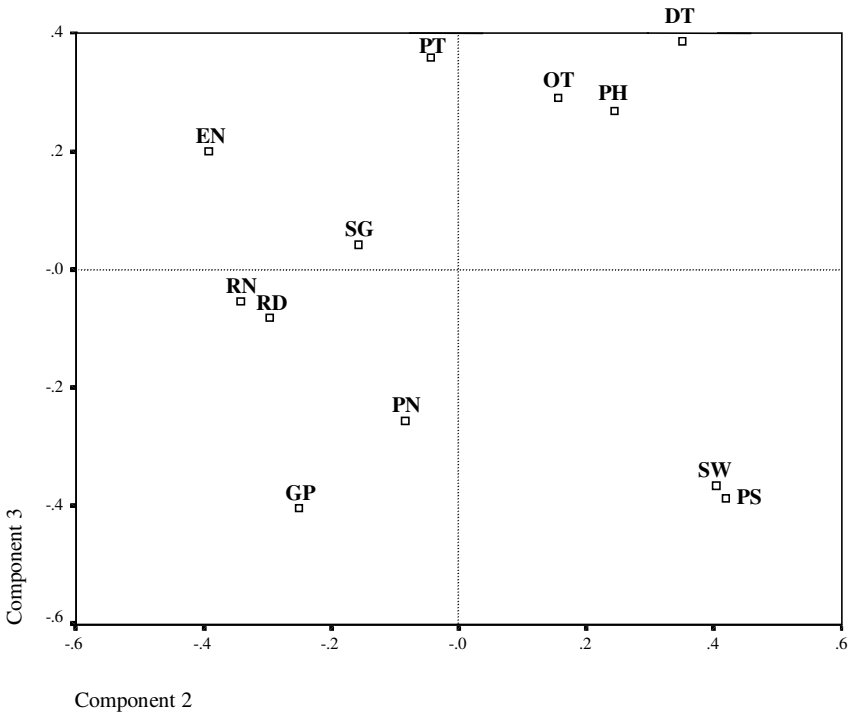


Figure 8.6: Group component 3 by component 2

Description of among group similarities and differences can only appropriately proceed beyond simple nomination in terms of the relations among the attribute and group components as described in the two frontal slices (one for each nurse component) of the core array or in terms of the corresponding joint plots (Figures 9.1 – 9.3 and 9.4). In general terms, however, component one distinguishes between the medical groups (SG, PN, PH, RD, GP) and PH, and the nurses (EN, RN) and the non-PH auxiliary groups (SW, OT, PS, PT) with DT centrally located. The strongest contrasts are between the medical specialists (SG, PN) and PH, and the nurses (EN, RN) and SW.

Component two distinguishes between the nurses (EN, RN) and medical groups (RD, GP, SG, PN), and the auxiliary groups (PS, SW, DT, PH, OT) with PT more centrally located on the nurses/doctors side. The strongest contrasts are between the nurses (EN, RN) and non-specialist medical groups (RD, GP), and the less physical auxiliary groups (PS, SW, PH, OT).

Component three is less easy to characterise but distinguishes between GP, PS, SW, and to some extent PN, and DT, PT, PH, OT and EN. At this point of the interpretive process, this might be supposed to be a distinction between two classes of groups whose roles are auxiliary to or in support of those groups most directly

concerned with the core activities of hospitals: SG, RD, RN and, to a slightly lesser extent, PN.

Nurse components

The unit length nurse components and standardised component weights, together with the total and residual sums of squares and standardised fit values of each nurse are reported in Table 8.6. The first nurse component accounts for .418 of total variance, about twenty eight times the proportion accounted for by the second (.015). A plot of nurse component two by component one is presented as Figure 8.7.

Table 8.6: Unit length nurse components and sums of squares

		Unit components		Sums of squares		
Nurse	Symbol	1	2	Total	Residual	Fit
1	1	0.146	-0.061	20.859	8.324	0.601
2	2	0.165	0.178	35.257	18.683	0.470
3	3	0.166	0.035	31.354	15.334	0.511
4	4	0.120	-0.096	23.890	15.282	0.360
5	5	0.187	-0.128	40.325	19.578	0.514
6	6	0.095	-0.022	11.367	6.145	0.459
7	7	0.101	-0.062	13.415	7.440	0.445
8	8	0.155	-0.170	25.872	11.273	0.564
9	9	0.125	0.116	21.387	11.946	0.441
10	a	0.153	-0.145	29.044	15.052	0.482
11	b	0.150	0.208	29.622	15.510	0.476
12	c	0.216	-0.079	38.518	11.334	0.706
13	d	0.094	0.283	22.093	15.263	0.309
14	e	0.114	0.115	32.926	25.097	0.238
15	f	0.172	0.032	29.505	12.291	0.583
16	g	0.140	0.017	34.534	23.072	0.332
17	h	0.114	-0.294	31.109	21.706	0.302
18	i	0.129	-0.089	16.007	6.121	0.618
19	j	0.147	-0.182	37.665	24.303	0.355
20	k	0.142	-0.131	23.239	11.124	0.521
21	l	0.124	0.057	19.480	10.485	0.462
22	m	0.066	0.015	17.723	15.218	0.141
23	n	0.094	0.150	11.149	5.570	0.500
24	o	0.100	0.090	26.204	20.203	0.229
25	p	0.116	0.028	17.065	9.168	0.463
26	q	0.173	0.045	31.828	14.349	0.549
27	r	0.135	0.060	18.730	8.038	0.571
28	s	0.102	0.040	10.789	4.667	0.567
29	t	0.135	-0.098	23.622	12.885	0.455
30	u	0.052	0.030	5.639	4.040	0.283
31	v	0.053	0.073	10.908	9.169	0.159
32	w	0.064	0.037	5.812	3.371	0.420
33	x	0.159	0.029	30.738	15.987	0.480
34	y	0.110	0.054	19.807	12.671	0.360
35	z	0.128	0.129	31.224	21.387	0.315

36	A	0.131	-0.100	18.119	7.964	0.560
37	B	0.080	0.112	18.794	14.758	0.215
38	C	0.123	0.030	24.335	15.538	0.361
39	D	0.114	0.141	16.118	8.182	0.492
40	E	0.142	-0.107	21.954	10.012	0.544
41	F	0.091	0.041	12.712	7.851	0.382
42	G	0.057	-0.034	6.039	4.124	0.317
43	H	0.135	0.004	22.433	11.834	0.472
44	I	0.131	0.081	25.197	15.123	0.400
45	J	0.091	-0.022	10.690	5.911	0.447
46	K	0.096	0.163	16.378	10.502	0.359
47	L	0.187	-0.067	35.167	14.664	0.583
48	M	0.109	-0.085	20.658	13.622	0.341
49	N	0.147	-0.033	25.533	12.983	0.492
50	O	0.109	0.375	31.707	21.807	0.312
51	P	0.188	0.026	37.387	16.794	0.551
52	Q	0.100	0.050	11.880	6.053	0.490
53	R	0.108	0.113	15.173	8.138	0.464
54	S	0.170	0.022	33.491	16.592	0.505
55	T	0.059	0.042	10.524	8.444	0.198
56	U	0.083	0.199	14.976	10.083	0.327
57	V	0.061	0.238	9.035	5.668	0.373
58	W	0.150	-0.104	27.998	14.707	0.475
59	X	0.135	-0.189	44.261	32.850	0.258
60	Y	0.177	-0.309	52.601	32.220	0.387
Total		0.415	0.849	1391.862	788.511	0.433
Std. weight		0.418	0.015			

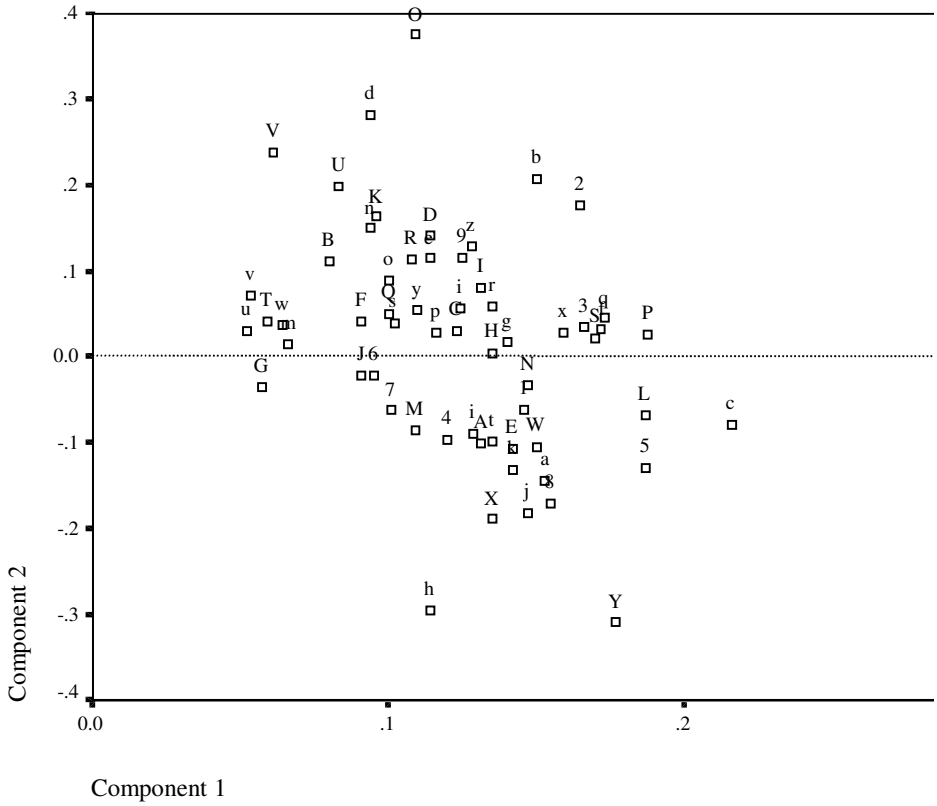


Figure 8.7: Nurse component 2 by component 1

The first nurse component, on which all scores are positive, refers to a shared attribute by group structure. The sizes of the scores describe the relative extent to which each nurse rated more groups further from more attribute means on that common structure. As such it represents the emphasis he or she places on shared distinctions among groups in terms of attributes: i.e., nurses with higher scores on the component discriminate more strongly among groups or perceive them to be quantitatively more dissimilar in a qualitatively shared way.

The second nurse component, with a mix of positive and negative scores, distinguishes among nurses in terms of the direction of judgments of dissimilarity among some groups in terms of some attributes: i.e., whilst some nurses distinguish among some groups as manifesting more (or less) of some attributes, others distinguish among them as manifesting less (or more) of those attributes. The signs of scores on this component represent a systematic judgmental disagreement among nurses in so far as they distinguish among certain groups in opposite ways. Although nurses vary more in the strength with which they discriminate among groups or in the extent to which they perceive them to be dissimilar on a shared structure, as described by the first component, the second component offers insight into

how they perceive them to differ. Whereas the first component describes differences among nurses in the extent (quantity) with which they make shared distinctions, the second describes differences in the content (quality), of their distinctions among groups.

The nature of this judgmental difference among nurses can be identified only subsequently to examination of the core array, which describes how the attribute, group and nurse components are related. Anticipating somewhat, the way in which essentially one group and one attribute component are related are opposite for nurses having positive and negative scores on the second component. Specifically, this 'oppositeness' is of meaningful extent only in respect of the relation between attribute component one and group component two.

Core Array

The core array is presented as Table 8.7.

Table 8.7: Core array and proportions of variance accounted for by (nurse by attribute by group) combinations of components

		Singular values			Proportion of variance		
Frontal slice	Components	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Nurses 1	Attribute 1	-20.022	.375	.196	.288	.000	.000
	Attribute 2	.375	10.326	-1.860	.000	.077	.002
	Attribute 3	.325	1.401	8.281	.000	.001	.049
Nurses 2	Attribute 1	.976	3.768	1.856	.001	.010	.002
	Attribute 2	-.609	1.183	.069	.000	.001	.000
	Attribute 3	.294	.804	.564	.000	.000	.000

The elements of the core array (singular values) describe the relations among the components on the nurse, attribute and group modes, and their squares are the variances accounted for by each combination (recall that variances are reported scaled by 10^{-2}). By way of example, the largest element of the core array, describing the strength and direction of the relationship among the components N1, A1, and G1, has square = 20.022 x 20.022 = 400.88, which is .288 of the total sum of squares (i.e., of 1391.86). In terms firstly of the relative strengths of the singular values, N1A1G1, N1A2G2, N1A3G3 and N2A1G2 are of meaningful size, each accounting for a minimum of .01 of total variance. Of these, only N2A1G2 involves the second nurse component, indicating that the relationship between A1 and G2 is in the opposite direction for nurses having positive and negative scores on N2. Moreover, as the trivial size of N1A1G2 indicates, the relationship between A1 and G2 is only trivially related to the common judgmental structure. Essentially, then, the second nurse component is associated with an attribute by group relationship that is very largely independent of the relationships associated with the first nurse component.

Initial approach to interpretation

The positive sign on N2A1G2 indicates a direct relationship between A1 and G2 for nurses scoring positively and an inverse relationship for nurses scoring negatively on N2. Groups with positive scores of reasonable size on G2 (Table 8.5; Figures 8.4, 8.6) are in order, PS, SW, DT and PH and groups with negative scores of reasonable size are in order, EN, RN, RD and GP. Whilst nurses with positive scores on N2 attribute the characteristics associated with the positive ('scientific') pole of A1 more to the PS, SW, DT and PH set of groups than to the EN, RN, RD and GP set, and attribute the characteristics associated with the negative ('humanistic') pole more to the EN, RN, RD and GP set than to the PS, SW, DT and PH set, these characteristics are applied in the opposite directions by nurses with negative scores on N2. It may not be too flippant to suggest that these differences represent a tension arising from perception of scientific humanists and humanistic scientists in a context largely described in terms of a contrast between humanistic care and involvement, and scientific treatment. The component may also represent differences in self-conception among nurses.

Because the A1G2 combination is of meaningful size only in association with N2, and because N2 is of meaningful size only in association with A1G2, the other three substantial combinations may be independently described.

The negative sign on N1A1G1 indicates a reverse relationship between A1 and G1: i.e., positive scores on A1 correspond to negative scores on G1 and vice-versa. Groups scoring positively on G1 are, in order, EN, SW, RN, OT, PS and PT. The higher their scores on this component (Table 8.5; Figures 8.4, 8.5) the more strongly the previously offered description of the negative pole of A1 applies to them: 'people-oriented and humanistic with a broad, holistic view of patients whom they approach with a personal style and a caring, empathetic attitude; they are involved with patients' mental-emotional, personal-everyday, social and other non-medical needs and problems; spend time in one-to-one, hands-on contact with them listening to them, developing rapport and getting close to them; maintain relationships that extend outside the time and place of the immediate medical situation, and by contrast with the positive pole of the dimension, tend to be female'. These groups are judged to be above average in terms of these characteristics (although PT is near the origin) and below average in terms of the characteristics describing the positive pole of A1, as summarised below.

Groups scoring negatively on G1 are, in order, SG, PN, PH, RD, GP and DT. The higher their scores (in the negative direction) on this component (Table 8.5; Figures 8.4, 8.5), the more strongly the previously offered description of the positive pole of A1 applies to them: 'highly educated and intelligent with an analytical, technical orientation which they employ in diagnosis

and treatment of organic disorder; their knowledge is expert and specialised, and focused in a specific area; they have high levels of authority and responsibility, status, prestige and power; and tend to be arrogant or aloof and male.' These groups are judged to be above average in terms of these characteristics (although DT and GP are near the origin) and below average in terms of the characteristics describing the negative pole of A1, as summarised above.

The positive sign on N1A2G2 indicates a direct relationship between A2 and G2: i.e., positive scores on A2 correspond to positive scores on G2 and vice-versa. Groups scoring positively on G2 are in order, the auxiliary groups PS, SW, DT, PH and OT. The higher their scores on this component (Table 8.5; Figures 8.4, 8.6) the more strongly the previously offered description of the positive pole of A2 applies to them. In general terms, they are considered to be above average on the attributes,

auxillary / peripheral to main treatment / care process
investigate / delve-into / deal with underlying causes or root problems,

and below average on the attributes,

involved in physical treatment (versus or as well as physical well-being or care)
involved with patients' physical well-being needs or problems
(and, to some extent)
hard-working,
practical - action or task-oriented / doers
generalists with knowledge / skills that overlap / crossover with other groups.

The opposite characterisation applies to the groups scoring negatively on G2, which are, in order, the nurses' and medical groups EN, RN, RD, GP and SG with PN and PT closer to the origin.

This description may be elaborated by taking into account the qualitatively different attributional contrasts on A2 on either side of the A1 origin. This discussion is facilitated by reference to Figure 8.4.

The groups in the second and third quadrants of Figure 8.4, (SW, PS, OT) and (EN, RN) respectively, are those to which the negative ('humanistic') pole of A1 applies.

Accordingly, among the more 'humanistic' groups, SW, PS and OT are judged to manifest relatively more the attributes,

see / are concerned with patients or their lives in the community / at home
involved with patients' social well-being / needs or problems
deal with problems or needs other than or as well as immediate medical ones

and relatively less of the attribute

provide direct / hands-on / physical patient care

with the opposite applying to the nurse groups EN and RN.

The groups in the first and fourth quadrants of Figure 8.4, PH (with DT near to quadrant two), and the medical groups SG, RD,

GP and PN respectively, are those to which the 'scientific' pole of A1 applies.
Accordingly, among the more 'scientific' groups PH (and to some extent, DT) are judged to manifest relatively more of the attributes,
narrow specialty / focus on a specific area or aspect
specialized knowledge / experts in an area,
deal with information / things / material rather than directly with people
and relatively less of the attributes,
involved in medical treatment / have a medical / clinical orientation
oriented to illness / disease / disorder
central / pivotal / focal role in health care process,
with the opposite applying to the medical groups, SG, RD, GP and PN.
The positive sign on N1A3G3 indicates a direct relationship between A3 and G3: i.e., positive scores on A3 correspond to positive scores on G3 and vice-versa. Groups scoring positively on G3 are, in order, DT, PT, OT, PH and EN with SG near the origin. The higher their scores on this component (Table 8.5; Figures 8.5, 8.6) the more strongly the previously offered description of the positive pole of A3 applies to them. In general terms, they are considered to be above average on the attributes,
auxiliary / peripheral to main treatment / care process
practical - action or task-oriented / doers
advise / inform / educate patients
involved in physical treatment (versus or as well as physical well-being or care)
and below average on the attribute,
investigate / delve-into / deal with underlying causes or root problems.
The opposite characterisation applies to the groups scoring negatively on G3, which are, in order, GP, PS, SW and PN with RD and RN closer to the origin.
The groups in the second and third quadrants of Figure 8.5, (PT, OT, EN) and (PS, SW with RN near the origin) respectively, are those to which the negative ('humanistic') pole of A1 applies.
Accordingly, among the more 'humanistic' groups PT, OT and EN are judged to manifest relatively more of the attribute,
provide direct / hands-on / physical patient care
and relatively less of the attributes,
involved with patients' mental-emotional well-being / needs or problems
involved with patients' social well-being / needs or problems
maintain long-term relationships with patients,
with the opposite applying to PS and SW.
The groups in the first and fourth quadrants of Figure 8.5, (PH with SG near the origin) and (PN, GP, RD) respectively, are those to which the positive ('scientific') pole of A1 applies.
Accordingly, among the more 'scientific' groups, PH and to some extent SG are judged to manifest relatively more of the attributes,
narrow specialty / focus on a specific area or aspect

specialized knowledge / experts in an area,
deal with information / things / material rather than directly with people
have a technical approach to patients or their illnesses / problems
and relatively less of the attributes,
arrogant / self-important / aloof / elitist
males
power / ability to direct or control others
responsibility / importance or potential impact of decisions / actions
administer / coordinate / administer / manage
central / pivotal / focal role in health care process
analytical / like to work things out / solve problems / diagnose
status / prestige,
with the opposite applying to GP, PN and to some extent RD.

Summary

These characterizations in terms of quadrants are relatively crude. Whilst, the statement above, for example, may be more or less appropriate for quadrants one and four as wholes, it tends to mislead in description of particular groups. SG scored very highly and GP moderately on component one to begin with so, relative to GP, SG may still be judged to manifest more of the above-listed 'arrogant', 'males', 'power', etc. set of characteristics than GP despite the location of SG in quadrant one and GP in quadrant four.

Indeed, the solution describes each group relative to the others with great subtlety in terms of a combination of scores on three attribute components which are, themselves, combinations of attributes and does so, moreover, from different points of view among nurses. Given a particular nurse perspective, this information is inherent in the precise locations of the groups in component space and the character of the dissimilarities among them is bound to be distorted in focussing simply on their locations within relatively large regions of the space. The dilemma here is the dilemma of summarisation, or how to reduce a complex set of interrelationships to cognitively manageable proportions without too severe a loss or distortion of important information. One response to this might be along the lines of 'why produce a detailed map if a few sentences will do?' Indeed, the solution might better be considered as a map to be read in different ways and for different purposes than to be summarised crudely in words. Construction of joint plots showing the relations among attributes and groups in a common or 'joint' space (one such plot for each of the nurse components) is consonant with this orientation. Interpretation of the solution in terms of joint plots is reported in Chapter 9.

Chapter 9

Analysis of the three-mode data III: interpretation of the three-mode PCA solution in terms of joint plots

The attribute by group structure for a single nurse might be modeled by means of the singular value decomposition (SVD) of his or her double-centred data. Following Veldscholte et al (in press), the SVD is defined as $z_{ij} = \Sigma \lambda_s a_{is} b_{js}$, where the z_{ij} are estimates of the double centred data, the a_{is} are the coefficients of the eigenvectors of the attributes, the b_{js} are the coefficients of the eigenvectors of the groups and the λ_s are the singular values. Summation is over the number of components.

In relation to ordinary PCA, the a_{is} and b_{js} are scores (z-scores) and the $\lambda_s a_{is}$ and $\lambda_s b_{js}$ are loadings (v-loadings) on the s-th component, and λ_s is the square root of the s-th eigenvalue representing the 'variation' (square root of sum of squares of double centred data) the corresponding component accounts for. Note that the loadings are not exactly correlations as the data are not scaled to equal variance.

The eigenvectors may be used in a number of ways to construct a biplot (Gabriel, 1971 in Veldscholte et al) displaying both the attributes and groups, in relation, jointly. Symmetrical scaling, as employed below, divides the variation equally between the attributes and groups and displays $\sqrt{\lambda_s} a_{is}$ and $\sqrt{\lambda_s} b_{js}$ as coordinates.

Arrows drawn through the origin to the coordinates of the attributes and groups in component space describe vectors for these elements. Relations among attributes are represented as the angles among their vectors, with vectors of attributes used to distinguish more similarly among the groups being more closely parallel. In the same way, relations among the groups are represented as the angles among their vectors, with vectors of groups distinguished among similarly by the attributes being more closely parallel. Relativities among the groups in terms of an attribute are obtained by their orthogonal projections onto its vector, with groups judged to be above (below) average on the attribute projecting onto the vector on the positive (negative) side of the origin. In like fashion, the relative extent to which the attributes apply to a group, in the sense of serving to distinguish it from others, are obtained by their orthogonal projections onto its vector.

Kroonenberg (1983, p. 164ff.) and Veldscholte et al show that biplots may constructed in a completely analogous way to represent the joint relations among the attributes and groups in the three-mode case by constructing one such plot for each component of the nurses mode (or, more generally, to represent the joint relations among the elements of two modes for each component of the third or reference mode). In the present solution, scores on the first nurse component are all positive and so the corresponding joint plot represents the shared view of nurses about the relationships among the attributes and the groups, with the sizes of the scores simply describing the sizes of the configurations. Scores on the second nurse component are mixed positive and negative and describe differences among corresponding sets of nurses in the way in which they perceive the attributes to distinguish among the groups. Consequently, the second joint plot describes these qualitative differences among nurses' judgments, which are in addition to and qualify or modify the general picture represented by the first joint plot. In attempting conceptually to combine the information in both plots it is pertinent to recall that only the second nurse

component is related to any considerable degree to the A1G2 relationship, and that the second nurse component is related only trivially to other attribute by group relations and accounts for only .015 compared to the first, which accounts for .418, of the total variance. Whilst, despite its small size, this component may nevertheless identify an important issue among nurses in negotiating their collective identity and their 'place' among the health occupations, the extent to which the relations represented in the second joint plot modify those in the first is relatively trivial: i.e. the two joint plots describe largely independent sets of relations.

Joint plot for nurses component 1

The plot has three dimensions, being the minimum of A and B (Veldscholte et al., in press). The proportion of variance accounted for by the first nurse component (standardised weight = .418) is distributed among the joint plot axes (here also referred to as components) as follows: standardised weights = .2882, .0792, .0507 respectively. The joint plot coordinates of the attributes and groups are reported in Table 9.1 and the three two-dimensional projections of the plot are shown in Figures 9.1 – 9.3.

Table 9.1: Joint plot coordinates (attributes and groups) for nurse components 1 and 2

	Nurse 1			Nurse 2		
	Component			Component		
Attribute	1	2	3	1	2	3
eduintel	-0.801	0.276	-0.005	0.399	-0.048	-0.012
status	-1.165	0.248	-0.383	0.492	-0.046	-0.058
authrty	-1.259	0.267	-0.406	0.533	-0.049	-0.062
power	-1.230	0.157	-0.593	0.472	-0.029	-0.082
rspnsbty	-1.065	0.009	-0.558	0.382	0.010	-0.077
arrognce	-1.408	0.284	-0.802	0.533	-0.070	-0.105
males	-1.558	0.048	-0.776	0.571	0.007	-0.108
scientfc	-1.632	-0.222	0.029	0.707	0.132	-0.029
humanstc	0.926	0.267	0.311	-0.323	-0.098	0.052
analytcl	-0.805	0.285	-0.396	0.334	-0.072	-0.052
practcl	0.283	-0.773	1.099	-0.046	0.274	0.109
genrlsts	0.263	-0.541	-0.266	-0.243	0.133	-0.028
speclizd	-0.790	0.988	0.877	0.653	-0.209	0.085
narrow	-0.966	1.521	1.434	0.907	-0.327	0.144
variety	0.158	-0.084	-0.409	-0.155	-0.004	-0.040
infothng	-1.073	0.649	0.945	0.743	-0.095	0.083
rootprob	-0.109	0.570	-0.692	0.010	-0.200	-0.067
auxilary	0.137	1.183	1.370	0.350	-0.277	0.155
central	-0.508	-0.807	-0.490	0.025	0.229	-0.068
manage	-0.333	-0.316	-0.548	0.008	0.076	-0.065
cooprtve	0.406	-0.059	0.605	-0.085	0.034	0.069
hardwork	-0.060	-0.641	0.134	-0.042	0.197	0.006
medtrt	-1.107	-1.134	-0.233	0.293	0.363	-0.056
phystrt	-0.057	-1.862	0.601	-0.138	0.579	0.041
mentemot	1.128	0.311	-1.137	-0.662	-0.198	-0.092

soclwb	1.254	0.494	-0.916	-0.654	-0.245	-0.065
perswb	1.329	0.010	-0.181	-0.628	-0.066	0.006
physwb	0.312	-1.252	0.413	-0.249	0.376	0.035
advise	0.290	0.116	0.767	0.021	-0.004	0.085
disease	-1.044	-0.678	-0.050	0.363	0.237	-0.031
problems	1.182	0.462	-0.031	-0.470	-0.184	0.024
perstyle	0.821	0.122	0.226	-0.312	-0.057	0.039
tecstyle	-1.338	-0.199	0.660	0.689	0.148	0.041
broadvw	0.732	0.307	-0.339	-0.344	-0.138	-0.018
holistic	0.976	0.205	-0.188	-0.442	-0.109	0.001
empathy	0.906	0.145	0.154	-0.359	-0.070	0.034
timewp	1.200	0.011	0.113	-0.518	-0.045	0.034
rapport	1.019	0.118	0.090	-0.425	-0.071	0.029
listen	0.844	0.303	0.046	-0.328	-0.120	0.023
closetop	1.167	-0.034	-0.358	-0.593	-0.057	-0.015
handson	0.828	-1.919	0.740	-0.519	0.567	0.071
contact	0.657	0.037	0.000	-0.290	-0.037	0.013
longterm	0.640	0.337	-0.648	-0.353	-0.160	-0.051
athome	0.851	0.788	-0.208	-0.305	-0.276	0.003
Group						
DT	-0.055	0.630	0.937	0.726	0.006	0.050
EN	1.603	-0.981	0.258	-0.261	0.450	0.009
GP	-0.192	-0.396	-0.932	-0.623	-0.081	-0.051
OT	0.598	0.227	0.662	0.454	0.151	0.023
PH	-1.215	0.427	0.646	0.396	-0.214	0.074
PN	-1.207	-0.085	-0.567	-0.391	-0.272	-0.001
PS	0.444	1.140	-0.626	0.360	-0.126	-0.114
PT	0.161	-0.266	0.722	0.187	0.138	0.064
RD	-0.513	-0.650	-0.287	-0.505	-0.043	0.022
RN	0.889	-0.756	-0.245	-0.422	0.236	-0.017
SG	-1.511	-0.389	0.014	-0.324	-0.231	0.069
SW	0.998	1.100	-0.584	0.404	-0.013	-0.127

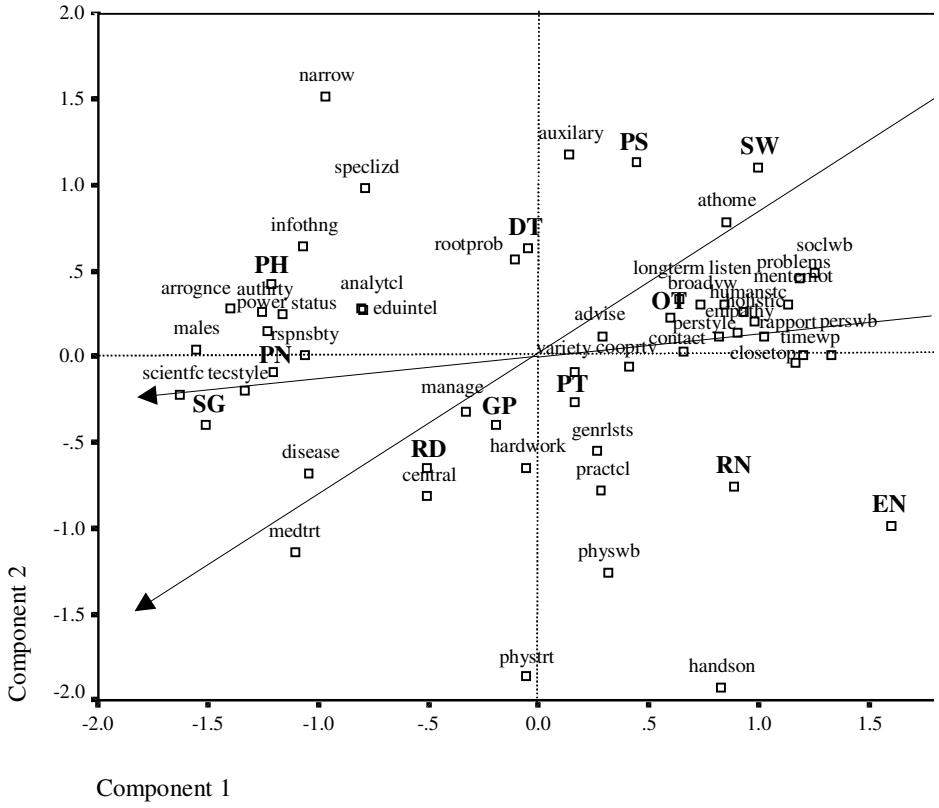


Figure 9.1: Joint plot (attributes and groups): component 2 by component 1 for nurse component 1

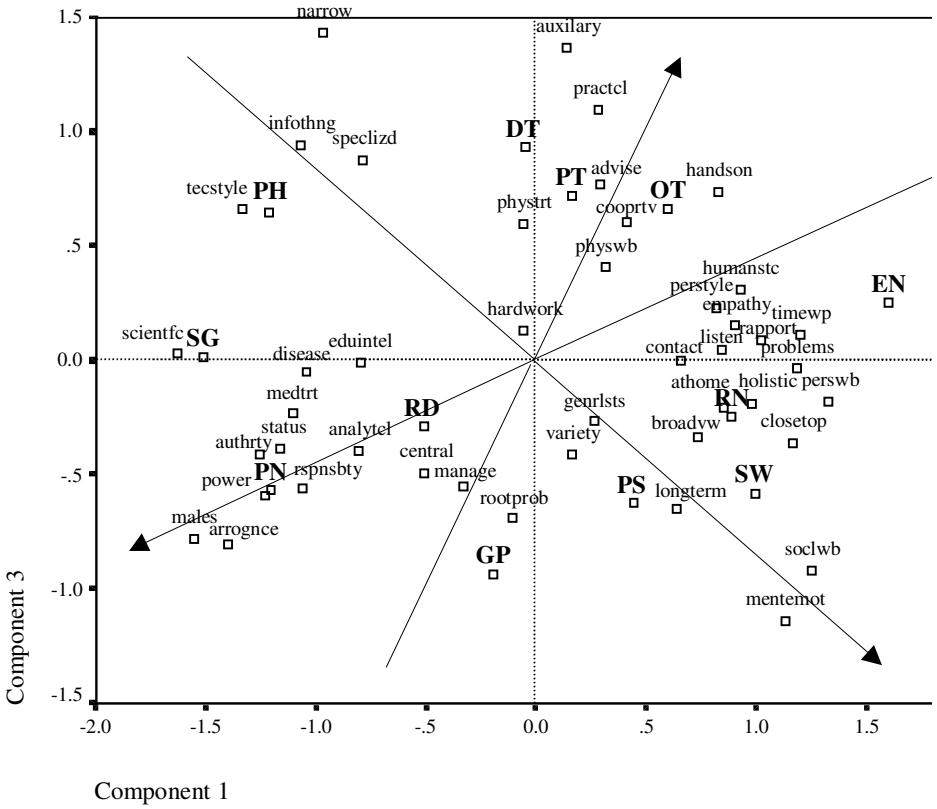


Figure 9.2: Joint plot (attributes and groups): component 3 by component 1 for nurse component 1

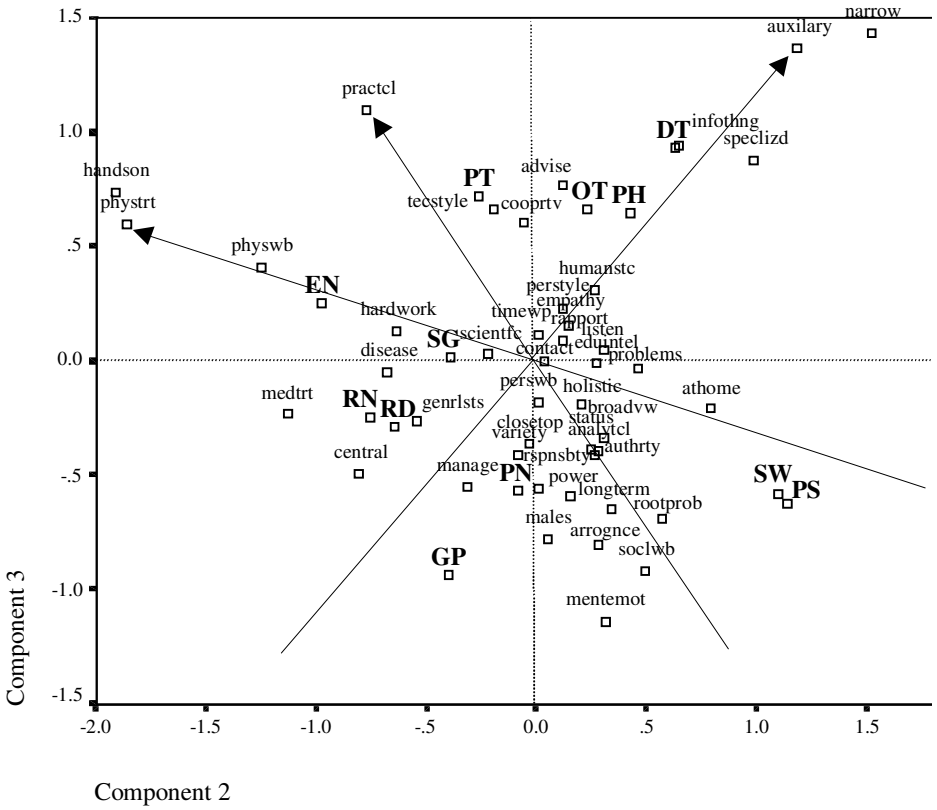


Figure 9.3: Joint plot (attributes and groups): component 3 by component 2 for nurse component 1

Relativities among the groups in terms of attributes

As Table 9.1 shows, most attributes load strongly (>0.5) on one or two but rarely all three components, exceptions including in particular 'specialised', 'narrow', 'information / things' and 'hands-on'. Whilst interpretation involving these attributes requires consideration of the full configuration, one or other of the two dimensional projections offers good interpretability in terms of the remainder.

The set of attributes 'status', 'authority', 'power', 'responsibility', 'arrogance', 'males', 'humanistic', 'analytical', 'variety', 'manage', 'cooperative', 'mental - emotional wellbeing', 'social wellbeing', 'personal wellbeing', 'advise', 'personal style', 'technical style', 'broad view', 'empathy', 'time with patients', 'close to patients' and 'long term relationships' have their two highest loadings on components one and three and are best examined in Figure 9.2.

The vectors for 'authority', 'responsibility', 'power', 'status', 'analytical / diagnose', 'males' and 'arrogance' are closely parallel in the Figure and serve to distinguish

among (ordinate) the groups highly similarly. The pair of groups SG and PN rate most highly on this dimension, followed by the set of groups PH, GP and RD, who also rate above average. EN rates most lowly, followed by OT, then the set of groups RN, SW, PT and DT, with PS rating near the mean. The vectors for 'humanistic', 'personal style' and 'empathy' are closely parallel to each other and point generally in the opposite direction to the 'authority', 'responsibility', etc. set of vectors, and so ordinate the groups oppositely.

The vectors for 'mental-emotional wellbeing', 'social wellbeing' and 'long term relationships' are also closely parallel to each other, approximately oppositely directed to the vector for 'technical style' and approximately orthogonal to the contrast just described. The order of groups in the 'mental-emotional and social wellbeing' direction is SW, EN, RN, PS and GP who rate above average, then OT at about average, followed by RD, PT, PN, DT, SG and PH who rate below average.

The vectors for 'advise' and 'cooperative' are closely parallel to each other and oppositely directed to the vector for 'administer / manage'. The order of groups in the 'advise / cooperative' direction is EN, OT, DT, PT and RN who rate above the average, SW and PH at about average, followed by PS, RD, SG, GP and PN who rate below average.

The vectors for the remaining attributes in the set, 'time with patients', 'close to patients', 'personal wellbeing' and 'broad view', are somewhat spread but approximately parallel to the component one axis on which the order of groups is EN, SW, RN, OT, PS and PT above the mean, followed by DT, GP, RD, PH, PN and SG below the mean.

The set of attributes 'education / intelligence', 'scientific', 'medical treatment', 'illness / disease', 'problems', 'holistic', 'rapport', 'listen', 'contact with patients' and 'at home' have their two highest loadings on dimensions one and two and are best examined in Figure 9.1.

The vectors for 'disease' and 'medical treatment' are closely parallel and oppositely directed to the vector for 'at home'. The order of groups in the 'disease / medical treatment' direction is SG, PN, PH, RD and GP a bove the mean, and PT, DT, RN, OT, EN, PS and SW below the mean.

The vectors for the set of attributes 'problems', 'holistic', 'rapport', 'listen' and 'contact' are closely parallel and oppositely directed to the vector for 'scientific'. The order of groups on this dimension is EN, SW, RN, OT, PS

and PT above the mean, with DT near the mean, followed by GP, RD, PN, PH and SG below the mean.

The set of attributes 'practical', 'auxiliary', 'hard work', 'physical treatment' and physical wellbeing' have their two highest loadings on dimensions two and three and are best examined in Figure 9.2.

The vectors for 'physical treatment', 'physical wellbeing' and 'hard work' are closely parallel. The order of groups on the dimension is EN, RN, RD and PT, SG (above the average), GP and OT (near the average), and PN and PH, DT, SW and PS (below the average).

The order of groups on the vector for 'auxiliary' is DT, PH, OT, PT, SW and PS (above the average), and SG, EN, PN, RN, RD and GP (doctors and nurses, below the average).

The order of groups on the vector for 'practical' is PT and EN, OT and DT, PH, SG, RN and RD (above the average), and PN, GP, and SW and PS (below the average).

The attributes 'specialised', 'narrow', 'information / things' and 'hands-on' have substantial loadings on all three dimensions and their implications for distinguishing among the groups require consideration of the full configuration. This is a demanding task and will be postponed until subsequent discussion of the 'inner products' between attributes and groups.

Again, as with the previous interpretation in terms of quadrants defined in terms of components as wholes, this interpretation from the joint plot is relatively crude: it ignores non-zero loadings, however small, on one of three components and has been described only in terms of orders rather than distances among groups. Reference to the inner products between attributes and groups allows considerable improvement in the precision of this exercise.

The second joint plot, which describes systematic differences among nurses in the way in which they distinguish among the groups in terms of the attributes, is discussed prior to description of the solution in terms of inner products.

Joint plot for nurse component two

The proportion of variance accounted for by the second nurse component (standardised weight = .015) is distributed among the joint plot axes (components) as follows: standardised weights = .0147, .0007, .0000 respectively. Clearly, of the joint plot components, only the first accounts for a potentially meaningful proportion of variation and should be the only component to be interpreted. The joint plot coordinates of the attributes and

groups are reported in Table 9.1 and the two-dimensional projection of component two by component one is shown as Figure 9.4, in which the strongest relations among attributes and groups represented on the first component are shown projected down. The relations between attributes and groups on this component are oppositely directed for nurses scoring positively and negatively on the second nurse component. The positions of the more extreme groups on the component are shown appropriately reversed at the bottom of the Figure.

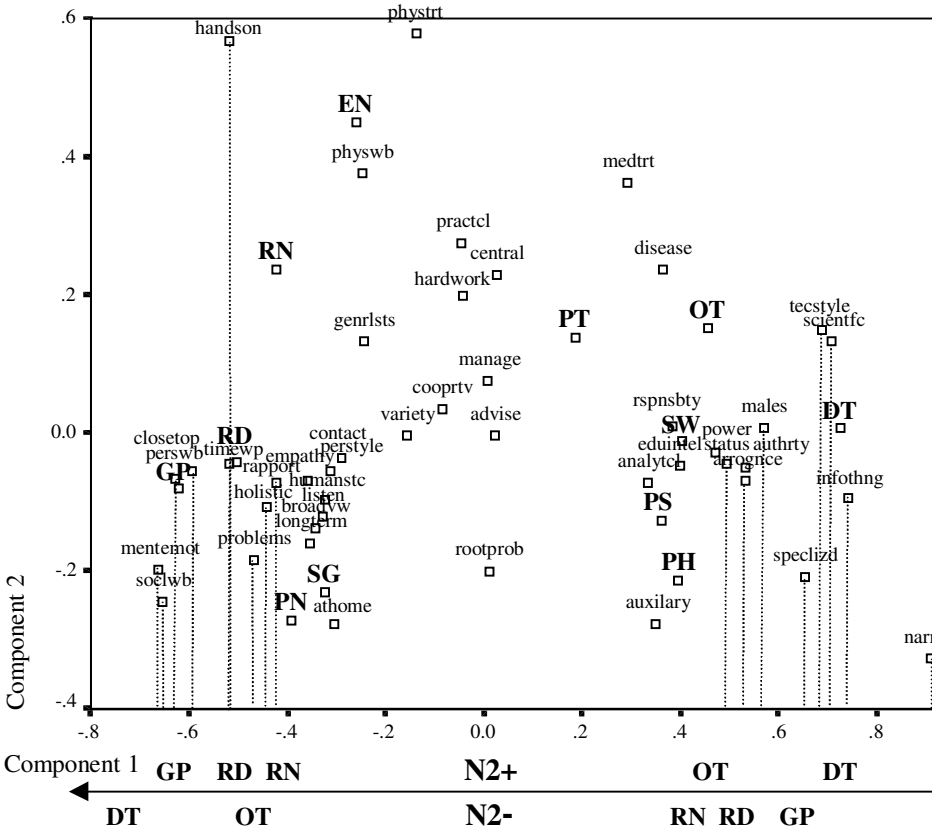


Figure 9.4: Joint plot (attributes and groups): component 1 for nurse component 2

As previously described, the first nurse component which describes what nurses have in common accounts for a far greater proportion of variance than the second which describes how they differ. The implication is that, in terms of the systematic variation the solution identifies, nurses have far more in common than is different among them in terms of their judgments of the differences among the groups in terms of the attributes. Nevertheless, the joint plot for the second nurse component, which represents their differences, shows a potentially interesting set of relations which is largely independent of the general

pattern of agreement represented in the joint plot for the first nurse component.

The nature of this disagreement among nurses may be read directly from Figure 9.4. For nurses with positive scores on the second nurse component, the attributes 'mental-emotional wellbeing'. 'social wellbeing', 'close to patients', 'personal wellbeing', 'hands-on', and 'time with patients' are more closely associated with the groups GP, RD and RN, and the attributes 'narrow', 'information / things', 'scientific', 'technical style', 'specialised', 'males', 'authority' 'arrogance', 'status' and 'power' are more closely associated with the groups DT and OT. The opposite applies to nurses with negative scores on the second nurse component.

The difference between this interpretation and that previously offered in terms of components as wholes is largely due to the former ignoring relatively sizeable elements other than N2A1G2 the N2 slice of the core array. Consequently, the interpretation offered here is preferred.

Interpretation of the first joint plot in terms of inner products

The inner products between attributes and groups are the orthogonal projections of the group points on each attribute vector and simultaneously the projections of the attribute points on each group vector. As such they measure, according to the solution, the relative positions of the groups on the attributes and the relative positions of the attributes on the groups. Indeed, the joint plots are arrangements of vectors such that the orthogonal projections equal the inner products (Kroonenberg, 1983, Chapter 6). The inner products between attributes and groups and their sums of squares for attributes over groups for nurse component one are reported in Table 9.2.

Table 9.2: Inner products for first nurse component

	Group and sum of squares												
Attribute	DT	EN	GP	OT	PH	PN	PS	PT	RD	RN	SG	SW	SS[1]
eduintel	0.213	-1.556	0.049	-0.420	1.088	0.946	-0.038	-0.206	0.234	-0.920	1.103	-0.494	7.130
status	-0.139	-2.211	0.482	-0.894	1.274	1.603	0.006	-0.531	0.547	-1.130	1.659	-0.667	15.180
authrty	-0.144	-2.386	0.515	-0.962	1.382	1.728	-0.001	-0.567	0.590	-1.222	1.794	-0.727	17.700
power	-0.389	-2.280	0.727	-1.093	1.179	1.808	0.004	-0.668	0.700	-1.067	1.789	-0.709	17.510
Rspnsbty	-0.459	-1.861	0.721	-1.005	0.937	1.601	-0.113	-0.577	0.701	-0.817	1.598	-0.728	13.230
Arrognce	-0.495	-2.744	0.905	-1.309	1.314	2.131	0.201	-0.882	0.768	-1.271	2.006	-0.625	24.010
males	-0.612	-2.745	1.004	-1.435	1.412	2.317	-0.151	-0.825	0.992	-1.231	2.324	-1.049	28.040
scientfc	-0.023	-2.392	0.374	-1.008	1.908	1.973	-0.996	-0.183	0.974	-1.291	2.553	-1.891	28.140
humanstc	0.409	1.303	-0.574	0.821	-0.810	-1.317	0.520	0.303	-0.738	0.545	-1.499	1.036	9.780
analytcl	-0.147	-1.673	0.410	-0.678	0.844	1.172	0.216	-0.491	0.341	-0.835	1.100	-0.259	7.910
practcl	0.528	1.495	-0.773	0.721	0.037	-0.899	-1.443	1.045	0.042	0.566	-0.111	-1.209	9.410
genrlsts	-0.605	0.883	0.412	-0.142	-0.723	-0.120	-0.334	-0.006	0.293	0.708	-0.191	-0.177	2.640
speclizd	1.488	-2.010	-1.057	0.332	1.949	0.373	0.227	0.243	-0.489	-1.665	0.822	-0.215	15.260
narrow	2.355	-2.670	-1.753	0.716	2.750	0.225	0.407	0.476	-0.904	-2.360	0.889	-0.130	31.460
variety	-0.445	0.230	0.385	-0.195	-0.493	0.048	0.231	-0.248	0.091	0.304	-0.212	0.305	1.040
infothng	1.354	-2.112	-0.933	0.131	2.192	0.704	-0.327	0.337	-0.143	-1.677	1.382	-0.909	18.270

rootprob	-0.284	-0.912	0.440	-0.393	-0.072	0.475	1.035	-0.669	-0.116	-0.358	-0.067	0.923	4.010
auxilary	2.022	-0.587	-1.772	1.258	1.224	-1.043	0.553	0.697	-1.233	-1.109	-0.649	0.639	16.110
central	-0.940	-0.150	0.874	-0.812	-0.044	0.960	-0.838	-0.221	0.926	0.279	1.074	-1.108	7.320
manage	-0.695	-0.366	0.701	-0.634	-0.085	0.740	-0.165	-0.366	0.534	0.077	0.619	-0.360	3.030
cooprtve	0.507	0.865	-0.618	0.630	-0.128	-0.828	-0.265	0.518	-0.344	0.258	-0.582	-0.012	3.350
hardwork	-0.275	0.568	0.140	-0.093	-0.114	0.051	-0.841	0.258	0.409	0.399	0.342	-0.843	2.370
medtrt	-0.872	-0.723	0.879	-1.074	0.711	1.565	-1.638	-0.045	1.373	-0.070	2.111	-2.217	20.110
phystrt	-0.607	1.890	0.188	-0.060	-0.337	-0.113	-2.524	0.921	1.068	1.210	0.819	-2.456	20.630
mentemot	-0.931	1.209	0.720	-0.007	-1.972	-0.744	1.566	-0.722	-0.455	1.046	-1.841	2.132	19.500
soclwb	-0.616	1.290	0.417	0.257	-1.906	-1.037	1.693	-0.591	-0.702	0.966	-2.100	2.331	21.470
perswb	-0.236	2.075	-0.091	0.678	-1.728	-1.504	0.714	0.081	-0.637	1.219	-2.015	1.444	18.630
physwb	-0.419	1.835	0.052	0.175	-0.647	-0.504	-1.547	0.682	0.536	1.124	0.021	-1.307	10.360
advise	0.776	0.550	-0.817	0.708	0.193	-0.795	-0.218	0.570	-0.445	-0.018	-0.473	-0.030	3.540
disease	-0.417	-1.022	0.516	-0.812	0.947	1.347	-1.205	-0.024	0.991	-0.403	1.841	-1.759	13.930
problems	0.198	1.434	-0.381	0.792	-1.259	-1.449	1.070	0.045	-0.899	0.709	-1.966	1.706	15.780
perstyle	0.243	1.255	-0.416	0.668	-0.800	-1.130	0.363	0.263	-0.566	0.582	-1.285	0.823	7.360
tecstyle	0.567	-1.781	-0.279	-0.410	1.968	1.259	-1.233	0.314	0.627	-1.202	2.109	-1.940	20.860
broadvw	-0.164	0.784	0.054	0.284	-0.977	-0.717	0.886	-0.209	-0.478	0.501	-1.230	1.266	6.620
holistic	-0.101	1.315	-0.094	0.506	-1.220	-1.089	0.784	-0.033	-0.581	0.759	-1.557	1.310	10.350
empathy	0.186	1.350	-0.375	0.677	-0.939	-1.193	0.471	0.219	-0.604	0.658	-1.423	0.974	8.800
timewp	0.047	1.943	-0.340	0.796	-1.381	-1.514	0.474	0.272	-0.656	1.031	-1.816	1.144	15.120
rapport	0.103	1.541	-0.326	0.696	-1.129	-1.291	0.530	0.198	-0.626	0.794	-1.584	1.094	10.960
listen	0.187	1.068	-0.325	0.604	-0.867	-1.071	0.692	0.088	-0.644	0.511	-1.393	1.150	7.970
closetop	-0.421	1.812	0.123	0.454	-1.665	-1.204	0.704	-0.062	-0.475	1.151	-1.756	1.338	14.820
handson	-0.561	3.400	-0.089	0.549	-1.346	-1.255	-2.283	1.178	0.610	2.006	-0.494	-1.716	29.750
contact	-0.013	1.017	-0.141	0.402	-0.783	-0.796	0.334	0.096	-0.362	0.556	-1.007	0.697	4.520
longterm	-0.430	0.528	0.348	0.031	-1.053	-0.434	1.074	-0.455	-0.362	0.473	-1.108	1.389	6.760
athome	0.255	0.538	-0.282	0.551	-0.832	-0.976	1.405	-0.223	-0.889	0.212	-1.595	1.837	11.160

[1] Sum of squares

Two difficulties in interpretation of the joint plots (Figures 7.1 – 7.4) for the present solution arise from the three-dimensionality of the spaces and the considerable number of attributes (in particular) represented in them. The approach to dealing with this complexity to this point has been firstly, to attempt to identify sets of attributes that are approximately orthogonal to at least one component in order to reduce the dimensionality of the space from which their implications for relativities among groups can be read and; secondly, to reduce the complexity among attributes by identifying sets in the reduced spaces that are approximately parallel. This amounts to an informal procedure for identifying sets of attributes that are approximately parallel in 3-space and which therefore have similar implications for ordination of the groups. A more formal approach to identification of structure among the attributes is discussed below.

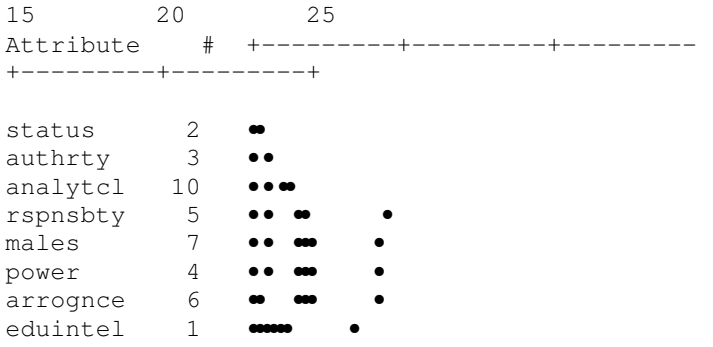
Structure among the attributes

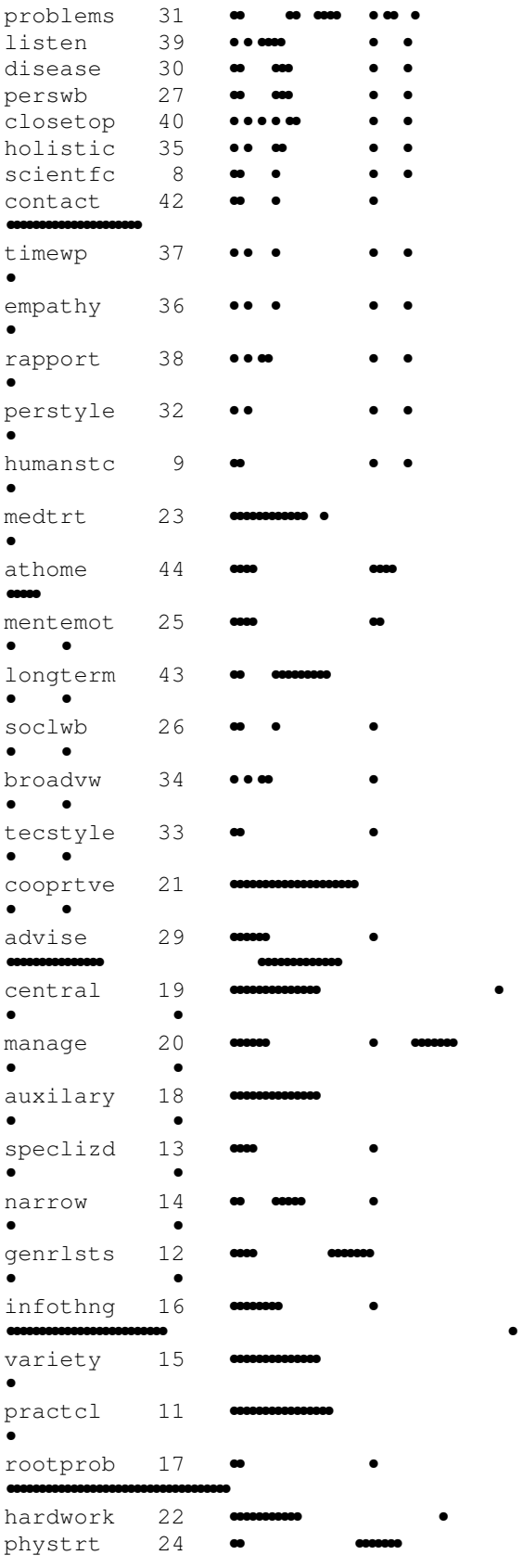
Attributes are not scaled (standardised) to common variance in the analysis so that those with larger variation effect greater separation among the groups. Attributes

that are parallel, however, separate the groups by proportional distances: i.e., they have the same implications (qualitatively) in respect of the similarities and differences among groups except that those with larger variance make those distinctions with more emphasis (scale or quantitatively). Attributes that are at 180 degree to each other have exactly opposite implications in respect of the (dis)similarities among groups. Identification of sets of attributes that are approximately parallel or at 180 degrees to each other (attribute 'bundles') identifies structure among the attributes at a level that is considerably more subtle than in terms of components as wholes and provides a means of reducing the complexity of the joint plots.

Attributes with highly correlated inner products over groups are closely parallel in 3-space. The absolute value of the correlation coefficient between pairs of attributes is a measure of the extent to which they are either parallel or 'oppositely parallel'. Consequently, clustering the attributes according to the absolute values of their bivariate correlation coefficients is a means of identification of the sought after attribute bundles. The directions of the attributes within bundles may subsequently be recovered from the inner products matrix, and the extent to which (scale on which) they make similar distinctions among groups can be recovered as the square root of their sums of squares over groups (Table 9.2).

A dendogram displaying the results of clustering the attributes according to the absolute values of their correlation coefficients (agglomeration method = between groups average) is presented as Figure 9.5. The double vertical line in the Figure 'cuts' the structure at a fairly high level of similarity and separates out ten attribute bundles. Because of the number and overall importance of the attributes in the first bundle, for purposes of further discussion, these attributes are separated into two further bundles making a total of eleven.




problems 31
listen 39
disease 30
perswb 27
closetop 40
holistic 35
scientfc 8
contact 42
timewp 37
empathy 36
rapport 38
perstyle 32
humanstc 9
medtrt 23
athome 44
mentemot 25
longterm 43
soclwb 26
broadvw 34
tecstyle 33
cooprtve 21
advise 29
central 19
manage 20
auxilary 18
speclizd 13
narrow 14
genrlsts 12
infothng 16
variety 15
practcl 11
rootprob 17
hardwork 22
phystrt 24

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physwb      28    ••••••••••
handson     41    ••
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Figure 9.5: Dendogram from cluster analysis on absolute values of correlation coefficients among attribute inner products over groups for nurse component 1

Figures 9.6 – 9.16 display the standardised inner products of the groups on the attributes within each bundle. These Figures were produced according to the following process. The inner products were standardised by division through the square roots of their sums of squares. Within each attribute bundle the attributes were ordered from highest to lowest sum of squares (inner products over groups). Standardised inner products on attributes that are 'oppositely parallel' to the majority within a bundle were reversed by changing sign. The order of groups on the horizontal axis is their order on the attribute with largest sum of squares and the order of attributes in the legend is the descending order of their sums of squares.

The sort of interpretation of the joint plot offered above may now be read directly and with more precision from these Figures.

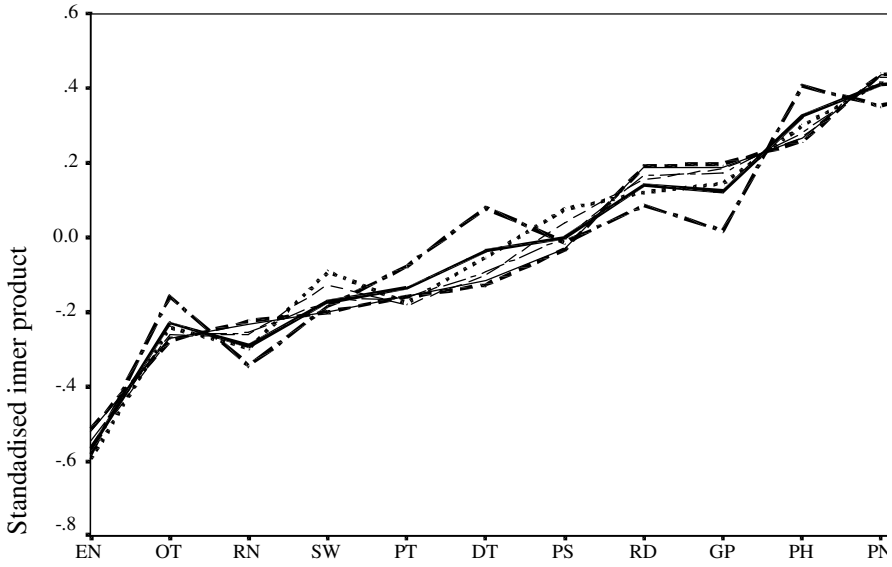

Figure 9.6: Standardised inner products of groups on attributes in bundle 1

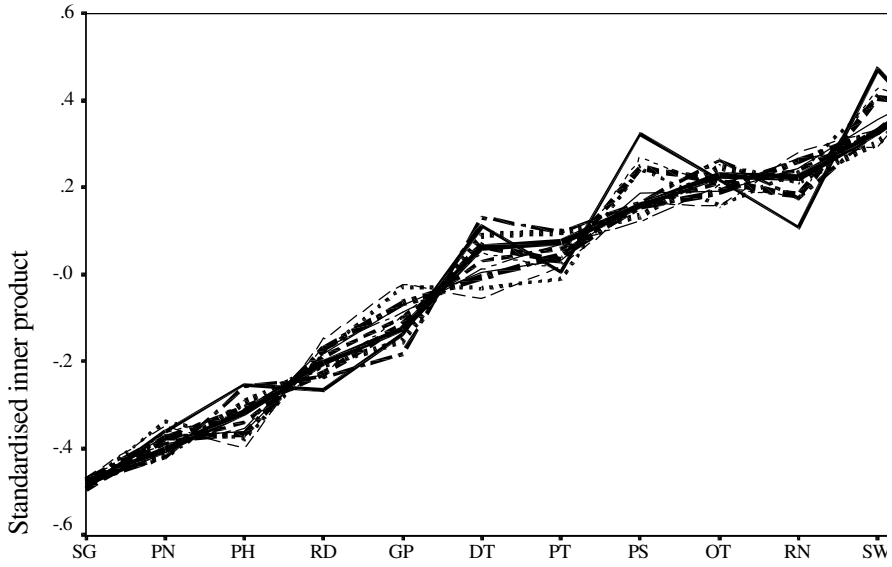

Figure 9.7: Standardised inner products of groups on attributes in bundle 2

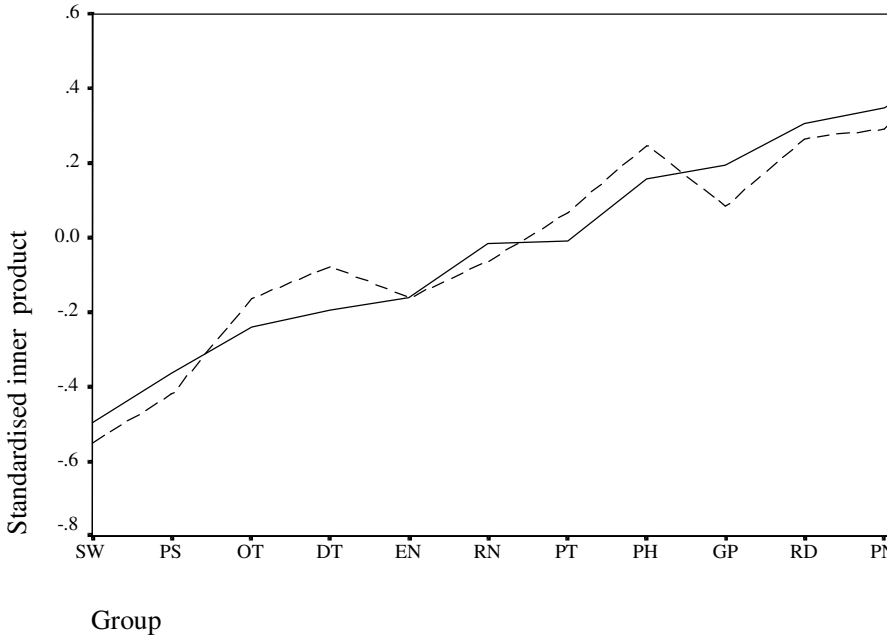

Figure 9.8: Standardised inner products of groups on attributes in bundle 3

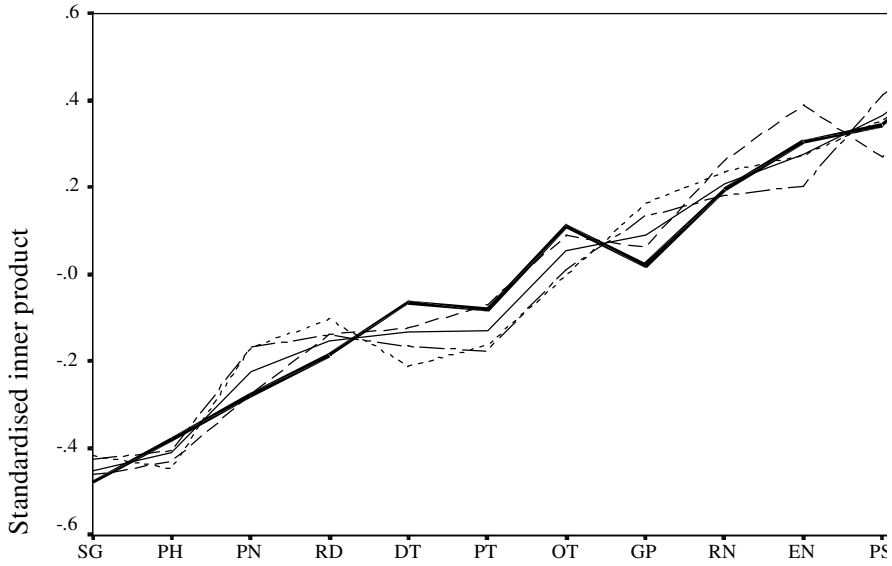

Figure 9.9: Standardised inner products of groups on attributes in bundle 4

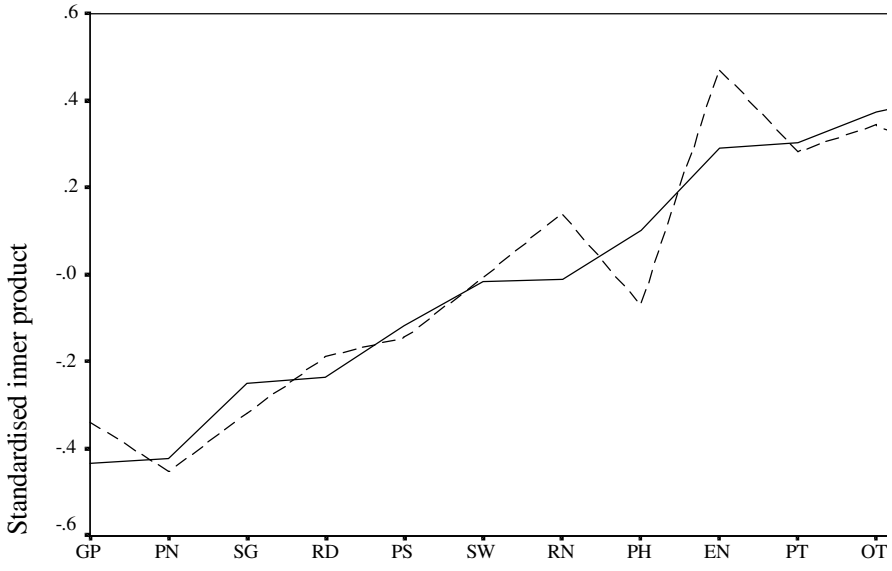

Figure 9.10: Standardised inner products of groups on attributes in bundle 5

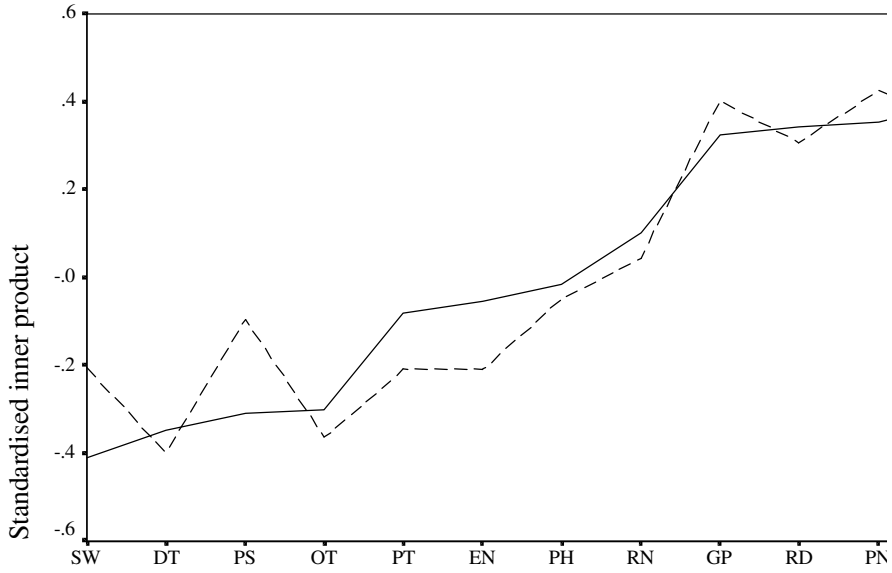

Figure 9.11: Standardised inner products of groups on attributes in bundle 6

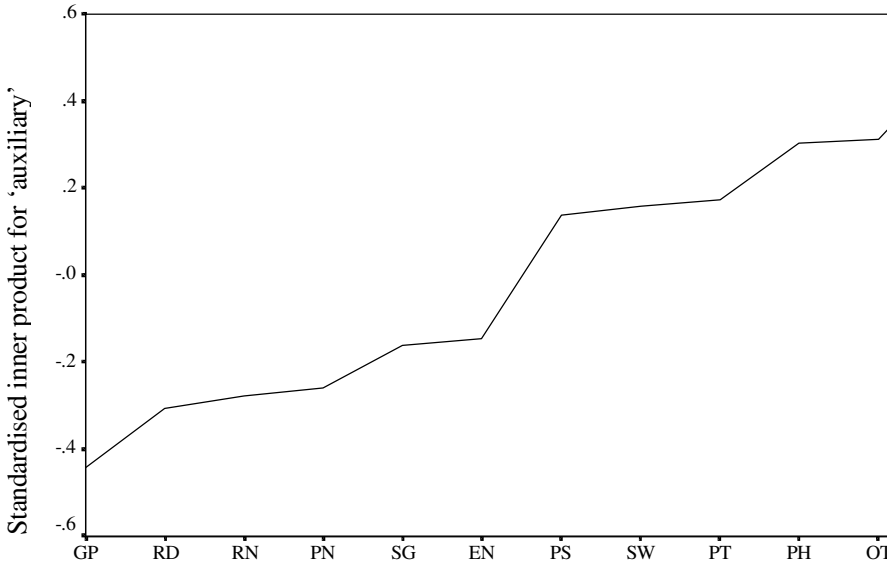

Figure 9.12: Standardised inner products of groups on attributes in bundle 7

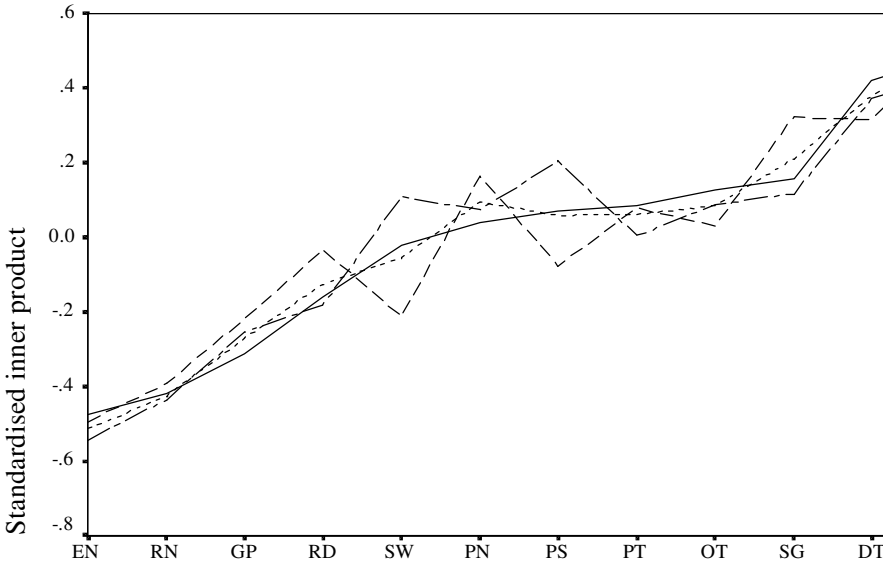

Figure 9.13: Standardised inner products of groups on attributes in bundle 8

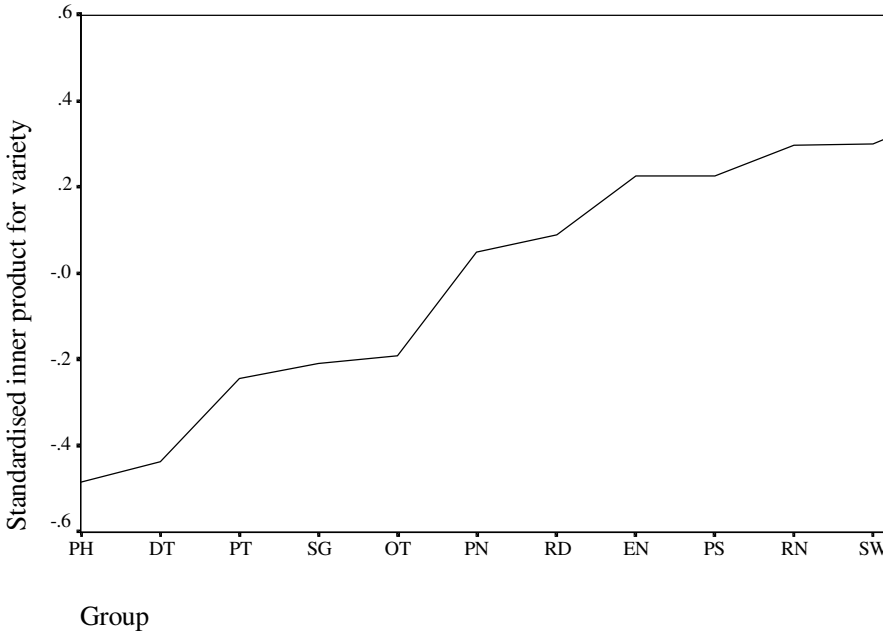

Figure 9.14: Standardised inner products of groups on attributes in bundle 9

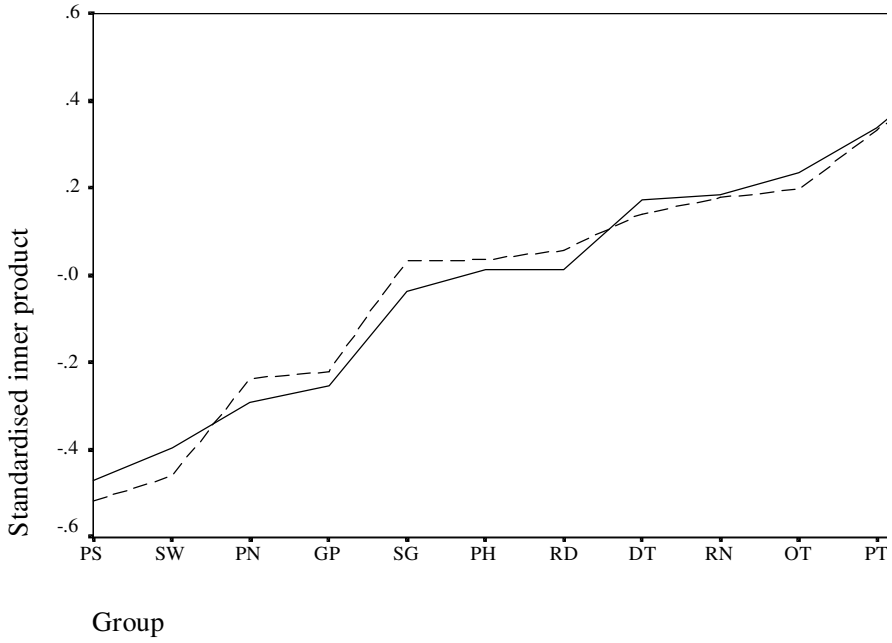

Figure 9.15: Standardised inner products of groups on attributes in bundle 10

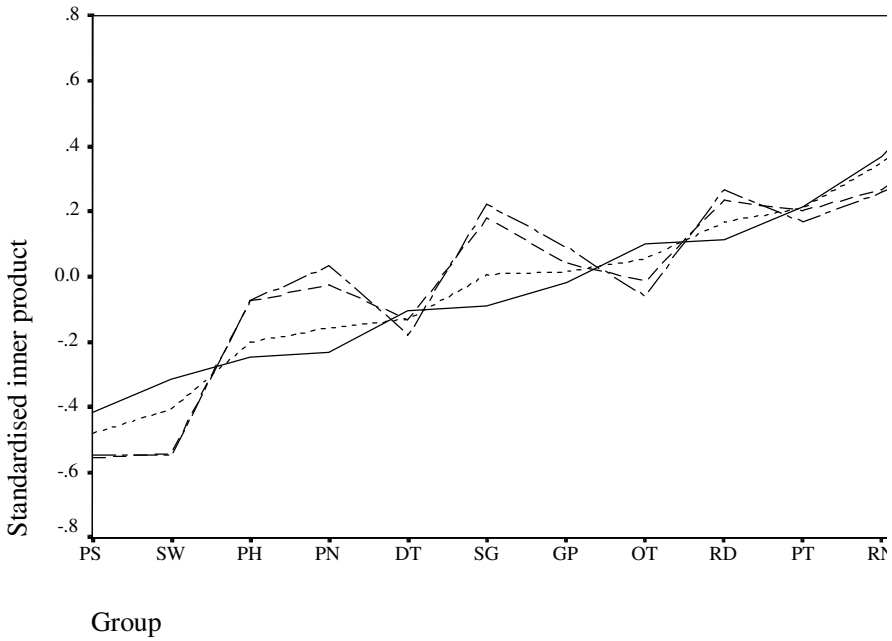

Figure 9.16: Standardised inner products of groups on attributes in bundle 11

The attributes within bundles are highly similar in that they ordinate the groups in highly similar ways, although the scale on which (extent to which) they effect separation among them varies with the square roots of their sums of

squares. The attribute bundles as wholes are related to each other in extent as depicted by Figure 9.5. The nature of their relations is inherent in the joint plot (Figures 9.1-9.3).

Structure among the groups

Whilst reduction of the complexity of attribute by group relations by reducing the relatively large number of attribute vectors to a smaller number of sets of similarly-oriented (bundles of) attributes is perhaps more useful towards simplification of the joint plots, identification of similarity structure among the groups leads the discussion back towards the underlying substantive issue of categorization. The groups were clustered on two different measures of similarity among their inner products on attributes: Euclidean distances on unstandardised inner products and correlation coefficients which standardise over inner products. The latter measure results in clustering the groups according to the orientation of their vectors in joint plot space or in terms of their kind or quality. The former measure results in clustering the groups according to their interpoint distances in joint plot space and represents something of a mixture of kinds and degrees (qualities and quantities). Clustering on this measure might possibly identify a set of groups located near the origin the space which, although different in kind are similar in extent, or more generally, might identify sets of groups that are more different in kind (whose vectors are less closely parallel) than those built on the correlation measure but which may be at more similar distances from the origin of the configuration. Dendograms from these two analyses are presented as Figures 9.17 and 9.18.

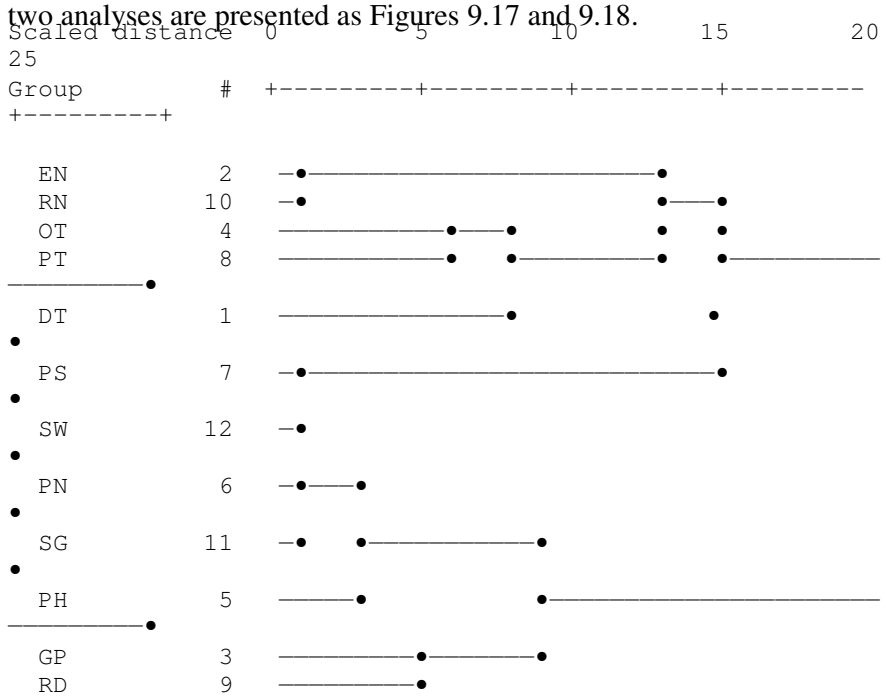

Figure 9.17: Dendogram from clustering of groups on correlation coefficients among inner products

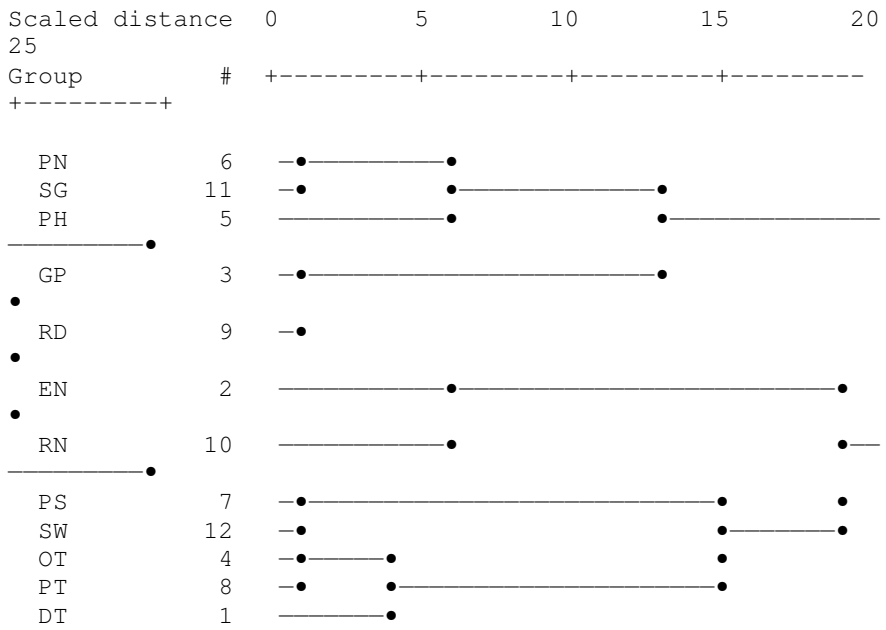

Figure 9.18: Dendogram from clustering of groups on Euclidean distances among unstandardised inner products

Perhaps the most pertinent use of these solutions in the context of categorization research is that they serve to identify potentially psychologically available superordinate groupings or categories at higher levels of generality than the level of the individual occupational groups represented here. If so, such 'intermediate superordinates' may be serve a cognitive-organisational a role as points of reference for judgment of more fine-grained dissimilarities. At a fairly high level of generality there appear to be three large groupings: the set of doctors (PN, SG, GP, RD) into which PH is included, the nurses (RN, EN) and the auxiliary groups (PT, OT, PS, SW and DT). As a pair, the nurses are considered to be more similar overall to the auxiliaries than to the doctors or PH. In kind, as represented in Figure 9.17, they are perceived to be more similar to PT, OT and DT than to PS and SW but overall perhaps PS and SW are perceived to have more in common with the other auxiliary groups than with the nurses, as represented in Figure 9.18.

General comment on interpretation of the solution

Broadly, two approaches have been employed towards interpretation of the solution: interpretation of the components on each of the modes separately with their subsequent integration in terms of the core array (Chapter 8), and interpretation of joint attribute by group relations as represented in joint plots, one for each component of the nurse mode (the present Chapter). It is perhaps unusual to pursue the first approach without employing rotation as a means of simplifying interpretation of individual components. Some reasons have already been adduced for preferring to interpret unrotated components in this particular example. A further reason relates to the arbitrariness of rotations in the absence of specific reasons to prefer one among the potentially infinite number of different descriptions of the solution following alternative rotations. The

concern here is with the tendency to reify the higher-order (abstract) concepts associated with a particular description in the absence of adequate reason to assume that particular combinations of the elements of each mode (rotated components) represent constructs with privileged status. The directions a researcher 'looks through' the component spaces might, alternatively to accepting the results of particular rotation procedures, be better decided in terms of the particular purpose he or she has for examining the solution. Whilst familiarity with the language of attributes might favour researcher identification of particular combinations among them as meaningful coherent constructs, a question for the researcher is the extent to which such combinations are likely to represent psychologically coherent concepts among subjects. In respect of directions through the group space, there is a strong suggestion in the data that subjects are distinguishing broadly among three higher-order groupings, the doctors (and PH), the nurses and the auxiliaries. If so, then rotation in that space might seek to display these distinctions as directly as possible. However, other particular contrasts among groups may better correspond to research purposes or, indeed, to distinctions subjects may effect in different contexts. Similar considerations apply to research purposes in distinguishing among nurses. Overall, rotation to 'simple structure' may be less useful than purpose-driven rotations to target directions and may tend to reify constructs that may or may not correspond to higher-order concepts that are natural or psychologically real among subjects. One orientation to the solution, rather than to attempt to reduce it to a single description, is to treat it as a map to a social-cognitive domain to be read, perhaps through the lens of target rotations, for a variety of particular purposes.

The second approach to interpretation, in terms of group by attribute joint plots, tends to focus attention more on the space as a whole and less on particular directions through it. From this perspective, the joint plot approach does not encourage reification to the same degree as component by component interpretation. One danger in this approach is, however, to treat the separate joint plots for each of the components of the third mode as if they are independent when they may not be. Strictly, each nurse's perspective is represented as a combination of his or her score on the two nurse components and consequently is represented as a combination of the relations in the two joint plots. As it turns out in this solution, for reasons already given (the structure of the core array and relative proportions of variance explained), the two joint plots may for practical purposes be interpreted independently. One potential remedy for non-independence when it does occur is to conduct the analysis with constraints on the elements of the core array (Kiers, 1992) setting some of them, for example, to zero. In the present analysis it might be tempting to set all elements other than N1A1G1, N1A2G2, N1A3G3 and N2A1G2 to zero.

The strategy of identifying bundles or clusters of elements (defined in terms of inner products) in joint plot space appears to be useful, perhaps in particular, in spaces of three or more dimensions. The bundles

(attributes) and clusters (groups) identified in this solution, moreover, stand a better chance of corresponding to psychologically real constructs (or higher-order groupings) than components as wholes if for no other reason than that whole components, the first attribute component in particular, appear to be too complex or to synthetically conflate a number of likely distinct if related concepts. However, the relations among attributes both within and between bundles may vary with judgmental context as may relations among groups both within and between clusters. The context-dependency of those relations is discussed in Chapter 10.

This Chapter concludes with a brief examination of the relationship between nurse demographic characteristics and nurse component scores.

Relationship between nurse demographic characteristics and nurse component scores

A general linear (regression-type) main effects model was fitted with the scores on the two nurse components as dependent variables, and gender, training (hospital, tertiary, hospital with tertiary in progress, hospital and tertiary), specialised (yes, no), age and years of experience as a nurse as joint independent variables. Age and experience are highly correlated in the sample (r = .837) and the estimates for these variables are likely confounded.

Results of the multivariate tests of significance are reported in Table 9.3.

Table 9.3: Tests of significance of multivariate effects of demographic variables on nurse component scores

Effect	Wilks' Lambda	F-ratio[1]	Probability
Gender	.989	0.293	.748
Training	.800	2.008	.071
Specialised	.953	1.256	.293
Age	.837	4.951	.011
Experience	.995	0.140	.870

[1] Degrees of freedom are 2,51 for all tests except 'training' for which they are 6,102

Results of univariate tests of significance are reported in Table 9.4.

Table 9.4: Tests of significance of univariate effects of demographic variables on nurse component scores

Effect	Nurse component	F-ratio[1]	Probability
Gender	1	0.151	.699
	2	0.273	.604
Training	1	3.233	.030
	2	0.809	.495
Specialised	1	2.047	.158
	2	1.231	.272
Age	1	9.855	.003
	2	1.961	.167
Experience	1	0.020	.888
	2	0.284	.596

[1] Degrees of freedom are 1,52 for all tests except 'training' for which they are 3,52

As Table 9.4 shows there were no significant ($p<.05$) univariate effects on nurse component two, although significant univariate effects for training and age were identified on nurse component one. Although the

multivariate effect for training was not significant (Table 9.3), the univariate differences among training types are that nurses who are tertiary trained only (with no hospital training) separate the groups significantly less on the common structure than the other three training types (estimated adjusted means: hospital = .129, tertiary = .093, hospital with tertiary in progress = .125, hospital and tertiary = .137). These results are after adjustment for all other effects, age in particular: i.e., for nurses of the same age (tertiary only trained nurses are in general relatively young), those that are tertiary-trained only consider the groups to be significantly more similar than those whose training has a hospital component. Similarly, the adjusted effect of age is that the groups are perceived to be increasingly similar with increasing age (B_{age} = - .003). Note that the effect of age in this analysis may to some extent be a proxy for experience. In sum, tertiary only trained nurses independently of their age and older nurses independently of their training perceive the groups to be more similar than nurses of other training backgrounds or of younger age. It may be that both tertiary trained and older nurses are treated more equally by and share more of the status, knowledge, skills, responsibilities and attitudes of the other groups.

Other variables may further account for the variation among nurses' judgments of the (dis)similarities among health occupational groups in terms of attributes.

Chapter 10
Conclusions

Among implications from the research into natural categorization and similarity judgments reported in Chapter 2 are that categorization is inherently comparative among categories aligned under a superordinate in context, inherently multivariate among attributes contextually selected, re-defined, associated and weighted to account for differences and relations among categories, and variable among perceivers and with their purposes. The hierarchical model of categorical schemes presented there accords well in its important features with categorization processes as they are presented among the basic propositions of self-categorization theory. That it is by reference to these processes that SCT accounts for a wide variety of social psychological phenomena, which phenomena are ubiquitous and implicated in socially important intra- and intergroup relations including cooperation and competition, is indicative of the importance and potential utility of integrated data collection and analysis processes adequate to simultaneously model the core features of social categorical schemes. Such models are potentially useful not only in application of theoretical principles to potentially beneficial social and personal change initiatives but also to extending experimentation towards further theoretical development from its traditional univariate form into multivariate forms that more closely approximate the forms in which categorization processes naturally occur.

The data collection, analysis and interpretational processes reported here are by no means comprehensive although those chosen as examples are presented in extensive detail. The extent of that detail is intended to provide opportunities

for identification of points of contact among pertinent data, models and theoretical principles, and to illustrate for a mainly social psychological audience how they might employ empirical processes in practice with which they may be more or less unfamiliar or of the direct relevance to their research purposes of which they may not have been previously aware. However, extensive and detailed data collection, analysis and interpretive processes may also be inherent in any attempt to model categorization processes in a multivariate context which is to that extent manifestly time-consuming and expensive. Whilst with experience those processes might be streamlined, the potential of the resulting models to inform both socio-economically beneficial and new research initiatives may justify allocation of the necessary resources. In this particular case, to the extent that intergroup relations among the occupational groups involved are associated with the functionality of the public health system, a substantial part of the relevant social psychological modelling is done, although its usefulness would be greatly extended by collecting and simultaneously modelling the perspectives of all groups on each other and investigation of group functions and intergroup relations within multi-disciplinary teams. A description of the commonalities and differences among groups in their perspectives on the situations in which they functionally interact is likely to provide a sound basis for understanding, anticipating and perhaps modifying the cooperative or conflictual nature of their relations.

Although the 3PCA model treats the three modes symmetrically, for purposes of discussion to this point, the group mode has been considered to be that upon which we are most interested in categorization. This may appear to be natural because the objects on the group mode in the present research consist of 'collectives' of individuals or social categories. However, it is not necessary that one of the modes consist of social categories, nor that categorization effects may not be observed and studied on all three modes. Nevertheless, the primary focus of social categorization research is generally how categorization is involved in how people make judgments about people including themselves. Accordingly, generally, one mode will consist of people being perceived, another of people as perceivers (or perhaps a combination of perceivers and conditions) and another of the terms in which the perceivers describe and distinguish among the perceived (attributes).

In this kind of more general scenario, we might seek to observe categorization effects on all three modes. As the discussions in Chapters 2 and 3 indicate, the objects of judgment (people), the subjects of judgement (perceivers) and the terms in which judgment is made (attributes) are structured or categorized simultaneously. Consequently, we might seek to identify categories on all three modes. In any such exercise, however, it needs be borne in mind that the solution represents the product of categorization processes but does not directly identify cognitively salient categories. It follows that identification of categories on the three modes represented in the solution is always the product of inference on the part of the researcher. This does not mean, however, that there may not be more or less sound bases for such judgments, such as clear and distinct clustering of vectors in component space.

Whilst there is evidence of relatively distinct clustering of groups and attributes in the categorical scheme model presented in Chapters 8 and 9, examination of

the plot of the nurse component space (Figure 8.7) does not reveal a distinctly clustered pattern: i.e. the variation among nurses appears to be more or less continuous in 2-space. The dimensions of the nurse space might be rotated to any directions (orthogonal or otherwise) that are convenient for the purposes of a particular research, although, technically, its needs to be remembered that this involves counter rotation of the core array and re-description of how the nurse components relate to the group and attribute component combinations. In this instance, although there is considerable variation among nurses' perceptions of their occupational environment and their 'place' in it, it may be the case that these are relativities among emphases within a coherent contextually-defined social identity. This is what SCT would lead us to expect under the circumstances: the attention of respondents was drawn to their identity as registered nurses in the invitation to participate, those who responded are likely to have chosen to do so as representatives of that identity as implicitly and explicitly communicated among them, and the context of judgment was such that nurses differ from so many groups in so many ways that the similarities within their own group are far greater than the similarities various potential sub-groupings among them may share differently with the various other groups represented in context. In another context, however, in which fewer or less contrasting groups were presented for judgment, distinct identifications (self-categorizations) among nurses may become salient and emerge as clusters in nurse space.

One potential cleavage in nurses' social identities that may emerge with greater clarity in some other context may be associated with the second (unrotated) nurse component. This component essentially represents a 'disagreement' among nurses about what they have in common with doctors in contrast to the auxiliary groups (Figure 9.4). To the extent that nurses identify with doctors (in contrast to the auxiliaries) they will associate attributes that they consider represent them favourably with the higher-order 'nurses+doctors' category in the interests of maintenance of social-categorical self-esteem. The indications from the present model are that the difference among nurses that N2 describes may depend upon the extent to which they approve of or pursue high levels of scientific or technical education and specialisation, and wish to attract power, status, authority and responsibility, or perhaps, be more 'masculine' as that appears to be defined in the broad health-occupational context. An interesting related point is that the attributional contrast involved, A1, is the strongest in the data and that which, in the shared perspective, N1, is responsible for greatest separation among the groups, as described by G1, on which nurses and doctors are strongly contrasted. It may not be straightforward for nurses to assimilate with doctors in contrast to auxiliaries when that involves assimilating attributes that are important to defining their identities in contrast to them.

Comment on structure among the attributes

There is no immediate basis for deciding which among sets of associated attributes are associated by virtue of their meanings and implications in some more general semantic structure and which are associated because they effect similar likenesses and distinctions among objects of attention (categories) in context. Moreover, because the meanings of constructs are derived as the conceptual commonality among sets of associated

attributes and the meanings of attributes are modified according to the constructs they compose, the meanings of both constructs and their elements are dependent to some unknown degree on the contexts in which they emerge. Nevertheless something of the meaning of concepts transcends the contexts in which they are invoked. To think otherwise is to completely undermine the possibility of communication and perhaps of thought itself. One avenue of recourse is to reformulate the problem in terms of related superordinates or contexts. Two nested superordinates were, for example, suggested above: 'some more general semantic structure' (perhaps as it relates to occupational description) and a superordinate adequate to discrimination among the set of twelve health occupations considered in this research. Whilst in descending from one to the other certain meanings are modified and new meanings constructed as compounds among concepts associated in context contingently upon the entities (categories) they describe and the distinctions they effect among them, it is nevertheless by reference to the kinds of similarities and differences the attributes serve to effect more generally that meanings are constructed in the more specific context.

The meaning of 'male' (or 'female') or 'masculine' (or 'feminine') as it emerges in interpretation of the 3PCA solution is a case in point. 'Males' is closely associated in this context with arrogance, authority, power, status, responsibility, analytical and educated/intelligent (attribute bundle 1), these attributes serving to effect highly similar distinctions among the groups. In this context, reference to 'males' is likely to invoke these associated attributes and thus to imbue 'males' with this particular contextually-defined meaning or set of associations. However, it can only do so to the extent that the meanings of the attributes with which it is associated are somewhat independent of their specific contextual connotations.

The extent of coherence of the attribute bundles in terms of the strengths of intercorrelation among the attributes which compose them is high and certainly higher than that of the attribute components as wholes, and it was suggested previously that they are more likely on this account to correspond to coherent concepts. Apart from the relatively arbitrary way in which their boundaries were identified (the choice of number of clusters), two related questions arise in response to the empirical coherences of sets of attributes: the stability of the bundles over a range of related contexts and the extent of their salience in context as cognitively coherent constructs or attributional categories. Leaving aside differences in perspective or condition as a matter for the third mode, empirically the first of these is a matter of what happens to the attribute bundles as different groups are included or excluded from the judgmental context. Speculation about this is inherently associated with the structure among groups or the higher-order categories into which these new groups may be assimilated, from which they may be removed or which their presence or absence works to reconstitute. As a brief thought experiment, however, we might ask what is the expected effect on attribute bundle 1 of separate inclusion of two particular groups,

radiographers and wardsmen. It may be reasonable to expect that radiographers would be considered to be similar to pharmacists as scientific, technical and auxiliary although perhaps somewhat more directly involved with patients: i.e. they are likely to be located somewhere between PH, DT and PT in the first quadrants of figures 7.10 and 7.11. It is unlikely that a group so (apparently) readily assimilated to the existing structure would, in order that they might be described as manifesting some but not all of the attributes in bundle 1, effect a spreading among them. 'Wardsmen', a group consisting mostly of males with low levels of education, authority, power or status, however, is likely to have a far greater effect on the attributional structure. In particular, their location in group space somewhere in the region of EN, closest to them in respect of these attributes but contrary to them in respect of gender, is likely to separate the 'males' vector away from the bundle 1 attributes, changing to some degree the contextual meaning of 'male' and nature of the bundle 1 construct as a whole.

If this speculation has succeeded in identifying a potential point of fracture in bundle 1 with contextual change, we might further speculate about other possible points of fracture and, by contrast, sub-sets of attributes that are likely to be more stable over contexts. Intuitively, we might expect the set {authority, power, status, and perhaps arrogance and responsibility} to remain intact over a wide range of contexts – in accordance with some general naive social or social psychological theory – although their relation to high levels of education, intelligence and an analytical orientation (which may themselves constitute a relatively stable set) may be more contextually contingent. Whilst bundle 1 as a whole may constitute a coherent construct in the specific context of the twelve groups judged by nurses, its integrity is apparently dependent upon both higher-order (trans-contextual) and context-specific attributional associations.

These kinds of considerations are immediately pertinent to the potential utility of the 3PCA solution reported and of others like it. This is a question of what information such solutions contain and to what and how it might reasonably be applied. It would seem abstemious to take the position that the attribute and group structures and the relations among them that the solution describes refer in a meaningful way to none but the set and to only the full set of the twelve occupations considered (and, in the extreme, only for the 60 nurses who provided the data under the circumstances under which they provided it). Although from an experimental point of view, we might seek to compare solutions obtained under different subject by object by condition combinations, our knowledge of the principles of social categorization and the way the model works, together with the information the solution contains and our general knowledge of the nature of the objects that might be included or excluded from the comparison set, should support generation of some relatively sound hypotheses or expectations. What this amounts to is a sophisticated employment of our world knowledge and theory to categorization and expectation-generation in specific contexts, as the

object of our attention – a social categorical scheme – is the outcome of the employment of the world knowledge and theory of the perceiver group in describing and distinguishing among the entities we present them with for judgment.

Two particularly relevant aspects of our knowledge and theory are that categorization is inherently involved in the process of describing and distinguishing among entities and that categorical schemes are hierarchically organised. In respect of our generating expectations, it is particularly useful to be able to identify relatively stable higher-order categories of attributes (constructs) and groups (superordinates). This is a matter both of identifying coherent clusters of attributes and groups in a particular solution and making some judgments about the range of related contexts over which they are likely to apply relatively unchanged or under which we are able to anticipate the nature of expected variation.

Comment on structure among the groups

There is good evidence in the present data that, under an overall superordinate, which we might label as something like 'health occupations in a hospital environment', there are three main intermediate superordinate categories: doctors, nurses and auxiliaries. There are also categorical distinctions among the doctors (the specialists and the generalists) and among the auxiliaries (the mental/social, physical and technical sub-sets). Whilst there is a subtle overlapping of these categories in identification of particular groups, it may be reasonably safe to assume that this categorical structure is informative about nurses' cognitive organisation of similarities and differences among groups describable as 'health occupations in a hospital environment'. We continue our thought experiment on the basis of this assumption. In passing, however, this is not to say that new categories may not be formed among even the specific twelve groups compared under conditions that make particular higher-order roles or 'characters' salient: e.g. a category constructed to distinguish between the core workers in the hospital from others is likely to include the two nurse groups and the resident doctor.

Introduction of groups into the comparative context who fall outside the overall superordinate ('health occupations in a hospital environment') may add completely new dimensions to the solution and heavily modify the relations among the health occupations as represented within it: consider accountants, airline pilots or soldiers, for example. Even the previously considered group, 'wardsmen', who although familiar workers in the environment, may transform the superordinate and invoke very different sets of categories and attributes.

Groups who fit the overall superordinate, however, are likely also to fit more or less well one or other of the intermediate superordinate categories identified, and consequently to fit more or less well into rather than to greatly modify the given group by attribute structure. We would not expect that structure to remain completely unchanged by the inclusion of such a group, but given a description of them in terms of the attributes within the structure (or indeed, new attributes whose

relationship to those already included we understand), it is possible to anticipate more or less well the nature of the transformations their inclusion would effect. Similar considerations apply to removing a group but removing a whole intermediate superordinate may have more profound effects.

General summary

It may contribute little to the present discussion to continue this speculative process if for no other reason than that researchers who understand both the multivariate expression of SCT, the nature of the data analytic models presented and illustrated here and the relation between them are in a position to make such judgments or design relevant experiments themselves. Researchers with more applied orientations may see the immediate relevance to their fields of application of both categorization processes and their effects on judgment and behaviour, and the modelling process exemplified here.

One aspect of this sort of modelling process of particular relevance to experimental research is how such descriptive models may fit into research in which inferential statistics are considered important. A solution may be considered to be purely a matter of measurement or of convenient redescription of categorization-relevant data, or interest may focus on the sampling probabilities associated with the relations it described by or which are internal to a solution. The latter orientation to three-mode solutions is well represented among the papers collected in Law, Snyder, Hattie and McDonald (1984) and, although not a central issue in the current research, it worthy of further investigation. Conceived of as models for purely measurement purposes, there is a sense in which solutions as wholes might be considered to be structured dependent or independent variables, i.e. when they are conceived of as representing respectively the effects or 'causes' of other variables. Specifically, the vectors of component loadings and the elements of the core array may be used as dependent or independent variables in an inferential research context, or variables may be constructed from solution parameters to represent such structures among subjects, attributes or groups (and relations among them) as are considered coherent and stable over the contexts involved. A typical research may focus on tests of differences among categories partitioning the third mode (e.g. categories defined as perceiver-group by condition combinations) in terms of their scores on variables representing third-mode variation. What resulting significant differences mean descriptively may then be interpreted through the core array to the attribute by group structure.

In sum, it has been argued that categorization is inherently comparative among entities, inherently multivariate among attributes and variable with perceiver perspectives and the conditions of judgment: that entities are structured into categories and attributes into constructs simultaneously in accordance with knowledge (including knowledge of categories and categorical structures) and naive theory in ways that vary systematically with the entities under comparison and the contextual

purposes and perspectives of perceivers. The outcome of this process – a structured set of ideas and relations among them – has been referred to as a categorical scheme. A number of methods of data collection and analysis with the potential to model categorical schemes have been described and illustrated. The modelling exercise itself offers insight into the nature of categorization processes, and multivariate models of categorical schemes are potentially useful in applied contexts and a means of conducting research into categorization as an inherently multivariate process. The links between categorization processes and social psychological phenomena forged within SCT, and their influence on the functioning of individuals and groups in social systems, offer a means of putting this sort of research to application in contexts with psychologically and socially important consequences.

References

Armstrong, S. L., Gleitman, L. & Gleitman, H. (1983). What some concepts might not be. *Cognition*, *13*, 263-308.

Austin, J. L. (1961). *Philosophical Papers*. Oxford: Oxford University Press.

The Australian Nursing Journal. Melbourne: Australian Nursing Federation.

Barsalou, L.W. (1982). Context-independent and context-dependent information in concepts. *Memory and Cognition*, *10* (1), 82-93.

Barsalou, L W. (1983). Ad hoc categories. *Memory and Cognition*, *11*, 82-93.

Barsalou, L. W. (1985). Ideals, central tendency and frequency of instantiation. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *11*, 629-654.

Barsalou, L. W. (1987). The instability of graded structure: implications for the nature of concepts. In U. Neisser (Ed.), *Concepts and Conceptual Development: Ecological and Intellectual Factors in Categorization*, (pp.101-140). Cambridge: Cambridge University Press.

Basford, K.E., Kroonenberg, P.M. & DeLacy, I.H. (1991). Three-way methods for multiattribute genotype by environment data: An illustrated partial survey. *Crops Research Journal*, *27*, 131-157.

Bedside Manners. Lismore, N.S.W.: Centre for Professional Development in Health Sciences, Southern Cross University.

Berlin, B., Breedlove, D. E. & Raven, P. H. (1974). *Principles of Tzeltal Plant Classification*. New York: Academic.

Berlin, B. & Kay, P. (1969). *Basic Color Terms: Their Universality and Evolution*. Berkely: University of California Press.

Borg, I. & Groenen, P. (1997). *Modern Multidimensional Scaling: Theory and Applications*. NY: Springer.

Boring, E. G. (1950). *A History of Experimental Psychology*. New York: Appleton-Century-Crofts.

Brown, H. I. (1979). *Perception, Theory and Commitment*. Chicago: University of Chicago Press.

Brown, R. (1965). *Social Psychology*. New York: Free Press.

Bruner, J. S. (1957). On perceptual readiness. *Psychological Review*, *64*, 123-51.

Bruner, J. S. (1983). *In Search of Mind: Essays in Autobiography*. New York: Harper and Row.

Bruner, J.S. & Goodman, C.C. (1947). Value and need as organizing factors in perception. *Journal of Abnormal and Social Psychology, 42*, 33-44.

Campbell, D.T. (1958). Common fate, similarity and other indices of the status of aggregates of persons as social entities. *Behavioural Science*, *3*, 14-25.

Carroll, J.D. & Chang, J.J. (1970). Analysis of individual differences in multidimensional scaling via an N-way generalization of the "Eckart-Young" decomposition. *Psychometrica*, *35*, 283-319.

Coombs, C.H. (1964). *A Theory of Data*. New York: John Wiley and Sons.

Cox, T.F. & Cox, M.A.A. (1994). *Multidimensional Scaling*. London: Chapman & Hall.

Coxon, A.P.M. & Davies, P.M. (1982). *The User's Guide to Multidimensional Scaling*. London: Heinemann.

Coxon, A.P.M. & Jones, C.L. (1978). *The Images of Occupational Prestige*. London: Macmillan.
Coxon, A.P.M. & Jones, C.L. (1979a). *Class and Hierarchy*. London: Macmillan.
Coxon, A.P.M. & Jones, C.L. (1979b). *Measurement and Meanings: Techniques and Methods of Studying Occupational Cognition*. London: Macmillan.
DeLeeuw, J., Young, F.W. & Takane, Y. (1976). Additive structure in qualitative data: An alternating least squares method with optimal features. *Psychometrica*, *41*, 471-503.
Everitt, B.S. (1980). *Cluster analysis*. (2nd Ed.). London: Heinemann Educational Books Ltd.
Fodor, J. A. (1981). The current status of the innateness controversy. In J. Fodor (Ed.), *Representations*. Vermont: Bradford Books.
Goldstone, R.I., Medin, D.I. & Gentner, D. (1991). Relational similarity and the non-independence of features in similarity judgments. *Cognitive Psychology*, *23*, 222-262.
Goodman, N. (1976). *Languages of Art: An Approach to a Theory of Symbols.* Indianapolis: Hackett.
Gower, J.C. (1975). Generalised procrustes analysis. *Psychometrica*, *40*, 33-51.
Hanson, N. (1961). *Patterns of Discovery: An Inquiry into the Conceptual Foundations of Science.* Cambridge: Cambridge University Press.
Harshman, R.A. & Lundy, M.E. (1984a). The PARAFAC model for three-way factor analysis and multidimensional scaling. In H.G. Law, C.W. Snyder Jr., J.A. Hattie & R.P. McDonald (Eds.), *Research Methods for Multimode Data Analysis* (pp.122-215). NY: Praeger.
Harshman, R.A. & Lundy, M.E. (1984b). Data preprocessing and the extended PARAFAC model. In H.G. Law, C.W. Snyder Jr., J.A. Hattie & R.P. McDonald (Eds.), *Research Methods for Multimode Data Analysis* (pp.216-284). NY: Praeger.
Harshman, R.A. & Lundy, M.E. (1994). PARAFAC: Parallel factor analysis. *Computational Statistics and Data Analysis*, *18*, 39-72.
Harvey, J.H., Ickes, W.J. & Kidd, R.F. (1976). *New Directions in Attribution Research*. (Vol. 1). Hillsdale, NJ: Erlbaum.
Haslam, S.A. (in press). *Psychology in Organizations: The Social Identity Approach*. London: Sage.
Haslam, S.A. & Turner, J.C. (1992). Context-dependent variation in social stereotyping 2: The relationship between frame of reference, self-categorization and accentuation. *European Journal of Social Psychology*, *22*, 251-277.
Heider, E. (Eleanor Rosch) (1971). "Focal" color areas and the development of color names. *Development Psychology, 4*, 447-55.
Heider, E. (Eleanor Rosch) (1972). Universals in color naming and memory. *Journal of Experimental Psychology, 93*, 10-20.
Heider, E. (Eleanor Rosch) & Olivier, D. (1972). The structure of the color space in naming and memory for two languages. *Cognitive Psychology, 3*, 337-54.
Heider, F. (1958). *The Psychology of Interpersonal Relations*. New York: Wiley.

Hogg, M.A. (1987). Social identity and group cohesiveness. In J.C. Turner, M.A. Hogg, P.J. Oakes, S.D. Reicher & M.S. Wetherell, *Rediscovering the Social Group: A Self-Categorization Theory*. Oxford: Blackwell.
Hogg, M.A. (1992). *The Social Psychology of Group Cohesiveness*. Hempel Hempstead: Harvester Wheatsheaf.
Hunn, E. S. (1977). *Tzeltal Folk Zoology: The Classification of Discontinuities in Nature*. New York: Academic Press.
Jackson, J.E. (1991). *A User's Guide to Principal Components*. New York: John Wiley and Sons.
Johnson, M. (1987*). The Body in the Mind. The Bodily Basis of Meaning, Imagination and Reason*. Chicago: University of Chicago Press.
Kiers, H.A.L. (1992). TUCKALS core rotations and constrained TUCKALS modelling. *Statistical Applications*, 655-667.
Kiers, H.A.L. (1997). Three-mode orthomax rotation. *Psychometrica*, 579-598.
Kiers, H.A.L. (in press). Joint orthomax rotation of the core and component matrices resulting from three-mode principal components analysis. *Journal of Classification*.
Kiers, H.A.L. & van Mechelen, I. (in press). Three-way component analysis in practice: Principles and illustrative application. *Psychological Methods.*
Kroonenberg, P.M. (1983). *Three Mode Principal Component Analysis: Theory and Applications*. Leiden: DWSO Press.
Kroonenberg, P.M. (1994). The TUCKALS line. A Suite of programs for three-way data analysis. *Computational Statistics and Data Analysis*, *18*, 73-96.
Kroonenberg, P.M. (1996). 3WAYPACK (version 2) [Computer software]. Leiden: The Three-Mode Company, Department of Education, Leiden University, Wassenaarseweg 52, 2333 AK Leiden, The Netherlands.
Kroonenberg, P.M. & De Leeuw, J. (1980). Principal component analysis of three-mode data by means of alternating least squares algorithms. *Psychometrica*, *45*, 69-97.
Kruskal, J.B. (1964). Non-metric multidimensional scaling. *Psychometrica*, *29*, 1-27; 115-199.
Lakoff, G. (1987). *Woman, Fire and Dangerous Things: What Categories Reveal About the Mind*. Chicago: University of Chicago Press.
Law, H.G., Snyder, C.W. Jr., Hattie, J.A. & McDonald, R.P. (Eds.), (1984) *Research Methods for Multimode Data Analysis* (pp. 122-215). NY: Praeger.
Locke, J. (1690). *An Essay Concerning Human Understanding*. (Edition annotated by A. C. Fraser, 1959). New York: Dover.
Markman, A.B. & Gentner, D. (1990). Analogical mapping during similarity judgments. *Proceedings of the Twelfth Annual Conference of the Cognitive Science Society* (pp.38-44). Hillsdale, NJ: Erlbaum.
Markman, A.B. & Gentner, D. (1991). Communalities, differences and alignment of conceptual frames during similarity judgments. *Proceedings of the Thirteenth Annual Conference of the Cognitive Science Society* (pp.287-292). Hillsdale, NJ: Erlbaum.
Matlab [computer software]. (1994). Natick, MA: Matlab Inc

McCauley, R. N. (1987). The role of theories in a theory of concepts. In U. Neisser (Ed.), *Concepts and Conceptual Development: Ecological and Intellectual Factors in Categorization*, (pp. 101-140). Cambridge: Cambridge University Press.
McGarty, C. (1996). *The Categorization Process in Social Psychology: How Categorization Effects Reflect Expectations About Social Groups*. Unpublished MS, Australian National University.
McGarty, C., Haslam, S.A., Hutchinson, K.J. & Grace, D.M. (1995). Determinants of perceived consistency: the relationship between group entitativity and the meaningfulness of categories. *British Journal of Social Psychology*, *34*, 237-256.
McGarty, C.& Turner, J.C. (1992). The effects of categorization on social judgment. *British Journal of Social Psychology*, *31*, 147-157.
McGee, V.C. (1968). Multidimensional scaling of n sets of similarity measures: A non-metric individual differences approach. *Multivariate Behavioural Research*, *3*, 233-248.
Medin, D.L., Goldstone, R.L. & Gentner, D. (1993). Respects for similarity. *Psychological Review*, *100*, 254-78.
Medin, D. L. & Ortony, A. (1987). Psychological essentialism. In S. Vosniadou & A. Ortony (Eds.), *Similarity and Analogical Reasoning*, (pp.179-195). Cambridge: Cambridge University Press.
Medin, D. L. & Schwanenflugel, P. J. (1981). Linear separability in classification learning. *Journal of Experimental Psychology: Human Learning and Memory*, *7*, 355-368.
Medin, D. L. & Wattenmaker, W. D. (1987). Category cohesiveness, theories and cognitive archeology. In U. Neisser (Ed.), *Concepts and Conceptual Development: Ecological and Intellectual Factors in Categorization*, (pp.101-140). Cambridge: Cambridge University Press.
Medin, D. L., Wattenmaker, W. D. & Hampson, S. E. (1987). Family resemblance, conceptual cohesiveness and category construction. *Cognitive Psychology*, *19*, 242-271.
Mervis, C.B. & Rosch, E. (1981). Categorization of natural objects. In M.R. Rosenzweig & L.W. Porter (Eds.), *Annual Review of Psychology, 32*, 89-115.
Messick, S.J. & Abelson, R.P. (1956). The additive constant problem in multidimensional scaling. *Psychometrica*, *21*, 1-15.
Mill, James (1829) *Analysis of the Phenomena of the Human Mind*. Later edited and annotated by J. S. Mill (1869)
Miller, G. & Johnson-Laird, P. (1976). *Language and Perception*. Cambridge Massachusetts: Harvard University Press.
Murphy, G.L. & Medin, D.L. (1985). The role of theories in conceptual coherence. *Psychological Review*, *92*, 289-316.
Neisser, U. (Ed.). (1987). *Concepts and Conceptual Development: Ecological and Intellectual Factors in Categorization*. Cambridge: Cambridge University Press.
Oakes, P.J. (1987). The salience of social categories. In Turner, J.C., Hogg, M.A., Oakes, P.J., Reicher, S.D. and Wetherell, M.S., *Rediscovering the Social Group: A Self-Categorization Theory*, pp. 117-141. Oxford: Blackwell.

Oakes, P.J., Haslam, S.A. & Turner, J.C. (1994). *Stereotyping and Social Reality*. Oxford: Blackwell.
Oakes, P.J., Haslam, S.A. & Turner, J.C. (1998). The role of prototypicality in group influence and cohesion: Contextual variation in the graded structure of social categories. In S. Worchel, J.F. Morales, D. Paez & J-C. Deschamps (Eds.), *Social Identity: International Perspectives*, pp.75-92. London: Sage
Oakes, P. J. & Turner, J. C. (1986). Distinctiveness and the salience of social category membership: Is there an automatic perceptual bias towards novelty? *European Journal of Social Psychology*, *16*, 325-344.
Osherson, D. & Smith, E. (1981). On the adequacy of prototype theory as a theory of concepts. *Cognition*, *9*(1), 35-58.
Rips, L.J. (1989). Similarity, typicality and categorization. In S. Vosniadou and A. Ortony (Eds.), *Similarity and Analogical Reasoning*, pp. 21-59. Cambridge: Cambridge University Press.
Rips, L.J. & Handle, J. (1984). Classification without similarity. *Unpublished manuscript*. University of Chicago.
Romesburg, H.C. (1984). *Cluster Analysis for Researchers*. Belmont, CA: Lifetime Learning Publications.
Rosch, E. (1973). Natural categories. *Cognitive Psychology*, *4*, 328-50.
Rosch, E. (1974). Linguistic relativity. In A. Silverstein (Ed.), *Human Communication: Theoretical Explorations*, pp. 95-121. Hillsdale, NJ: Erlbaum.
Rosch, E. (1975). Cognitive representations of semantic categories. *Journal of Experimental Psychology: General 104*, 192-233.
Rosch, E. (1978). Principles of categorization. In E. Rosch & B.B. Lloyd (Eds.), *Cognition and Categorization*, pp. 27-48. Hillsdale, NJ: Erlbaum.
Rosch, E. and Mervis, C.B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology, 7*, 573-605.
Rosch, E., Mervis, C.B., Gray, W.D, Johnson, D.M. & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology, 8*, 382-439.
Shepard, R.N. (1962). The analysis of proximities: Multidimensional scaling with an unknown distance. I and II. *Psychometrica*, *27*, 125-140; 219-246.
Spence, I. & Graef, J. (1974). The determination of the underlying dimensionality of an empirically obtained matrix of proximities. *Multivariate Behavioural Research*, *9*, 331-342.
Tajfel, H. (1969). The cognitive aspects of prejudice. *Journal of Social Issues*, *25*, 79-97.
Tajfel, H. (Ed.) (1978). *Differentiation Between Social Groups: Studies in the Social Psychology of Intergroup Relations*. London: Academic Press.
Tajfel, H. (1979). Individuals and groups in social psychology. *British Journal of Social and Clinical Psychology*, *18*, 183-90.
Tajfel, H. (1981). *Human Groups and Social Categories*. Cambridge: Cambridge University Press.
Tajfel, H., Sheikh, A.A. & Gardner, R.C. (1964). Content of stereotypes and the influence of similarity between members of stereotyped groups. *Acta Psychologica*, *22*, 191-201.
Tajfel, H. & Wilkes, A.I. (1963). Classification and quantiative judgment. *British Journal of Psychology*, *54*, 101-111.

Torgerson, W.S. (1952). Multidimensional scaling: I Theory and method. *Psychometrica*, *17*, 401-419.
Tucker, L.R. (1964). The extension of factor analysis to three-dimensional matrices. In H. Gullikson & N. Frederiksen (Eds.), *Contributions to Mathematical Psychology*, (pp.100-119). NY: Holt, Rinehart and Winston.
Turner, J.C. (1981). Some considerations in generalizing experimental social psychology. In G.M. Stephenson and J.M. Davis (Eds.), *Progress in Applied Psychology*, Volume 1. Chichester: Wiley.
Turner, J.C. (1982). Towards a cognitive redefinition of the social group. In H. Tajfel (Ed.), *Social Identity and Intergroup Relations*. Cambridge: Cambridge University Press.
Turner, J.C. (1985). Social categorization and the self-concept: A social cognitive theory of group behaviour. In E.J. Lawler (Ed.), *Advances in Group Processes*. Greenwich, Conn.: JAI Press, vol. 2.
Turner, J.C. (1987a). A self-categorization theory. In J.C. Turner, M.A. Hogg, P.J. Oakes, S.D. Reicher & M.S. Wetherell*, Rediscovering the Social Group: A Self-Categorization Theory*. Oxford: Blackwell.
Turner, J.C. (1987b). The analysis of social influence. In J.C. Turner, M.A. Hogg, P.J. Oakes, S.D. Reicher & M.S. Wetherell*, Rediscovering the Social Group: A Self-Categorization Theory*. Oxford: Blackwell.
Turner, J.C. (1991). *Social Influence*. Milton Keynes: Open University Press.
Turner, J.C. & Giles, H. (Eds.) (1981). *Intergroup Behaviour*. Oxford: Blackwell.
Turner, J.C., Oakes, P.J., Haslam and McGarty, C. (1994). Self and collective: Cognition and social context. *Personality and Social Psychology Bulletin*, *20*, 454-463.
Turner, J.C. & Onorato, R.S. (in press). Social identity, personality and the self-concept: A self-categorization perspective. In T. R. Tyler, R. Kramer & O. John (Eds.), *The Psychology of the Social Self*. Hillsdale, NJ: Lawrence Erlbaum.
Tversky, A. (1977). Features of similarity. *Psychological Review, 84*, 327-352
Tversky, B. & Hemenway, K. (1984). Objects, parts and categories. *Journal of Experimental Psychology: General, 113*, 169-193.
Varela, F. J., Thompson, E. & Rosch, E. (1993) *The Embodied Mind.* Cambridge, Massachusetts: The MIT Press.
Veldscholte, C.M., Kroonenberg, P.M. & Antonides, G. (in press). Three-mode analysis of perceptions of economic activities in Eastern and Western Europe. *Journal of Economic Psychology*
Wattenmaker, W.D., Dewey, G.I., Murphy, T.D. & Medin, D.L. (1986). Linear separability and concept learning: Context, relational properties and concept naturalness. *Cognitive Psychology*, *18*, 158-194.
Wetherell, M.S. (1987). Social identity and group polarization. In J.C. Turner, M.A. Hogg, P.J. Oakes, S.D. Reicher & M.S. Wetherell*, Rediscovering the Social Group: A Self-Categorization Theory*. Oxford: Blackwell.
Wittgenstein, L. (1953). *Philosophical Investigations* (G.E.M. Anscombe, trans.). Oxford: Blackwell
Young, F.W. & Hamer, R.M. (Ed.). (1987). *Multidimensional Scaling: History, Theory and Applications*. Hillsdale, NJ: Erlbaum.

Young, G.W. & Householder, A.S. (1938). Discussion of a set of points in terms of their distances. *Psychometrica*, *1*, 19-22.
Zadeh, L.A. (1965). Fuzzy sets. *Information and Control, 8*, 338-53

Appendix A

Part 1: Sorted and selected comments from accounts of pairwise dissimilarities among groups

This section reports comments selected from subjects' accounts of pairwise commonalities and differences between groups. The rationale for selection of pairs of groups is described in Chapter Six, as is the rationale for examining either the attributional commonalities or differences within selected pairs. The content and organisation of the material presented here constitutes the basis of interpretation of the four dimensional group space configuration from INDSCAL analysis of the twenty pairwise dissimilarity matrices from the interview sample.

Dimension 0ne

Similarities within the pairs {PN, SG}, {EN, RN}, {GP, PH}, {GP, PS}, {PH, PS}, {PH, RD} and {PH, SW}.

{PN, SG}

PN and SG are closely adjacent on dimensions one and two but separated on dimensions three (most) and four. PN-SG commonalities should refer mainly to dimension one and dimension two attributes.

(PN=SG)

analytical / diagnosis / problem-solving

both come across as being fairly academic in their role and what they do with clients

arrogant / aloof / superior / elitist

in a private hospital that is owned by the doctors the feeling is that some nurses are seen as being really quite stupid and don't have a great deal of standing you can have people like PTs and OTs and DTs because they've come from a background that's clinically based, they have to have a score like 90 - to me that makes no sense whatsoever - there's a great disparity there

consider themselves heads of the team, and separate

authority / right to decide

specific about their needs

didactic

(both) would see the other occupations as not on the same level as they are - they're a step higher and what they say is supposed to govern what everybody else does

central to hospital / health care

not part of the team from the nurses' point of view

communicate – patients

doctors and surgeons who need 99.4 to get in may be very bright but often their communication skills are so poor that they can't enlist the proper information from the patient to make a good diagnosis anyway or good treatment of the patient

communicate / respect - other groups

approachable in most cases

education / training / knowledge

distinguished by their education qualities - because they've studied more than other people - except the SGs probably

they've both reached their potential, although they've got different outlooks one's physical and one's surgical - they depend on each other an enormous amount

well trained

PNs are much more highly educated - the top of the rung as far as professionals are concerned - with the SG

studied for a lengthy period - wealthy
they' re much more clinically based and they' re trained so well
gender
SGs and PNs - my immediate thought is that they' re males which I know is not true
intelligence / ability
clever little buggers
intelligent
medical treatment / model
both specialist doctors, and that' s a great similarity however, in the work they do, they couldn' t be more dissimilar
patient contact
often have minimal patient contact
physical / biomedical science
they come form the same discipline, yet they have different mind-sets and look at information from a slightly different perspective
responsibility / importance of decisions
at the top of their field and the top of the health system - they' re vital people die without them
where you end up if you really want to be treated
status / prestige
I don' t know who thinks they' re the best but they' re pretty much the same they both drive the same sort of cars
don' t belong with anyone else similar to each other but in a category of their own - both specialists at the top of the ladder
in so far as the ladder of priority goes, they' re the same the top of the ladder
teamwork / complementary
work closely with each other
time with patients
they' re sort of in and out and off they go

{EN, RN}

EN-RN distances are relatively small on all four dimensions and EN-RN commonalities might refer to attributes pertinent to all four dimensions. However, the nurses are clearly separated from other groups at the high end of dimension one but located among them on the other dimensions. To the extent that attributes describing their commonalities are distinctive, they should refer more to dimension one attributes.

(EN=RN)
caring attitude / empathy
their goals in their professions are pretty well the same - I suppose the professions seem to attract typical caring sort of people, but they' re also capable of being extremely judgmental
gender
perceived as a place for females to get into uni at a low level and a reasonable job
hands-on / physical contact – care
both hands-on bedside nurses
holistic / whole person
holistic view
both nurses and both look at patients with a holistic view
intrinsic orientation
I see them in the same light as RNs and I don' t like to make any distinction we' re all nurses - the distinction is made because of levels of education but its certainly no measure of their commitment to nursing
patient care - direct / general
both can do the same sort of caring for a patient
they do exactly the same as RN' s (except) give out medications
direct patient care

similar (role) in a hospital setting
they do the same job except that the RN is more accountable because of the training
both looking after the patients' well being
direct care givers
patient contact
have the most contact with patients - ENs likewise
personal approach / style / orientation / skills
their similarity lies in their being a familiar, everyday person - GPs, RNs and ENs have a similarity in the 'common-placeness' of their relationships with patients
personal involvement / know patients well / close
nurses have a common purpose - providing for personal needs, physical and emotional needs - they get closest to the patients, more than doctors or the others ('peripherals' OT DT PT PH PS SW)
close contact with patients and do a lot of physical treatment - they get closer to patients than doctors and provide what people probably think are more important services for their everyday lives - people tell nurses more than they tell doctors
practical
nursing is a very practical profession
teamwork / complementary
they play a very important role on our ward - even though they can't give drugs and look after "iv's" and things like that they do know the symptoms if a child is going off - you can rely on their information, their diagnoses, a lot of times with children
a good part of the team - you can rely on them

{GP, PH}

GP and PH are closely associated on dimensions one and two but widely separated on dimensions three and four. Accounts of GP-PH similarities should refer mainly to dimensions one and two attributes.

(GP=PH)

communicate / respect - other groups
I don't think they have a lot to do with each other in the system except they probably have to liase at the community level for long-term problems
communicate well (PH - GP)
education / training / knowledge
similar levels of education
similar amount of training and knowledge
medical treatment / model
the same kinds of awareness in terms of their roles
pharmaceuticals / medicines
GPs do deal with drugs very often - the training is about the same, the understanding is certainly the same
teamwork / complementary
they're both in a specialised role, they're respected members of the community and they work closely together - a symbiotic relationship, quite a good interaction
work closely together - a GP and a PH are both into the medicating side of things
both in a way depend on each other
PHs in the community are a sort of back-up for the GPs - they both work with drugs
rely on one another a lot - more than PH – PN

{GP, PS}

GP and PS are closely associated on dimensions one and three but separated on dimensions two and four. Accounts of GP-PS similarities should refer mainly to dimensions one and four attributes.

(GP=PS)

advising role – patients
both like talking to people but about different subject matter
counselling role / listeners

if the GP is any good they do the same sort of work - many people go to GPs for that and get propped-up with drugs, but when the GP' s any good and can create their own ambience, they' re very similar
education / training / knowledge
similar education
holistic / whole person
both have value for other than the obvious medical problem - both need to and are prepared to take time to find out - both quite able to look more at their patients as a whole
mind / mental - emotional aspects
GPs do look at people' s emotional states and then take them into consideration
personal involvement / know patients well / close
have to get to know you at a fairly intimate level if they' re going to be able to help
well-being oriented (personal / social)
the GP is dealing with the medical side but he' s also dealing with the social side as well, so I think the GP' s role overlaps with PS's role

{PH, PS}

PH and PN are closely associated on dimension one and relatively closely associated on dimension four but widely separated on dimensions two and three. Accounts of PH-PS commonalities should refer mainly to dimensions one and four attributes.

(PH=PS)
advising role – patients
clinically based and academic - there to talk with their patients
specialised / particular role
both specialised
status / prestige
probably similar in education - probably similar in status
occupy the same sort of professional development area - approximately the same sort of position (status as independent professionals, cf PTs also. >RNs)
technical - orientation / role
both academic professions, not that they' re very much alike they' re very different in one way but they' re very academic sort of professions

{PH, RD}

PH and RD are closely associated on dimensions one and two but widely separated on dimensions three and four. Accounts of PH-RD commonalities should mainly refer to dimensions one and two attributes.

(PH=RD)
pharmaceuticals / medicines
both use drugs
RDs feel that their knowledge of drugs is pretty good too
physical / biomedical science
doctors look at the biochemical issues as well - the same sort of background - more similar than PH - RN
specialised / particular role
both have jobs to do - specialties - RDs know all about the medical side, PHs know all about the pharmacological side
status / prestige
similar responsibility and status - RD greater, maybe
teamwork / complementary
PHs get very annoyed with RDs because their demands are too great and they want all sorts of things - but they also know that the RDs of today might be the SGs and PNs of tomorrow, so they' re going to have a fairly good working relationship with them dependent on one another

{PH, SW}

PH and SW are relatively closely associated on dimension one, widely separated on dimensions two and three and somewhat separated on dimension four. Accounts of PH-SW commonalities should mainly refer to dimension one attributes.

(PH=SW)

education / training / knowledge

academic background is the same

there may be a similarity in the length and breadth of their education

similar levels of training

similar levels of education but different kind or orientation

specialised / particular role

their paths wouldn't cross, not unless the patient was taking too many of the wrong kind – SW's knowledge would probably be pretty good of those sorts of drugs likely to cause problems and a PH obviously knows why a SW sees a patient

Differences within the pairs {EN, PN}, {EN, SG}, {PN, RN}, {RN, SG}, {EN, GP}, {EN, SW}, {GP, RN}, {EN, RD}.

{EN, PN}

EN and PN are separated on dimensions one (most) and two but occupy similar positions on dimensions three and four. Most accounts of PN-EN differences should refer to dimensions one and two attributes.

(EN~PN)

hands-on / physical contact – care

PNs are not interested in hands-on healing of any kind

patient care - direct / general

the EN is taken up with the general care of the client and doesn't have much to do with what the PN's got to do with

their job doesn't allow them to be caring with their patients

personal involvement / know patients well / close

PN just comes in and says what he thinks

(PN~EN)

analytical / diagnosis / problem-solving

they've got to keep on their books and the latest methods of dealing with problems - ENs don't make decisions, they follow orders they don't have that responsibility

a PN can be a really academic person

arrogant / aloof / superior / elitist

a PN probably wouldn't go to an EN to consult because they don't really consider them to be very important

power / control

directed by SG, PN via RN

see their role as being directed

(EN>PN)

caring attitude / empathy

EN is a totally caring sort of person

patient care - direct / general

direct patient contact

patient contact

PNs have very little contact in hospitals

time with patients

a PN usually has to spend quite a lot of time with a patient to glean the information that he needs

EN's with the patient all the time, and experiences what the patient experiences

(PN>EN)

analytical / diagnosis / problem-solving

ENs are very task oriented, PNs have a more analytical approach

authority / right to decide

greatest difference, PNs and SGs and nurses (particularly EN) - often ENs have got the greatest insight into a patient and have got the smallest amount of impact or input that they can have into the patients' wellbeing directly through the surgeon or whatever
education / training / knowledge
don't have much to do with each other because of their knowledge backgrounds obviously, differences in the level of education
responsibility / importance of decisions
responsibility, education, status
status / prestige
same as the SGs really - nothing more to add (income, education, social class, life chances, male)
profoundly different in every way - PNs are powerful, earn a lot of money, ENs have an image of being uneducated - almost the lowest form of life
very different in their way of thinking and their position in the hierarchy
sometimes ENs feel that they don't belong and are unappreciated and they have a bit of a problem with that whereas PNs are overconfident
PNs think differently and occupy a very high role in the hierarchy
ENs, particularly from the general public, don't engender anything like the respect that the PNs do

{EN, SG}

EN and SG are separated on dimensions one (most), three (next), two and four. Accounts of SG-EN differences should refer mainly to dimension one and, to some extent, dimension three attributes.

(EN~SG)
personal approach / style / orientation / skills
ENs are there for the patient
personal involvement / know patients well / close
ENs are there all the time with their (patients') problems

(SG~EN)
arrogant / aloof / superior / elitist
they give little respect to ENs
SGs have that elitist mentality as well
avaricious / self-serving
SGs are there for the money
power / control
directed by SG, PN via RN
see their role as being directed
specialised / particular role
ENs are broad-based, SGs are specific on task
status / prestige
SGs are top of the tree

(EN>SG)
personal approach / style / orientation / skills
an EN is in your face - and a SG is operating on a person who is anaesthetised and only concentrating on one tiny area - a good EN, especially a mature EN, can look at a person and tell how they feel, what they need, and know what they can do for them - ENs are 'salt of the earth' people
very different ideals and manner (EN more personal, caring)
personal involvement / know patients well / close
SGs have very little conscious patient contact - when they do its not very intimate - ENs have very intimate contact with patients
time with patients
length of time involved in interaction
the SG isn't there on a day-to-day basis and the EN is

(SG>EN)
arrogant / aloof / superior / elitist

the EN is probably petrified of the SG and feels totally inadequate in their presence and the SGs probably think the ENs are bits of scums - they wouldn' t have much time for ENs - wouldn' t know they existed
authority / right to decide
greatest difference, PNs and SGs and nurses (particularly EN) - often ENs have got the greatest insight into a patient and have got the smallest amount of impact or input that they can have into the patients' wellbeing directly through the surgeon or whatever
one extreme to the other in terms of the hierarchy
education / training / knowledge
length of time involved in training
about as different as you can get ... the level of training is completely different
way off the ends of the scale in terms of education and status and the way they view the patient
intellect and training
specialised knowledge
specific knowledge
specific / narrow focus / aspect
SGs don' t seem to be interested in anything much other than surgical problems
status / prestige
SGs have much more income, much better education, come from upper middle-class families and they' ve had more life chances plus they' re usually male that says a lot - ENs are fairly opposite to that
opposite ends of the spectrum - the spectrum of how people are classified on the social scale
they come from totally different backgrounds and never the twain shall meet

{PN, RN}

PN and RN are separated on dimension one but have similar locations on the other three dimensions. Accounts of PN-RN differences should refer mainly to dimension one attributes.

(PN~RN)
authority / right to decide
we recognise that, when it comes to ordering drugs and tests, we know that they' re going to do that and that' s their role, and our role is to look after the patient and observe them for any adverse signs or symptoms or whatever

(PN>RN)
authority / right to decide
PNs are at the top of the tree and RNs do as the PNs tell them - but nurses often pick up the diseases that the doctors miss
a RN is just like a PN except a RN doesn' t have the legal right to order particular tests, invasive procedures or even get involved in particular procedures - they do, by the nature of their job but they' re not in a position where they are solely responsible
PNs reads charts and make decisions, RNs prepare charts for them to read - training is different and status
a PN is further up the ladder - he prescribes, the nurse gives
their decision power and occupational hierarchy is different
RN has to follow (the PN' s) directions
education / training / knowledge
both interested in patients, helping people, on a different level
PNs have got the more skill even though we' re both caring
their levels of training and financial status are very different and being a PN is much more glamorous
understand a lot
medical treatment / model
both medically oriented - nurses are medically oriented to some extent
power / control
PNs find nurses very useful people but they' re after handmaidens well, they used to be, and "How dare they not be any more?!"

specialised knowledge
knows more in detail
status / prestige
status
(RN>PN)
holistic / whole person
we look at health maybe a bit more holistically
personal approach / style / orientation / skills
RN's got to spend time with clients as people - approach to people is different
time with patients
RN's there all the time
{RN, SG}
RN and SG are separated on dimensions one (most), three (next), two and four. Accounts of SG-RN differences should refer mainly to dimensions one and three attributes.
(RN~SG)
holistic / whole person
RNs have a holistic view, SGs have a very focused view
patient care - direct / general
the nurse is looking after the patient's immediate wellbeing and the SGs hacking the diseased bit out
personal involvement / know patients well / close
RN is there with the patient all the time and knows about them
(SG~RN)
invasive / aggressive treatment
I think most RNs have a bit of distaste for chopping people - I find SGs a bit strange
specific / narrow focus / aspect
once the diseased bit's gone they really don't care much any more
(RN>SG)
communicate – patients
so many times you hear clients complain that the doctor hasn't explained what they've done adequately
holistic / whole person
SG's focused on general adjustment to a wound, RN holistically treats the patient
nurses are more caring of the patient as a whole
patient care - direct / general
the SG creates a wound or an incision and the nurses have to look after that and make sure it heals
have very little to do with the patient - the care of the person tends to come back to the registered staff
patient contact
SGs don't have much contact with patients whereas nurses do
personal approach / style / orientation / skills
the difference is that the SG's bedside manner is completely different - a RN is much more interested in the human attitude, in your feelings: if you're sad or if you're hurting - a RN is much more likely to feel a patients' hurt than a SG is they have more face-to-face time with patients than SGs do
personal involvement / know patients well / close
like SGs and ENs (SGs have very little conscious patient contact - when they do its not very intimate - ENs have very intimate contact with patients)
the RNs seem to have a lot more of the caring, ongoing relationship with the client whereas the SGs just do their job and they're in and out so to speak
(SG>RN)
arrogant / aloof / superior / elitist
I like them least of all because they're always right and they're God
socially, they feel that they're way above us

they just think of the nurses as their kind of secretaries - that they should be there when they want them and that's it
authority / right to decide
after the SG's done his bit they always end up with the nurses to follow through - they're similar in that sense but the SG is higher up in the area of healing that person in that the SG does the operation and gives his orders to the nurse
have to prove a point to be accepted
medical treatment / model
medical model thinking
power / control
SGs realise that the nurses work very hard with their patients but the male-female thing comes into it - they really would like nurses to be more subservient than they are now - it was very comfortable for them a few years ago when nurses were more subservient - they pay more attention to the ones who are being educated but they don't like nurses to be too knowledgeable
there's a male-female thing with the RNs and doctors - it used to be that all doctors were male and all nurses were female - the doctors were more powerful and he's a male and but that will always be - but nurses aren't subservient to doctors any more not to the degree that they were
status / prestige
SGs see themselves as important people with independent sort of skills and practices that an RN doesn't a SG works on his own and a RN works as a team in a group of people so you've got a work-base of clinical nurses and then somewhere way above you've got a SG
SGs are on a pedestal above the nurses and they look down on us
different - different disciplines, different hierarchies, hierarchical positions - they think differently - they look at the patient from a different perspective
status

{EN, GP}

EN and GP are widely separated on dimension one but relatively closely associated on the other three dimensions. Accounts of EN-GP differences should refer mainly to dimension one attributes.

(GP~EN)
analytical / diagnosis / problem-solving
a GP's got to call on a whole battery of tests and so on in order to make a diagnosis whereas an EN doesn't have to concern themselves with diagnosis, just the physical aspects of their work
arrogant / aloof / superior / elitist
a lot of GPs tend to be elitist
avaricious / self-serving
GPs are there for the money - maybe I have a bad view

(EN>GP)
caring attitude / empathy
very caring, special kinds of people
hands-on / physical contact – care
direct physical care
personal approach / style / orientation / skills
focus on the patient (as a person)
ENs have an approach towards patients which is fun-loving
time with patients
EN is there all the time with the patients

(GP>EN)
advising role - patients
an EN doesn't get so involved with advising more to follow the advice of a GP or RN
authority / right to decide
on different levels
the decision-making process

ability to order things and knowledge (even more than GP - RN)
education / training / knowledge
GPs are usually well-educated people, ENs are usually not
different in the amount of training and ability
responsibility / importance of decisions
responsibility, education and status
status / prestige
career patterns dissimilar

{EN, SW}

EN and SW are widely separated on dimension one, separated on dimension two but separated by smaller distances on dimensions three and four. Accounts of EN-SW differences should refer mainly to dimension one, and to a lesser extent, dimension two attributes.

(EN~SW)
hands-on / physical contact – care
ENs are directly giving physical care - SWs probably have more interaction with people but are not involved in physical care
they' re both sort of caring except that nurses a SW would never be into the basic requirements and things – bedside…
(SW~EN)
auxiliary / peripheral
they' re called in to help with problems
(EN>SW)
breadth of view / scope of practice
both are concerned with the person but ENs are also interested in disease processes
generalists / versatile / role overlap
in the everyday things you' re being a SW if you' re a nurse but you' re not being a nurse if you' re a SW
SWs have a little tiny bit of the nurses' role
patient care - direct / general
the nurses are the immediate care for the patient all the time - SWs are called in but the EN is the immediate carer
separate from each other because an EN is a very hands-on patient carer who is in a person' s face the whole time from feeding them bathing them and taking their pains away whereas a SW is a little bit more absent while they' re involved in what' s happening around a person - social engineering - an EN is not so much concerned with social engineering as a person' s physical needs
the SW is problem-focused where the EN is probably more encompassed by the person' s daily needs and activities
ENs have more of a general care responsibility
time with patients
SW' s not there all the time
valuable role
I don' t see the need for them (SWs)
(SW>EN)
authority / right to decide
ENs certainly don' t have the power that the SWs do
breadth of view / scope of practice
the EN is just focused on the client and the basic needs of that client - the SW is interested in the client plus the carers, so they' ve got a broader area
education / training / knowledge
again, there' s an educational/training difference between them
their levels of education are very different
different because of their education standards
rehabilitation / adjustment

they' re (SWs) not just in the hospital but they' re outside - they get involved with the client' s employment and their ongoing everyday living - the EN is only interested while they' re in hospital
specialised knowledge
EN has less knowledge of what to do
status / prestige
I think there' s a bit of a social stigma there - I don' t think many SWs would ask ENs for their opinion - even though they' re meant to be accepting of everyone as they are, I think they bypass the poor old ENs and ask the RNs

{GP, RN}

GP and RN are widely separated on dimension one, are closely adjacent on dimension two and separated by smaller distances on dimensions three and four. Accounts of GP-RN differences should refer mainly to dimension one attributes but, to a lesser extent, dimensions three and four attributes.

(GP~RN)
arrogant / aloof / superior / elitist
they often sort of discount my role as a RN in terms of its importance or relevance
private practise
my impression of RNs is working in hospitals - GPs are largely independent of hospitals

(GP>RN)
analytical / diagnosis / problem-solving
more interested than nurses in working out what a patient' s problems are
authority / right to decide
different in their knowledge of the patient, GP prescribes medication, RN can' t do that
if you get a good GP he will work in with RNs in lots of ways (but) they come in and order it and we still have to carry it out
I guess its one' s ordering the treatment and one' s doing it whichever way you do it
a general nurse is sort of following through with the doctor' s orders
a GP has more power to advise a person
there' s a big difference in their decision-making power
the GP is able to order things
breadth of view / scope of practice
RN looks after the patient when they' re unwell (GP' s when they' re well also)
central to hospital / health care
GPs are into primary care and RNs are trying to get into that position
education / training / knowledge
qualifications are different
medical treatment / model
healers
responsibility / importance of decisions
GPs will always have more responsibility, e.g. for drugs
status / prestige
GP sees himself above the RN and some registered staff will automatically put themselves below
standing - social and medical - from GP' s point of view

(RN>GP)
hands-on / physical contact – care
physicality of care is different
patient care - direct / general
GP doesn' t play all the caring that we do - we' re both caring for the children but the GP - just comes in and orders the treatment and we do all the caring
carers
personal approach / style / orientation / skills

they care about the patient obviously but nurses care about the patient in a different way - on a more personal level
a lot of GPs approach people as people but often they're focusing on the disease process rather than the person and they leave that to the nurses
personal involvement / know patients well / close
they get to know their patients over the years but there's just too many patients - I don't think that they have the personal rapport that a nurse does
specialised / particular role
generally considered a bit of a joke if they want to get involved in our area - they don't usually have the knowledge - quite often misdiagnosing or have been wrong
{EN, RD}
EN and RD are widely separated on dimension one, separated on dimension two but closely adjacent on dimensions three and four. Accounts of EN-RD differences should refer mainly to dimension one and, to a lesser extent, dimension two attributes.
(RD~EN)
authority / right to decide
the doctor is the one making the decisions and the nurse is the one carrying them out
(EN>RD)
experienced
sometimes the EN would be better off making the decision, after 20 years experience, than a brand new RD but they don't want that responsibility
personal approach / style / orientation / skills
you've got one group (ENs) who are there spending time with the client and being caring and the RD is just there to fix the job
time with patients
RDs don't spend much time with the client
(RD>EN)
analytical / diagnosis / problem-solving
the difference is, like the GP, the resident has to call on a lot of diagnostic information and batteries of tests - I suppose his worries are greater than an EN who actually comes in behind the resident and carries out the physical aspects of his diagnostic thinking
authority / right to decide
professionalisation, level of education, decision-making power
autonomous / independent / professional
ENs have got to be amazing people to stay as enrolled nurses and to keep giving to patients, whereas RDs know that they've got a great future ahead of them and for ENs the future is bleak
education / training / knowledge
RD is higher on the rung - more qualifications
the doctor has studied and learned whereas the EN hasn't studied and got the knowledge but in the system as a whole RDs are well on the way - education
knowledge bases are different
intelligence / ability
very different intellect and ambition
responsibility / importance of decisions
in terms of their integral responsibility everybody's the same but in terms of their responsibility as seen in terms of the hierarchy of the hospital they're different
status / prestige
because the RDs work in the wards, they see that ENs perform a really good role and they could have quite a good working relationship but I don't think ... (status: ENs cf doctors - distinction not so great for RDs).
have different goals - ENs tend to be resigned to what they're there doing and RDs seem to be on their way to achieving a different goal

Dimension two

Similarities within the pairs {GP, PH}, {OT, PS}, {OT, SW}, {PH, PN}, {PH, RD}, {PH, RN} and {RN, SG}.

{GP, PH}

GP and PH are closely adjacent on dimensions one and two but widely separated on dimensions three and four. Accounts of GP-PH commonalities should mainly refer to dimensions one and two attributes.

(GP=PH)

communicate / respect - other groups

I don' t think they have a lot to do with each other in the system except they probably have to liase at the community level for long-term problems

communicate well (PH - GP)

education / training / knowledge

similar levels of education

similar amount of training and knowledge

medical treatment / model

the same kinds of awareness in terms of their roles

pharmaceuticals / medicines

GPs do deal with drugs very often - the training is about the same, the understanding is certainly the same

teamwork / complementary

they' re both in a specialised role, they' re respected members of the community and they work closely together - a symbiotic relationship, quite a good interaction

work closely together - a GP and a PH are both into the medicating side of things

both in a way depend on each other

PHs in the community are a sort of back-up for the GPs - they both work with drugs

rely on one another a lot - more than PH - PN

{OT, PS}

OT and PS are closely adjacent on dimension two, relatively adjacent on dimension one but widely separated on dimensions three and four. Accounts of OT-PS commonalities should refer largely to dimensions two and one attributes.

(OT=PS)

communicate / respect - other groups

allieds who are generally more approachable than a doctor would be - when you' re working together with the allieds it seems to be on a more equal level than with doctors, who people put up or who put themselves up

education / training / knowledge

(similar) levels of training and similar backgrounds even though their jobs are different

same kind of academic background and motivation (PT also)

patient contact

similar levels of patient contact

personal approach / style / orientation / skills

both people based

time with patients

similar time spent with patients (perhaps PS more)

well-being oriented (personal / social)

OTs are a bit like SWs - they' ve got a much broader, not knowledge-base, but acceptance of all types of people, and they would see PSs as a bit the same – I think they would think they were similar types of people

{OT, SW}

OT and SW are closely adjacent on dimensions one and two but widely separated on dimensions three and four. Accounts of OT-SW commonalities should refer mainly to dimensions one and two attributes.

(OT=SW)

auxiliary / peripheral
out on that funny sort of periphery - sort of extra-medical - no one's quite sure where to slot them in
a bit like SWs - I'm not 100% sure what an OT does - in the children's hospital we used to call them 'play ladies'
I see them on the periphery - I think of them as paramedicals and I don't really give them much thought otherwise
helping attitude
I think OTs are a bit like SWs - there's a bit of background 'helping people' to it all that doesn't involve bedpans and blood and pain and washing people
holistic / whole person
both look to see how they can put the person back into their environment - SWs try to look at the whole social scene - and the OT just doesn't look at the deficit that the person's got
listen / talk - willing / do
both like talking to people
rehabilitation / adjustment
OT is really trying to get people to come terms with what's happened to them and get them to go through a recovery stage - SWs try and get people socially adapted to circumstances around them
they're looking at discharge and similar patient-type issues - they receive referrals from the same people as well, so they operate off the same links - and their academic discipline comes out of the same sort of stock
status / prestige
similar status and level of qualifications
similar kinds of people: academic level/hierarchy and time spent with patients
teamwork / complementary
doing similar kinds of work and they're both concerned about similar kinds of things dealing with the patients - and I find that their work is very much woven into each other
well-being oriented (personal / social)
OTs are a bit like SWs - they've got a much broader, not knowledge base, but acceptance of all types of people, and they would see PSs as a bit the same -I think they would think they were similar types of people
they both go out in the community and see the person's house and advise them on what they need to make their daily living easier
same as SWs (caring/welfare) - interested in the patient's whole wellbeing not just the family but the family environment
both looking after the patient in their total situation - involving their significant others and trying to overcome the problem of the moment

{PH, PN}

PH and PN are closely adjacent on dimension two but separated on the other two dimensions. Accounts of PH-PN commonalities should mainly refer to dimension two attributes.

(PH=PN)
communicate / respect - other groups
communicate well together
education / training / knowledge
same academic and cultural backgrounds
patient contact
similar patient contact
pharmaceuticals / medicines
try and treat any illness medically rather than surgically
PNs use drugs and diets - diet is a drug in a way - so I guess they're similar in the way they go about things
both use medication as their main thing - similar in their knowledge of drugs
I suppose PNs and pills go together - both have a kind of conservative approach
probably have the same knowledge about pharmaceuticals

great knowledge of pharmaceuticals
physical / biomedical science
on the same level as far as the pharmacology side of things go
they look at the body from a biochemical sort of perspective - very scientifically oriented
specialised / particular role
PNs look at the medical aspect of the patient, PHs are interested in medications
teamwork / complementary
a lot of PNs consult the PH on a regular basis on what would be best used and the side effects of different drugs, so they would depend on each other

{PH, RD}

PH and RD are adjacent on dimensions one and two but widely separated on dimensions three and four. Accounts of PH-RD commonalities should mainly refer to dimensions one and two attributes.

(PH=RD)
pharmaceuticals / medicines
both use drugs
RDs feel that their knowledge of drugs is pretty good too
physical / biomedical science
doctors look at the biochemical issues as well - the same sort of background - more similar than PH - RN
specialised / particular role
both have jobs to do - specialties - RDs know all about the medical side, PHs know all about the pharmacological side
status / prestige
similar responsibility and status - RD greater, maybe
teamwork / complementary
PHs get very annoyed with RDs because their demands are too great and they want all sorts of things - but they also know that the RDs of today might be the SGs and PNs of tomorrow, so they' re going to have a fairly good working relationship with them dependent on one another

{PH, RN}

PH and RN are adjacent on dimension two and widely separated on the other two dimensions. Accounts of PH-RN commonalities should mainly refer to dimension two attributes.

(PH=RN)
responsibility / importance of decisions
take the same amount of responsibility for what they do
teamwork / complementary
work quite strongly with nurses

{RN, SG}

No RN-SG commonalities were recorded.

Differences within the pairs {RD, SW}, {PS, RD}, {OT, SG}, {PT, SG}, {PN, SW}, {GP, SW}, {GP, PS} and {RN, SW}.

{RD, SW}

RD and SW are widely separated on dimension two but are closely adjacent on the other three dimensions. Accounts of RD-SW differences should refer mainly to dimension two attributes.

(RD~SW)
body / physical aspects
again, RDs are dealing with their body
RD just tells them what' s wrong - the physical thing
medical treatment / model
RDs are very much into medical management

(SW~RD)
counselling role / listeners
SW is there to listen - to be there for the patient' s problems
on-going / extended contact
SW stays around, finds out a bit more and will probably follow them up at home
rehabilitation / adjustment
SWs focus on the structural problems of the discharge process
well-being oriented (personal / social)
the RD' s working in the hospital and the SW' s sort of outside the RD would never be interested in what the person' s outside life is about
(RD>SW)
education / training / knowledge
RDs qualifications are higher
hard-working / task oriented / busy / do-ers
RD treats and is out of there
SW's got time and is willing to sit and work through things with a patient
intelligence / ability
RDs are generally much more intelligent and have a different perspective on life
SWs are more different from RDs than PSs - maybe because I have a low opinion of SWs intellect
medical treatment / model
I associate RDs with acute hospital situations
(SW>RD)
breadth of view / scope of practice
SWs have to interact with a lot of people, RDs deal just with the patient
I think RDs on the whole are a bit too focused: the dissimilarity is the focus and the breadth
rehabilitation / adjustment
sometimes the RD is concerned with the patient' s wellbeing and what' s going to happen with them when they go home
time with patients
RD just comes and does what he has to do and goes again
well-being oriented (personal / social)
RDs don' t know much about what' s out there in the community
(I associate SWs) with having a bigger kind of community role

{PS, RD}

PS and RD are widely separated on dimension two and to a lesser extent on dimension four, but are closely adjacent on dimensions one and three. Accounts of RD-PS differences should refer mainly to dimension two and four (less so) attributes.

(PS~RD)
listen / talk - willing / do
PS has time and is willing to sit and work through a problem with someone
(RD~PS)
hard-working / task oriented / busy / do-ers
RDs are too busy doing the immediate hands-on medical bit
(PS>RD)
analytical / diagnosis / problem-solving
a RD wouldn' t be involved in a person' s psychological problems - would just refer on - would never try to take the role of a PS, more into the basic problem at hand rather than the underlying cause
autonomous / independent / professional
PSs are generally through their training, RDs are still being told what to do, still finding out their way
breadth of view / scope of practice
RDs are only interested in the hospital environment ... PSs are out in the outside world and they' re looking at things differently

experienced
RDs (as young people) are unable to do that (work through PS problems)
mind / mental - emotional aspects
PSs are more interested in the mind, RDs are more interested in the whole person
I think that RDs probably feel, with their new found knowledge, that they know as much about mental health as anybody else - at that stage - but as they progressed they would feel it was better to leave that to someone else
status / prestige
PSs are probably a little bit above the RDs in the hierarchy
time with patients
RDs don't have the time to be PSs
PS and SW will spend time - a RD just comes and goes
well-being oriented (personal / social)
PSs deal more with their problems

(RD>PS)
hard-working / task oriented / busy / do-ers
I think RDs would like to be a lot more like PSs but haven't got the time similar in terms of their ideals
rd just doesn't have the time (for counselling)
intelligence / ability
RDs are higher in intelligence scale to get into the university system, not as high for PSs
medical treatment / model
they look at different focuses - doctors have a different mind-set altogether

{OT, SG}

OT and SG are separated on dimensions two (most) and one, and are closely adjacent on dimensions three and four. Accounts of OT-SG differences then, should refer mainly to dimensions two and one attributes.

(OT~SG)
holistic / whole person
one's holistic and one's not
rehabilitation / adjustment
OT is more of a rehab type of role

(SG~OT)
medical treatment / model
SGs are more interested in the patients' disease, whereas OTs 'play ladies' it's nothing to do with their disease

(OT>SG)
counselling role / listeners
SGs have a purely clinical approach whereas OTs will sit and talk and work things out - not as different as SG - SW
on-going / extended contact
the OT will have an on-going thing, perhaps for years, where with the SG you will have your hernia fixed and off you go and never see them again in your life
patient contact
OTs have contact with the patients, SGs have very brief contact with the patients - SGs tend to have poor communication skills, OTs tend not to
rehabilitation / adjustment
an OT has nothing to do with what an SG is - a SG operates on people and the OT tries to rehabilitate the person with games, handcrafts, exercises and things
well-being oriented (personal / social)
the OT is very focused on the life of the person where the SG has a very narrow perspective

(SG>OT)
arrogant / aloof / superior / elitist

SGs are more aloof
some very arrogant SGs
most SGs probably don't know the others (OTs) exist
education / training / knowledge
SGs come from the top 1% of academics - OTs are not quite as high
specialised knowledge
SGs are more specialised in their caring of the patient, a lot more
status / prestige
status, education
professional position in the hierarchy - and decision-making power

{PT, SG}

PT and SG are separated on dimensions two (most) and one, and are closely adjacent on dimensions three and four. Accounts of PT-SG differences then, should refer mainly to dimensions two and one attributes.

(PT>SG)
patient care - direct / general
PTs deal more directly with patients than SGs
patient contact
SGs don't have a lot to contact with people
personal involvement / know patients well / close
PTs have more interpersonal contact while they're having close one-to-one treatments with people - they develop personal relations generally
time with patients
PTs spend more time with people and seem to be better communicators

(SG>PT)
autonomous / independent / professional
the SG is far more autonomous - totally autonomous really
education / training / knowledge
both have a fair amount of training but SGs have more - vast experience
medical treatment / model
PTs are primarily looking at muscles and bones, whereas SGs make decisions on a totally different plane
power / control
the PT is doing what the SG tells them to do

{PN, SW}

PN and SW are separated on all four dimensions but most on dimensions two and one. Accounts of PN-SW differences should mainly refer to dimensions two and one attributes.

(PN~SW)
medical treatment / model
PN's looking from a biomedical outlook

(SW~PN)
well-being oriented (personal / social)
SW's looking from a social problem type outlook

(PN>SW)
education / training / knowledge
PNs have come from a higher academic standing than SWs
invasive / aggressive treatment
the difference is that the PN can go on and do invasive and non-invasive things to a person - a SW really concentrates on social engineering ... not as invasive
responsibility / importance of decisions
PN has more responsibility and qualifications
specialised / particular role
SWs aren't so specialised

status / prestige
status
(SW>PN)
counselling role / listeners
SW' s into the mental, listening
holistic / whole person
(PNs more holistic than SGs but not as holistic as SWs)
patient contact
SW has more direct dealing
personal approach / style / orientation / skills
one' s a person focus and one' s a disease focus
SWs have got a broader - I think they feel that all of human nature is there and worthwhile - doctors do but they think more its worthwhile because I' m here to look after them
time with patients
SWs have more time to spend with people
well-being oriented (personal / social)
poles apart, PNs usually fob off people' s problems
I think PNs just leave the SWs to do it because they don' t quite know what happens when a patient is in need and it needs sorting out - it' s not something that the PNs got time or the expertise to sort out - he' s quite happy to leave the SW to do it
a PN is overall health whereas a SW is more into getting a person surviving in society
{GP, SW}
GP and SW are separated on dimensions two (most) and one but are closely adjacent on dimensions three and four. Accounts of GP-SW differences should refer mainly to dimension two attributes.
(GP~SW)
medical treatment / model
they' re both caring one' s caring for their medical needs and one' s caring for their social problems
(GP>SW)
breadth of view / scope of practice
GPs share some characteristics with social workers but SWs don' t ... the other way around
wide knowledge, skills
education / training / knowledge
different in the amount of background it takes to get where they are
generalists / versatile / role overlap
very similar but do different things - GPs should be good SWs, just as they should be good at giving dietary advice and understanding drugs and so on
a GP ends up doing a lot of social work but a SW doesn' t take on the role of a GP
holistic / whole person
SWs are not interested in the disease so much as their coping with the disease whereas the GPs should be concerned with all of it
practical
specific (directed) in what he' s trying to do
status / prestige
SWs wouldn' t be anywhere near the position on the hierarchy as the GPs
(SW>GP)
airy-fairy / wishy-washy
airy -fairy
{GP, PS}
GP and PS are separated on dimensions two (most) and four and are closely adjacent on dimensions one and three. Accounts of GP-PS differences should refer mainly to dimensions two and four attributes.

(GP~PS)
generalists / versatile / role overlap
a lot of GPs think they' re PSs and will try to help the patient out- others will refer on to PSs
medical treatment / model
PSs are not, as far as I understand, really interested in prescribing medicines
(GP>PS)
central to hospital / health care
GPs feel that they' re looking after the physical health needs of the patient and the mental health needs if the patient hasn' t got a big- but if the patient has got something more specific, then I think they' d be more than happy to hand over that part to someone else - to a PS - but they would still feel mainly in charge of the person' s health
generalists / versatile / role overlap
the GP has a lot to deal with the patients' problems as well
GPs often wouldn' t call in a PS to deal with a problem because they feel they should be able to deal with it - anything that comes up
medical treatment / model
it' s not one of medicine- treating - but of psychosocial illnesses and approach
GPs in the community perform a more holistic type of approach but they' re still based on the medical model
they can do some of the benefits that I suppose a PS can do but have a more clinical focus within that as well and hopefully tie it in a bit better
responsibility / importance of decisions
GP has more responsibility - more obvious consequences
(PS>GP)
listen / talk - willing / do
GPs don' t seem to have the time to sit and talk to their clients for very long- a PS is going to make the time to deal with the particular problem
mind / mental - emotional aspects
one' s playing with their minds and one' s playing with their bodies
a GP is not so specialised in finding out a person' s psychological problems a GP would see the problem and refer them on to a PS

{RN, SW}

RN and SW are separated on dimensions two (most) and one but are adjacent on dimensions three and four. Accounts of RN-SW differences should refer mainly to dimensions two and one attributes.

(RN~SW)
generalists / versatile / role overlap
RNs hear everything about the patient - we sit down and listen to their problems - I don' t see the point of bringing in a SW- a RN is a SW
(SW~RN)
airy-fairy / wishy-washy
sit and talk - airy-fairy
(RN>SW)
breadth of view / scope of practice
the RN has a finger in social work but the SW has no finger in nursing
RNs work on a holistic principle as well as utilising the medical model - SWs are concerned with the person, as are the RNs, but they' re also interested in disease processes
broader scope of care
generalists / versatile / role overlap
crossover of roles
hard-working / task oriented / busy / do-ers
a SW is what a RN could be if we weren' t so bloody busy doing everything else
RNs are practical people and they want to get on with the work - they' re time-watchers because they have to be - there are set routines, whereas SWs are more - well, they' re not into the physical side, they' re into the emotional side- it' s very time-consuming and

they need to go into great detail - RNs have many more jobs and they don' t have time to do them in great detail
disciplined and under time constraint
holistic / whole person
RNs are more likely to view the person as a whole person rather than just as a problem
medical treatment / model
both come from social science, human science but RNs are heavily influenced by the medical model
patient care - direct / general
nurses just deal with the everyday stuff - SW deals more with interaction problems, family problems and when they go home problems
physical / biomedical science
the only difference I can see is that RNs have a slant on technology and pharmacology that a SW doesn' t need and doesn' t have a right or access to
time with patients
SWs aren' t there all the time
(SW>RN)
autonomous / independent / professional
a lot of RNs don' t like SWs, thinking they' re interfering, radical sorts who upset the status of the system, especially in the days when doctors were god and RNs were handmaidens, they resented SWs coming in and kicking a bit of arse

Dimension three

Similarities within the pairs {DT, SG}, {EN, PS}, {GP, PS}, {GP, SW}, {OT, PH}, {PH, PT}, {PS, RD} and {RD, SW}.

{DT, SG}

DT and SG are adjacent on dimension three but separated on he other three dimensions. Accounts of DT-SG commonalities should refer mainly to dimension three attributes.

(DT=SG)
advising role - patients
both direct and give information rather than listen
communicate / respect - other groups
SGs are quite happy to call in the DTs and they respect their role - they' re not similar types of people but they respect each other
listen / talk - willing / do
not really there to listen
specialised / particular role
both specialists - but their areas are very different
specific / narrow focus / aspect
there' s not a lot that is similar in their styles, although their focus is just as narrow
they' ve got one small area of the person they' re interested in
have different roles but are both there for one cause
teamwork / complementary
have different interests but sometimes the SGs depend on the DTs to shove vitamin pills in their patients to get their wounds healed but they' re completely different people, looking at different things
very different - they don' t interact a lot
technical - orientation / role
both very scientific and precise

{EN, PS}

EN and PS are adjacent on dimension three but separated more widely on the other three dimensions. Accounts of EN-PS commonalities should refer mainly to dimension three attributes.

(EN=PS)
listen / talk - willing / do

like to chat to patients
a nurse is always willing to listen (but they haven't got the training to advise or help)

{GP, PS}

GP and PS are closely adjacent on dimensions three and one but separated on dimensions two and four. Accounts of GP-PS commonalities should refer mainly to dimensions three and one attributes.

(GP=PS)

advising role - patients
both like talking to people but about different subject matter
counselling role / listeners
if the GP is any good they do the same sort of work - many people go to GPs for that and get propped-up with drugs, but when the GP's any good and can create their own ambience, they're very similar
education / training / knowledge
similar education
holistic / whole person
both have value for other than the obvious medical problem - both need to and are prepared to take time to find out - both quite able to look more at their patients as a whole
mind / mental - emotional aspects
GPs do look at people's emotional states and then take them into consideration
personal involvement / know patients well / close
have to get to know you at a fairly intimate level if they're going to be able to help
well-being oriented (personal / social)
the GP is dealing with the medical side but he's also dealing with the social side as well, so I think GP's role overlaps with the PS's role

{GP-SW}

GP and SW are closely adjacent on dimension three but separated on the other three dimensions, particularly dimension two. Accounts of GP-SW commonalities should refer mainly to dimension three attributes.

(GP=SW)

auxiliary / peripheral
specific task in mind - peripheral cf nurses
central to hospital / health care
GPs and SWs are dealing with the lesser problems on our ward, not the main problems, and they're dealing with the home problems
communicate - patients
they're ready to sort people through their problems they have to be good communicators
counselling role / listeners
you do go to GPs to talk about problems and SWs the same - listening
holistic / whole person
they take into account different things and not just the medical problem
deal with the patient as a whole
patient contact
like to have contact with people
rehabilitation / adjustment
both deal with the woes of the general public and both in the job of patching up
they are reasonably similar in some respects - GPs do deal with peoples' social problems and tend to deal with issues that may interfere with the health of the patient
teamwork / complementary
a GP might think "I've done all I can do and somebody else needs to go in - I'm aware of it but its not something I can give a prescription for"
the GP often heavily depends on the SW - whether they're in the hospital or in the community - the SW often sees things that she can refer back to the GP

work well together on a professional level - in less acute care - may not even meet, just talk on the phone - less camaraderie than RD - PT
are helpful to one another in regard of getting the patient back to functioning
time with patients
less different (than SW - other doctors) because GP gets to spend more time with the client

{OT, PH}

OT and PH are closely adjacent on dimension three, somewhat separated on dimension one and widely separated on dimensions two and four. Accounts of OT-PH commonalities should refer mainly to dimension three attributes and, to some extent, dimension one attributes.

(OT=PH)

autonomous / independent / professional
they don't have anyone to answer to they just have a role
auxiliary / peripheral
both reasonably small groups
status / prestige
similar education and status
teamwork / complementary
none of their work overlaps - they go about their areas differently

{PH, PT}

PH and PT are closely adjacent on dimension three, somewhat separated on dimension one and widely separated on dimensions two and four. Accounts of PH-PT commonalities should refer mainly to dimension three and, to some extent, dimension one attributes.

(PH=PT)

communicate / respect - other groups
they're completely different people and they're dealing with different things and I don't think they communicate all that much
education / training / knowledge
both come from a similar background, both have an academic standing
fairly similar amount of training involved in their jobs
physical / biomedical science
both scientific in outlook - research based - but different in their approach to health care problems
specialised / particular role
if a PT thought somebody needed something for pain - they'd just ask the nurse to do it - they (PT, PH) might be a similar sort of person but their job roles in our hospital don't crossover

{PS, RD}

PS and RD are closely adjacent on dimensions three and one but more widely separated on dimensions two and four. Accounts of PS-RD commonalities should refer mainly to dimensions three and one attributes.

(PS=RD)

advising role - patients
both tell you what's wrong with you and you expect them to tell you how to treat it
analytical / diagnosis / problem-solving
both clinically based
autonomous / independent / professional
they're both quite professional groups, have got a professional body and are clearly regarded as a profession
education / training / knowledge
similar qualifications and status

{RD-SW}

RD and SW are closely adjacent on dimensions three and one, separated on dimension four and widely separated on dimension two. Accounts of RD-SW commonalities should refer mainly to dimensions three and one attributes.

(RD=SW)

education / training / knowledge
both university trained
personal involvement / know patients well / close
both have got to know their patients
teamwork / complementary
RDs seem more tolerant of SWs than SGs and PNs - quite often their workload is hideous in the larger hospitals and they see that, even though they can counsel patients, that the SW has a real role to play if the patient is a bit needy - I think each recognises the other' s skills
time with patients
similar patient contact, timewise

Differences within the pairs {GP, PH}, {GP, SG}, {PH, PS}, {OT, PS}, {PT, SW}, {DT, RD}, {PH, RD}, {OT, RD}, {RD, SG} and {PN, SG}.

{GP, PH}

GP and PH are widely separated on dimensions three and four and adjacent on dimensions one and two. Accounts of GP-PH differences should refer mainly to dimensions three and four attributes.

(GP~PH)

analytical / diagnosis / problem-solving
GP is into diagnosis of the patient

(PH~GP)

advising role - other groups
specialists - a ' resource' for GPs

(GP>PH)

analytical / diagnosis / problem-solving
the PH isn' t doing much assessing, except if they feel there' s a drug interaction, and the GP is
central to hospital / health care
a GP would consider himself a more important part of the health system
communicate – patients
rapport with patients
patient contact
PHs have less contact with the patient then GPs
direct patient contact
personal involvement / know patients well / close
the GP has closer relationships with people than the PH

(PH>GP)

pharmaceuticals / medicines
they should have more contact with the doctors, then the doctors mightn' t make these mistakes - they have more knowledge about pharmacology and should sprout their wings a bit
physical / biomedical science
PH looks at the patient from a more scientific and biochemical perspective
specific / narrow focus / aspect
PHs are a bit more focused than GPs
technical - orientation / role
PH is into providing the medications and knowing about interactions and the effects of the medications

{GP, SG}

GP and SG are widely separated on dimension three and relatively adjacent on the other three dimensions. Accounts of GP-SG differences should refer mainly to dimension three attributes.

(GP~SG)

holistic / whole person

GPs are different to SGs and PNs because they do look at patients in a holistic view

patient care - direct / general

a lot like to be involved in total patient care

(SG~GP)

specific / narrow focus / aspect

like to specialise and do what they do and not worry about anything else (re the patient)

(GP>SG)

arrogant / aloof / superior / elitist

a distinct difference between GPs and specialists, not only in their knowledge base but also in how they relate to other members of the health care team - they (GPs) tend to be elitist more than the specialists

breadth of view / scope of practice

GPs have got a lot more involvement with patients in the community and I think they' re a lot more aware - a SGs job finishes when the patient leaves hospital - so a GP sees a lot more of the patient in the community and a lot more and see the OT as a worthwhile member of the team

there' s a lot that GPs do that SGs would have forgotten how to do

communicate – patients

SGs are often removed and the clients have problems communicating with them

communicate / respect - other groups

willing to listen

GPs are definitely more approachable and easy to talk to - they' re different in the way I can relate to them

counselling role / listeners

time spent talking and time spent trying to work out problems that may not even be medically oriented

GPs are more listening and counselling in their medicine

generalists / versatile / role overlap

some GPs may be members of the surgical profession as well

holistic / whole person

they look at the patient holistically, much more than SGs or PNs

both doctors and both working towards stopping illness and working towards health - I don' t think SGs work towards health- they' re involved in illness GPs have a very different style - although they can do some surgical stuff, I don' t see them as SGs

a SG has to be very mechanical in the delivery of what they' re doing- GP has to be a bit more holistic

patient contact

involvement with patient

both doctors, SG doesn' t have as much contact with patients as GP's do- one wants contact with the patient and one doesn' t

personal approach / style / orientation / skills

you get good GPs and bad GPs - but they' re more interested in people as a whole than SGs

a GP would be more like a nurse (than a SG would) I suppose - a SG is into the high powered sort of stuff - most of them don' t have a very nice bedside manner and don' t relate to people very well - but they can talk to their GP

surgery is a sort of mechanical job rather than anything that is directly associated with the patient

GPs are people friendly and SGs are just being issue oriented

personal involvement / know patients well / close

GP wants to know more from personal relationship side

power / control

the SG is totally reliant on the GP for referrals - an old political problem - and has to be nice to the GP

time with patients

a GP spends more time with a patient than a SG

(SG>GP)

arrogant / aloof / superior / elitist

the SGs are more aggressive sort of people where the GP is an easier person to communicate with and get along with

authority / right to decide

in the hospital setting - they're pushed out into the background and I find that the GPs are often not consulted - even though the client has a lot of confidence and faith in the GP, he's not involved in the actual surgery decision in a lot of cases

people (RNs) will stand up to them

education / training / knowledge

have the same basic training - GPs may or may not have had training beyond basic training

specialised skills

training and intellect

invasive / aggressive treatment

I've seen a change in GPs in the last couple of years - they're adopting alternative therapies and are not as radical as what SGs are

responsibility / importance of decisions

he's done more training and has a lot more responsibility

they're probably considered by SGs and PNs to be a little bit inferior - just sort of useful people to refer patients to them - GPs themselves, a lot of them feel that they'd rather do that than go on and be a SG or PN - its more varied and a lot more interesting - they have a lot more variety and they haven't got the stress of the SG and PN who have the ultimate responsibility

a GP wouldn't be so career-oriented - more into a laid-back sort of life than a full-on intense ... if a GP has a problem he can pass it on to the next man whereas a SG is at the end of the line

specialised knowledge

surgeons are more specialised in their care and the GPs are just the basic care

status / prestige

the SGs feel that they're superior to the GPs and the GPs feel that the SGs are too-

some GPs try to be SGs and parade around in theatre gear

the SG has far more prestige ... than the GP

SG is more hierarchical (more status/power)

standing

{PH, PS}

PH and PS are widely separated on dimensions three and two , adjacent on dimension four and closely adjacent on dimension one. Accounts of PH-PS differences should refer mainly to dimensions two and three attributes.

(PH~PS)

pharmaceuticals / medicines

one's a chemical agent - an outside thing - and ones a self-healing

sometimes a psychological problem might need to be treated with drugs - a PS might advise to see a psychiatrist for that

technical - orientation / role

PH is dealing with medication (not people as such)

(PS~PH)

mind / mental - emotional aspects

PSs are dealing with the patients' personal, psychological wellbeing

patient contact

PH has no dealings with patients

personal involvement / know patients well / close
direct contact and very close sort of relationships
(PH>PS)
physical / biomedical science
PH is probably more scientific and PS is more social science oriented
practical
PHs are more into the practical stuff and I think PSs would be a bit airy-fairy for them - they' d be more happy dealing with something more concrete
(PS>PH)
caring attitude / empathy
PS has more of a caring sort of a nature
holistic / whole person
PS deals more with the person as a whole
patient contact
PSs have more contact with patients than pharmacists
personal approach / style / orientation / skills
a PH is a much more sort of reserved, quieter sort of person who doesn' t get involved with people - I think a PS is probably someone who enjoys getting involved with people
PHs don' t relate much to people
personal involvement / know patients well / close
different amount of patient contact - direct patient involvement
{OT, PS}
OT and PS are separated on dimensions three and four, relatively adjacent on dimension one and closely adjacent on dimension two. Accounts of OT-PS differences should mainly refer to dimensions three and four attributes.
(OT~PS)
airy-fairy / wishy-washy
I' ve got this funny idea about OTs that all they do is macrame
body / physical aspects
OT deals with the physical
trying to provide tools to cope - on a physical level
(PS~OT)
mind / mental - emotional aspects
OTs don' t want to know about the bad things that are going on in their life
PS deals with the mental
(OT>PS)
body / physical aspects
OTs are more into the physical side of things than the psychological
mind / mental - emotional aspects
one is very much the inner and one is very much the outer, although they have overlaps of course
practical
deals with their problems in a practical way
rehabilitation / adjustment
the OT is interested in the environment
(PS>OT)
breadth of view / scope of practice
PS has broader range of responsibilities
education / training / knowledge
PS has more training
mind / mental - emotional aspects
the PS is interested in the person (as opposed to their environment) and trying to solve the person' s problems
deals with their problems - changing ideas and thoughts and trying to help them that way

working on an emotional level
status / prestige
differences - in level of professionalisation and position in the hierarchy
{PT, SW}
PT and SW are widely separated on dimension three, separated on dimension four, closely adjacent on dimension one and adjacent on dimension two. Accounts of PT-SW differences should refer mainly to dimensions three and four attributes.
(PT~SW)
body / physical aspects
they' re helping the patient walk again or do something again they' re interested in the patients in a physical way where a SW is interested in the mental
PT - I don' t think wants to hear about all of those (personal - mental matters) - they' re there to help physically not mentally
deals with the physical side
hands-on / physical contact – care
totally different ways of dealing with the patient
physical / biomedical science
(if you wanted uni and helping profession) if you were a bit physical you did physio and if you were a bit more social you did social work
(SW~PT)
mind / mental - emotional aspects
deals with the mental side
well-being oriented (personal / social)
SWs are interested in the whole wellbeing of the family - the patient and the family
(PT>SW)
autonomous / independent / professional
a lot of their (SW' s) work is prescribed by other professions PTs tend to be more autonomous and decision-making in their own profession
body / physical aspects
PTs are a more practical physical repair type of group - SWs are ' nice' people
PT is getting them physically functioning again
tuned to a patient' s body
hands-on / physical contact – care
PTs have a little more direct physical contact, SWs have more verbal contact
specific / narrow focus / aspect
a SW has to work globally with the whole person - a PT is interested more in a particular ailment of a person
(SW>PT)
breadth of view / scope of practice
A good PT will take an interest in people and talk to them about how they' re going on a long-term basis but generally not - SW' s breadth of focus ...
holistic / whole person
SW is involved in the whole person
mind / mental - emotional aspects
tuned to a patient' s mind
time with patients
PTs tend to work with patients for short, intense periods of time
well-being oriented (personal / social)
a PT is just working on a person with sports injuries and stuff like that where a SW is more interested in their wellbeing in the community
interested in the one client - just the one person - they' re not dealing with the family or anyone else (cf. SW, OT)
{DT, RD}
DT and RD are widely separated on dimensions three and four, separated on dimension two but adjacent on dimension one. Accounts of DT-RD

differences should refer mainly to dimensions three and four attributes, and to some extent, dimension two attributes.

(DT~RD)

auxiliary / peripheral

DT has a role because the doctor has no time

specific / narrow focus / aspect

one's looking after the food department and one's looking after the body

DTs are mainly focusing on diet

(RD~DT)

body / physical aspects

one's dealing with the dietary needs and one's dealing with the body

medical treatment / model

RDs are concerned with medical decisions and looking at disordered health states rather than health states

(DT>RD)

experienced

RDs are just launching their career and the DTs are already there

RD's still feeling his way and learning

specialised / particular role

a DT's knowledge base is more specific than a RD's

specialised knowledge

DTs are by now quite specialised

specific / narrow focus / aspect

a RD's got to know everything about a person and then everything about what they can do for a person - a DT's only interested in a particular part of a person's life

(RD>DT)

central to hospital / health care

DTs require limited training and have limited scope and effect within care delivery to the patient

hands-on / physical contact – care

RDs have much more to do with patients than DTs do - DTs are talking rather than doing and their contact is much briefer

hard-working / task oriented / busy / do-ers

RDs are sort of flashing around the ward - DTs just breeze in and out and do their little scientific things and off they go

{PH, RD}

PH and RD are widely separated on dimensions three and four and adjacent on dimensions one and two. Accounts of PH-RD differences should refer mainly to dimensions three and four attributes.

(PH~RD)

advising role - other groups

RD relies on everyone to tell them what's going on

(RD~PH)

authority / right to decide

a doctor prescribes and a PH doesn't

patient contact

PH has no contact with anyone

(PH>RD)

auxiliary / peripheral

RDs are young and fun-loving but I don't have much to do with PHs

pharmaceuticals / medicines

they're both very knowledgeable in the field of medicine both have to be up on pharmacology - the PH is more knowledgeable

specialised / particular role

more specialised

(RD>PH)
breadth of view / scope of practice
they have to deal with drugs but PHs, it's just drugs
patient contact
RD has more contact with the patient than a pharmacist
but the PH doesn't have to actually say to people, 'Here, take this'
RDs focus is purely medical (on the person) whereas a PH concentrates purely on an order sheet that they are given by a different person - a PH has no patient contact and a RD has plenty of patient contact
direct patient contact is limited with PHs but is high with RDs

{OT, RD}

OT and RD are widely separated on dimensions two and three and adjacent on dimensions one and four. Accounts of OT-RD differences should refer mainly to dimensions two and three attributes.

(OT~RD)
rehabilitation / adjustment
OTs are just physically trying to get a person moving, a doctor doesn't do that ... only in a sense - by handing down orders - they might see the need for an OT - but a doctor doesn't have the knowledge that an OT does in that sense
time with patients
RD doesn't have time (to spend with patients)
(RD~OT)
pharmaceuticals / medicines
OTs are nothing like doctors - they don't prescribe
(OT>RD)
autonomous / independent / professional
similar to physio & RD, they (OTs) know which stream
experienced
the RD is someone who's learning and the OT is someone who can teach them what's required
holistic / whole person
not is quite caring of the patient as a whole
time with patients
OT will spend more time with the patient, RD will come and go to where the immediate needs are
OT has a role to do and has time with the patients
(RD>OT)
analytical / diagnosis / problem-solving
a RD's got to concern himself with any number of problems anything can happen - an OT is called in after you've identified the problem RD has to identify the problem
autonomous / independent / professional
levels of professionalisation
breadth of view / scope of practice
RDs have a wider range of responsibilities
education / training / knowledge
training different but not dramatically
on-going / extended contact
RD just flies in and out and does what he has to do and may never see the patient again

{RD, SG}

RD and SG are separated on dimensions three and one and adjacent on dimensions two and four. Accounts of RD-SG differences should refer mainly to three and one attributes.

(SG~RD)
arrogant / aloof / superior / elitist
the SG says "I'm here, I'm your wealth of knowledge, I'm your book"
(RD>SG)

gender
a lot of difference in age and gender - a lot of RDs are young women
generalists / versatile / role overlap
it's more likely that a RD is going to be like a GP than a SG - whether he wants to or not, his practise is general practise in a hospital, whereas it's not necessarily surgical
hands-on / physical contact – care
a SG is not, as a rule, going to sit on the edge of the patient's bed and hold their hand and talk to them and discuss things with them - a RD would - he would do that because he's the resident of a SG - 'you do this and that and order these things and talk to the patient a see what's going on'.
the RD is doing a lot more physical stuff than the SG - apart from actual surgery
listen / talk - willing / do
RDs are always willing to learn but SGs are not often willing to take the time to teach them

(SG>RD)
arrogant / aloof / superior / elitist
they don't need the kudos of a brain surgeon or a physician yet - they're ok
authority / right to decide
one is under the direction of the other - deference
education / training / knowledge
RDs have got a long way to go before they get to be surgeons
both have had to go through the same basic medical training but SGs have had to go through a lot more training since then
they've (RDs) got minor surgical skills the SGs usually treat them like younger brothers
we wouldn't call them first-up because we would feel that we know more about the specific sub-specialty on our ward than they did - we would be inclined to by-pass them - do what we had to do and then call the SG but they're wonderful for emergencies
one has had more study and has been out for a longer period of time - master and apprentice
experienced
level of maturity (but only a 'sub-set' of RDs will become SGs)
power / control
some resident doctors are trying to be surgeons - a lot of residents have got no track to be surgeons and may want to go into a different field - SGs would view the RD as "I have a dog that barks too"
the difference is that the RD is there to carry out the orders of the SG - that's why the RD has more patient contact than the SG - because the SG delegates that sort of touch-feely work to the RDs
responsibility / importance of decisions
surgery is a more directly responsible job
specialised knowledge
the SG is more specialised
status / prestige
RD is way down the line from SG
time with patients
SG gives them a little bit of his time - because he's getting the money - whereas the RD doesn't

{PN, SG}

PN and SG are separated on dimension three, somewhat separated on dimension four, and adjacent on dimensions one and two. Accounts of PN-SG differences should refer mainly to dimensions three and four attributes.

(PN>SG)
breadth of view / scope of practice
interested in all of patient's 'parameters'
they have I think a broader view of the person - they're not just focused on surgery

caring attitude / empathy
seem to have a more caring attitude than a lot of SGs
communicate – patients
understanding
communicate / respect - other groups
I rate us a lot more similar to PNs and GPs than to other medical personnel - there is a respect that PNs have for our input and patients' input that SGs don't seem to have
willing to listen
reasonable and willing to listen
willing to listen
holistic / whole person
more holistic (than SGs, eg)
patient contact
PN more prefers to talk to his patients rather than operate on them - different personalities, SGs have very little contact with their patients
personal approach / style / orientation / skills
don't seem to have the ability for personal contact that PNs do
GPs and PNs are more human than SGs
personal involvement / know patients well / close
PNs have better personal skills and relate better to their patients
pharmaceuticals / medicines
one heals with medication and one heals with a knife - they often argue as to who should be the one to make the decision, whether it's an operation or a medication
one's to do with the operations side and one's to do with the medical side
specialised knowledge
I don't have as much respect for SGs (as PNs) as far as their knowledge base is concerned
PNs are more able to articulate things on a micro level - I have more respect for their knowledge
teamwork / complementary
work with other team members

(SG>PN)

arrogant / aloof / superior / elitist
I don't think of them as aloof as SGs they tend to be dealing with conscious people rather than unconscious people but still a bit dogmatic in their approach to patients - (but) they usually know what they're talking about
dogmatic and difficult to deal with
very different in personality - the SG's are very arrogant and sort of have a 'god' image where the PN will think he's pretty good but he doesn't have the 'god' image
they're very arrogant, a lot of them PNs are not as arrogant as SGs
see themselves as entities unto themselves
not as approachable as GP, PN - stuck up
not as arrogant as some of the SGs
aggressive
authority / right to decide
will come into ward and take over
avaricious / self-serving
not as money oriented as a lot of others (SGs in particular)
money oriented
breadth of view / scope of practice
only interested in that one area that they specialise in, where PNs do look a little bit further
invasive / aggressive treatment
they tend to be very careful with how they treat people - they prefer to treat with drugs and investigate disease processes than be interventional with surgery - they tend to be more conservative than SG's in their approach
SGs just chop it out

the mutilation is a bit gross, because I do not think that some of the surgery is necessary - a lot of people, in the back of their mind, associate surgery with some type of violence
SGs can treat problems by technical and mechanical manipulation, whereas PNs tend to prefer less interventional things
seem to be a more aggressive group of people (than PN's) where PN's sit back and wait for things to happen, SGs feel that they have to rush in and operate as soon as something comes up
they don't do the same sort of work - one's cutting and one's not cutting
PNs - the nature of their conservative approach indicates - its hard to say respect for the patient
specialised / particular role
I don't think there's as much specialisation involved in being a PN as in being a SG
specific / narrow focus / aspect
generally just focused like PNs but perhaps not as focused because they just look at their realm and that's it
looking for very definite signs

Dimension 4

Similarities within the pairs {DT, PH}, {DT, PS}, {GP, OT}, {GP, PT}, {OT, PN}, {OT, RD}, {PH, PS} and {PT, RD}.

{DT, PH}

DT and PH are closely adjacent on dimensions four and three, and separated but not widely on dimensions one and two. Although DT-PH commonalities might refer to attributes pertinent to several dimensions, DT and PH are together separated from other groups at the positive extreme of dimension four but are located among them on the other three dimensions. To the extent that attributes describing their commonalities are distinctive, they should refer more to dimension four attributes.

(DT=PH)
advising role - other groups
their role is a little like DTs' in that they aren't physically involved in the care of the patient - they have to some extent a teaching role (as DTs do) but its not usually directed at the patients - they normally talk to the nurses and expect the nurses to pass the information on to the patients
advising role - patients
similar because they're advising on diet and medication - something that they're taking orally - if a DT is good enough they can lessen the need for medication
there to inform or advise
both advisory roles
analytical / diagnosis / problem-solving
specific role, set task, based on information needed to work out a solution
autonomous / independent / professional
both professional occupations, but different fields
they're both quite professional groups both tend to relate well to other professions
patient contact
both don't have a lot to do with patients DTs are looking after the patients' meals and PHs are looking after their drugs
neither has much contact with patients
physical / biomedical science
in a way they're like DT's - but more men seem to do pharmacy - the scientific bent
specialised / particular role
both are in specialised fields
both have got their own little special areas to deal with
both got their roles within the hospital
specialised knowledge

least to do with face-to-face patient contact - absolutely on the periphery - similar background educationally in that they focus on a particular area - they must know that in a scientifically exact way

specific / narrow focus / aspect

same thing, but dealing with different aspects - all part of a team

they're as picky and determined to concentrate on just one area as a PH would - I see PHs and DTs as having a lot in common - another sort of 'squirrel me away' group of people - I don't think they have the people skills that RNs, ENs and RDs have

much the same because they both concentrate on one tiny little area

they're in narrow specialties but, on the whole, they're different

both have specialised in a small area

teamwork / complementary

they work close together, because the DT often depends on the PH for advice and vice-versa

similar goals, complementary roles

technical - orientation / role

a lot of diets are designed to have medicinal effects, so the PH and the DT are very similar - trying to find out the best stuff that should be given

{DT, PS}

DT and PS are relatively adjacent on dimensions one and four, and widely separated on dimension three and separated on dimension two. Accounts of DT-PS commonalities should refer mainly to dimensions one and four attributes.

(DT=PS)

auxiliary / peripheral

both sort of hangers-on in so far as the health system goes, in a hospital - they both breeze in and out - they're not there on a day-to-day basis - they're called in

counselling role / listeners

trying to help a patient change an attitude

education / training / knowledge

although their education is different its probably about the same time - probably about the same amount of glamour and dollars, although their focus is obviously different

similar educational backgrounds, same hierarchy level - allied health professionals

specialised / particular role

they'd both recognise that they're looking after one aspect of the patient's care

both small groups in terms of numbers - they're focusing on one aspect of health care - PS the mental and DT the nutritional

specific / narrow focus / aspect

DT, PS and PH get to see patients on different stages once a week to talk to the patient about their particular problems, they're all on different days similar but deal with different aspects

{GP, OT}

GP and OT are adjacent on dimension four but separated on the other three dimensions. Accounts of GP-OT commonalities should refer mainly to dimension four attributes.

(GP=OT)

communicate – patients

both communicators, people based - need to have good empathy with GP or OT to get good recovery or good progress

holistic / whole person

interested in the patient as a whole - getting them functioning again

listen / talk - willing / do

both like to talk to people

teamwork / complementary

the GP will need the OT to help them organise things for the patient and the OT will depend on the diagnosis from the GP to work out what they can do

{GP, PT}

GP and PT are reasonably adjacent on dimension four, more separate on dimensions one and two, and widely separated on dimension three. Accounts of GP-PT commonalities should refer to dimension four, and to some extent, dimensions one and two attributes.

(GP=PT)

communicate - patients

both there to get people back into good health, be it referring them on or, in physiotherapy, doing actual physical work with them - GPs are good communicators and physios too because if otherwise if people don' t do as instructed they' re not necessarily going to do the right thing - physios and GPs look at a whole range of issues as to why the person can' t do this or that

listen / talk - willing / do

different professions but both talk to people

patient contact

both have dealings with patients

private practise

share a lot of parallels, especially when they' re independent practitioners

can be out of the hospital system, in private practise

teamwork / complementary

can work in practises together - complement each other

{OT, PN}

OT and PN are reasonably adjacent on dimension four and more widely separated on the other three dimensions. Accounts of OT-PN commonalities should mainly refer to dimension four attributes.

(OT=PN)

holistic / whole person

both care for the patient in a totality

patient contact

both have patient contact and like talking to patients

personal involvement / know patients well / close

a PN gets to know you, so does an OT - they have to know a person to know what a person' s needs are

specialised / particular role

they' re both caring fotheir needs in their own specialised fields

teamwork / complementary

they probably have a lot to do with each other in a stroke case or spinal injury or something - they can work together - if the PN has any brains they understand that the OT has a lot to offer

time with patients

the same in the amount of time they spend with patients

{OT, RD}

OT and RD are adjacent on dimensions four and one and widely separated on dimensions two and three. Accounts of OT-RD commonalities should refer mainly to dimensions four and one.

(OT=RD)

patient care - direct / general

both into direct physical care - different types of care

{PH, PS}

PH and PS are relatively adjacent on dimension four, adjacent on dimension one and widely separated on dimensions two and three. Accounts of PH-PS commonalities should refer mainly to dimensions one and four attributes.

(PH=PS)

advising role - patients

clinically based and academic - there to talk with their patients
specialised / particular role
both specialised
status / prestige
probably similar in education - probably similar in status
occupy the same sort of professional development area - approximately the same sort of position (status as independent professionals, cf PTs also. >RNs)
technical - orientation / role
both academic professions, not that they' re very much alike they' re very different in one way but they' re very academic sort of professions

{PT, RD}

PT and RD are relatively adjacent on dimension four, adjacent on dimension one and widely separated on dimensions two and three. Accounts of PT-RD commonalities should refer mainly to dimensions one and four attributes.

(PT=RD)
hands-on / physical contact - care
(compared to PSs) they' re both dealing more directly with the patient in a physical way
status / prestige
similar expertise, status and education
teamwork / complementary
I think they' d be quite happy to converse with each other about what to do and I don' t think any of them would think that they have more knowledge than the other - they seem to work very well
have a team approach - both are approachable groups of people - they tend to work well together - they bring a jovial atmosphere to an acute hospital setting
time with patients
limited time with patients

Differences within the pairs {DT, PT}, {DT, SG}, {DT, OT}, {PH, PT}, {PH, SG}, {OT, PH}, {GP, PH}, {PS, PT} and {GP, PS}.

{DT, PT}

DT and PT are widely separated on dimension four and adjacent on the other three dimensions. Accounts of DT-PT differences should refer mainly to dimension four attributes.

(DT~PT)
auxiliary / peripheral
DTs do a lot of behind the scenes work
(PT~DT)
body / physical aspects
the PT is looking after the physical movement of the body
hands-on / physical contact – care
one' s dealing with the body and one' s dealing with the diet side
(DT>PT)
advising role – patients
the DT just advises on diet - the PT would never advise a person on what to eat - if someone was really obese they might say ' your knee will never be the same until you lose ten stone' but they wouldn' t tell them how to lose it
specific / narrow focus / aspect
DTs are very focused
the DT' s really concentrating on one thing
(PT>DT)
medical treatment / model
PT is more medically oriented
patient contact

one is dealing with the patients in lots of ways and the other - only has dealing with the food
PT has more patient contact and more qualifications
PTs have more patient contact - they tend to have developed that rapport
personal approach / style / orientation / skills
DTs are seen as uncommunicative whereas PTs have to be a bit more outgoing
personal involvement / know patients well / close
PT builds up more rapport with patients

{DT, SG}

DT and SG are widely separated on dimension four, separated on dimension one and to some extent on dimension two, and adjacent on dimension three. Accounts of DT-SG differences should refer mainly to dimensions four and one attributes.

(DT~SG)
specific / narrow focus / aspect
DTs are simply focusing on diet

(SG~DT)
medical treatment / model
one's diet and the other's specialised
specialised / particular role
a SG might order a certain diet for somebody but then its not their job - someone else has to do it

(DT>SG)
patient contact
poles apart in their contact
specialised / particular role
a doctor will advise on diet but a DT will never take the role of a doctor

(SG>DT)
authority / right to decide
have to prove a point to be accepted
education / training / knowledge
the education and money would be a lot different
SGs are on a different intellectual plane
power / control
SGs have got much more power in the hospital than DTs do

{DT, OT}

DT and OT are separated on dimension four and to some extent on dimension two but are adjacent on dimensions one and three. Accounts of DT-OT differences should refer mainly to dimensions four and two attributes.

(OT~DT)
patient care - direct / general
one's looking after the patient (as opposed to 'needs diet)

(OT>DT)
central to hospital / health care
I see OTs as more medically relevant, although DTs play an important part
manage / organise / coordinate
a DT is a passive sort of a person where an OT has to have some sort of aggression to get everything organised - an OT has to get right in there and get involved in everything to do their planning where the DT stands back a bit
personal involvement / know patients well / close
OT has more intimate contact
the OT is far more involved with the patient like say a PS - compared to the DT, their time with the patient is hugely expanded

{PH, PT}

PH and PT are widely separated on dimension four, separated on dimension two, and to some extent on dimension one, but adjacent on dimension three. Accounts of PH-PT differences should refer mainly to dimensions four and two attributes.

(PH~PT)

medical treatment / model

PH is more oriented to the chemical treatment of disease

pharmaceuticals / medicines

PTs don' t advise or have anything to do with medication- PHs survive on medication and knowing about drugs

(PT~PH)

body / physical aspects

PT does physical disabilities treatment

hands-on / physical contact – care

PTs base their job on hands-on manipulation

PTs are involved in direct patient contact whereas PHs aren' t

PT is involved with the person and has a lot of contact

patient care - direct / general

one' s caring for the needs and one' s caring for the patients

patient contact

PH has no actual contact with people

(PT>PH)

patient contact

PT has more contact with the person than the PH

PTs have plenty of patient contact - a PH has no patient contact

PHs don' t have a lot of direct patient contact, PTs do.

the PTs have contact with people whereas the PHs - don' t have much to do with people

time spent and patient contact

PH doesn' t have much to do with patients

contact with the patient

{PH, SG}

PH and SG are widely separated on dimension four, separated to some extent on dimension one, and adjacent on dimensions two and three. Accounts of PH-SG differences should refer mainly to dimensions four and one attributes.

(SG>PH)

arrogant / aloof / superior / elitist

PH not quite aloof as surgeon, easier to talk to a PH than a SG

hard-working / task oriented / busy / do-ers

the PH is much more of a relaxed sort of person whereas the SG is a high pressured, high-powered person

invasive / aggressive treatment

I don' t think PHs think you can just fix things, whereas I think a lot of SGs think you can do it and fix it and if it doesn' t work, well, that was just the person' s karma

patient contact

the SG has a lot to do with the patient and the PH has a lot to do with their drugs

direct patient contact (but) SGs don' t have as much as PNs do

PH has nothing to do with patients - SG little

status / prestige

SGs have more status

the SGs think they' re more special than a PH a lot of the time- I think that each respects what the other does but the SG still thinks he' s top dog and the PH goes along with that

{OT, PH}

OT and PH are separated on dimensions four and two, somewhat separated on dimension one and adjacent on dimension three. Accounts

of OT-PH differences should refer mainly to dimensions four and two attributes.

(OT~PH)

patient contact

PH doesn't deal with patients

(PH~OT)

pharmaceuticals / medicines

we're all carers but PHs are doing the drugs and OTs are caring for their different needs

an OT doesn't have anything to do with prescribing medications or have any knowledge of medications

physical / biomedical science

come from different sorts of backgrounds (science v social science)

(OT>PH)

breadth of view / scope of practice

an OT would understand a PHs role but I think PHs would not understand fully what an OTs role would be - they don't have lot to do with each other

patient contact

the OT is caring for the patient and the PH hasn't really got a lot to do with the patient

PH has less patient contact

PH has limited patient contact

neither has much contact with patients

personal approach / style / orientation / skills

PHs are people who I can't imagine have much personality - who could sit and look at pills all day? - OTs are more interesting people - they have some imagination to occupy people and give them something to do - to find out people's interests before they can treat them

you don't see them (PHs) relate to other people much

(PH>OT)

autonomous / independent / professional

PHs occupy a more professional model

specific / narrow focus / aspect

one looks at a single issue and OT although look at a physical thing …

{GP, PH}

GP and PH are separated on dimensions four and three and adjacent on dimensions one and two. Accounts of GP-PH differences should refer mainly to dimensions four and three attributes.

(GP~PH)

analytical / diagnosis / problem-solving

GP is into diagnosis of the patient

(PH~GP)

advising role - other groups

specialists - a 'resource' for GPs

(GP>PH)

analytical / diagnosis / problem-solving

the PH isn't doing much assessing, except if they feel there's a drug interaction, and the GP is

central to hospital / health care

a GP would consider himself a more important part of the health system

communicate – patients

rapport with patients

patient contact

PHs have less contact with the patient then GPs

direct patient contact

personal involvement / know patients well / close

the GP has closer relationships with people than the PH

(PH>GP)
pharmaceuticals / medicines
they should have more contact with the doctors, then the doctors mightn' t make these mistakes - they have more knowledge about pharmacology and should sprout their wings a bit
physical / biomedical science
PH looks at the patient from a more scientific and biochemical perspective
specific / narrow focus / aspect
PHs are a bit more focused than GPs
technical - orientation / role
PH is into providing the medications and knowing about interactions and the effects of the medications
{PS, PT}
PS and PT are widely separated on dimensions three and four and relatively adjacent on dimensions one and two. Accounts of PS-PT differences should refer mainly to dimensions three and four attributes.
(PS~PT)
mind / mental - emotional aspects
a PS is looking after the emotional body and the PT is looking after the physical body
the PS is looking at the mental side of a person
PTs work on the physical side of things and PSs work on the mind
mental
(PT~PS)
body / physical aspects
one' s dealing with the mind and one' s dealing with the body
the PT is looking at the physical side of a person
physical
hands-on / physical contact – care
hands-on physically
medical treatment / model
PTs are primarily concerned with the medical model
(PS>PT)
mind / mental - emotional aspects
both involved in patient care but different - physical versus emotional
PS concentrates more on the mind
personal approach / style / orientation / skills
PTs on the whole are not cheerful, warm - I don' t know if that' s been beaten out of them by, like the dentist, long-term experience of ' Oh my God, here they come'
(PT>PS)
body / physical aspects
PT concentrates more on the body
practical
PSs are a fairly airy-fairy group, PTs are more practical
specific / narrow focus / aspect
a PS has got to get to know all of you - a PT will only concern himself with part of you
{GP, PS}
GP and PS are relatively separated on dimensions two and four and adjacent on dimensions one and three. Accounts of GP-PS differences should refer mainly to dimensions two and four attributes.
(GP~PS)
generalists / versatile / role overlap
a lot of GPs think they' re PSs and will try to help the patient out- others will refer on to PSs
medical treatment / model
PSs are not, as far as I understand, really interested in prescribing medicines
(GP>PS)

central to hospital / health care
GPs feel that they're looking after the physical health needs of the patient and the mental health needs if the patient hasn't got a big but if the patient has got something more specific, then I think they'd be more than happy to hand over that part to someone else - to a PS - but they would still feel mainly in charge of the person's health
generalists / versatile / role overlap
the GP has a lot to deal with the patients' problems as well
GPs often wouldn't call in a PS to deal with a problem because they feel they should be able to deal with it - anything that comes up
medical treatment / model
it's not one of medicine treating - but of psychosocial illnesses and approach
GPs in the community perform a more holistic type of approach but they're still based on the medical model
they can do some of the benefits that I suppose a PS can do but have a more clinical focus within that as well and hopefully tie it in a bit better
responsibility / importance of decisions
GP has more responsibility - more obvious consequences
(PS>GP)
listen / talk - willing / do
GPs don't seem to have the time to sit and talk to their clients for very long - a PS is going to make the time to deal with the particular problem
mind / mental - emotional aspects
one's playing with their minds and one's playing with their bodies
a GP is not so specialised in finding out a person's psychological problems a GP would see the problem and refer them on to a PS

Part 2: Non-linear Principal Components Analysis: Dimension Loadings

Code	Attribute	Dim1	Dim2	Dim3	Dim4
V101	specialists / focus on one area	-.814	-.516	-.090	-.077
V102	generalists / wide variety of problems	.798	.339	-.182	.244
V103	treat main or 'root' problems	.177	-.546	-.768	-.011
V104	mainly males	-.025	-.976	-.196	.032
V105	mainly females	.177	.929	.225	.072
V109	become personally close to patients	.823	.536	.082	.083
V110	work closely with patients physically	.644	-.466	.088	-.567
V111	have a lot of patient contact	.670	-.273	-.651	-.210
V112	obliging and communicative people	.801	.353	.390	.121
V114	follow instructions / procedures initiated by others	.503	.420	.583	-.340
V115	concerned with diagnosis or assessment	-.271	-.654	-.539	.401
V116	work is vital - serious or life-threatening problems	.373	-.856	.094	.210
V117	high level of academic achievement	-.438	-.830	-.179	.044
V118	secondary to primary medical treatment	-.320	.896	-.079	-.184
V119	concerned with physical needs	.227	-.463	.640	-.530
V120	concerned with personal or emotional needs	.559	.416	-.460	.521
V121	central role in hospital context	.617	-.511	.050	-.545
V122	part of the medical team	.629	-.573	.241	-.361
V123	part of the non-medical team	-.758	.106	-.313	-.027
V301	hard-working / busy	.669	-.664	.279	.069
V303	concerned with politics of health setting	.589	-.755	.192	.150
V304	caring attitude	.730	-.284	-.239	.428
V305	high-brow knowledge / interests	.098	-.861	-.175	.286
V308	focused on direct patient care	.679	-.645	.284	.063
V309	deal with 'nitty-gritty' matters	.911	-.111	.220	.157
V310	central role in health care process	.689	-.648	.252	.067
V311	narrow therapeutic focus	-.671	.276	.278	-.509

V312	focus on particular aspects / problems / areas	-.759	.369	-.263	-.184
V313	have ' human' skills	.733	-.336	-.558	-.177
V314	have talking and listening skills	.898	.114	.029	.291
V315	materialistic	.422	-.869	.000	.162
V316	powerful / influential	.382	-.744	-.096	.034
V317	interested in patients as people	.626	.215	-.529	.518
V318	interested in the way people think	.444	.195	-.693	.501
V319	interested in people' s social circumstances	.673	-.291	-.646	-.190
V320	interested in people' s feelings / emotions	.703	-.257	-.654	-.024
V321	interested in people' s physical conditions	.632	-.504	.016	-.539
V322	interested in people' s medical conditions	.326	-.913	.090	-.141
V323	people-oriented / humanistic	.681	-.293	-.635	-.189
V324	arrogant / self-opinionated	-.054	-.843	-.326	-.106
V325	holistic approach	.775	-.315	-.540	.039
V326	close to patients physically	.680	-.340	-.596	-.236
V327	close to patients mentally / emotionally / spiritually	.731	-.236	-.629	-.037
V328	technical - mechanical skills / knowledge	-.037	-.784	-.080	-.164
V329	team-workers	.822	.283	.375	.054
V330	diagnostic skills	.461	-.828	-.036	.229
V331	use invasive treatments	.318	-.893	.081	.166
V332	respond to wide range of types of events	.724	-.338	-.567	-.183
V333	face-to-face contact time with patients	.932	-.031	.057	.171
V402	arrogant, ' superior' or ' stupid'	-.713	-.591	-.298	-.048
V405	focused mainly on disease processes	.038	-.954	.001	-.007
V408	closely involved with patients	.907	.215	.303	.090
V409	spend a lot of time with patients	.904	-.136	.372	.099
V414	narrowly focused in their approach	-.589	-.769	-.117	-.022
V419	close contact with patients	.781	.545	.182	.036
V428	know and understand patients	.885	.117	.209	.149
V429	narrow or technical role	-.868	-.229	-.376	-.120
V501	direct patient contact	.662	-.292	-.646	-.228
V502	large overall impact on patient wellbeing	.716	-.653	.196	-.002
V503	limited scope of practice	-.714	.512	-.151	-.360
V504	good interpersonal / communication skills	.644	.330	-.573	-.071
V505	concerned with patients' mental wellbeing	.667	-.303	-.641	-.202
V506	concerned with patients' social wellbeing	.670	-.273	-.651	-.210
V507	concerned with patients' physical wellbeing	.726	-.626	.231	.070
V508	concerned with patients' medical wellbeing	.716	-.639	.223	.066
V509	concerned with patients' personal wellbeing	.670	-.273	-.651	-.210
V510	involved with patients as people	.685	-.250	-.644	-.227
V511	limited or narrow therapeutic focus	-.666	.377	.187	.414
V512	intelligent	-.186	-.851	.370	.076
V513	clever	-.138	-.864	.250	.289
V514	central or focal role in health-care delivery	.670	-.658	.300	.090
V515	clinical or analytical approach	-.151	-.804	.221	.342
V518	problem solvers	.627	-.485	.053	.362
V519	spend time talking to patients	.676	.022	-.622	-.124
V520	focus is ' cure'	.160	-.934	.103	.114
V521	a lot of theoretical knowledge	-.128	-.867	.244	.288
V523	holistic approach	.626	-.464	-.190	.135
V524	broad range of responsibilities	.668	-.705	.177	.095
V525	respect knowledge and skills of other groups	.574	.301	-.537	-.030
V526	work well as a team with other groups	.572	.310	-.532	-.063
V527	compassionate	.687	.195	-.531	-.122

V528	highly trained	-.192	-.855	.296	.157
V601	technical / scientific orientation	-.325	-.853	.329	.144
V602	focus on one aspect	-.910	-.071	-.362	-.158
V603	share knowledge / collaborate	.388	.015	.747	.398
V604	well established professional organisation	.048	-.896	.297	.258
V605	make a large contribution to overall health care	.451	-.617	.591	.130
V607	high standing in health hierarchy	-.154	-.911	.311	.016
V608	central role in health-care delivery	.772	-.494	.356	.137
V609	generalists with a wide variety of skills	.597	-.688	.382	.141
V610	high level of responsibility	.377	-.827	.368	.196
V611	wide range of responsibilities	.594	-.670	.404	.158
V612	high level of academic education	-.326	-.921	.140	.145
V613	broad educational base	.162	-.418	.792	-.138
V614	specialists with particular, focused skills	-.813	.090	-.312	-.155
V615	holistic orientation	.859	.244	.397	.111
V616	people-oriented	.857	.299	.360	.138
V617	interested in medical wellbeing (organism)	.250	-.429	.823	.228
V618	interested in mental wellbeing	.684	.311	.033	.387
V619	interested in physical wellbeing (structure)	.124	-.330	.714	-.469
V620	interested in social wellbeing	.837	.408	.090	.261
V621	interested in personal wellbeing	.868	.229	.375	.120
V622	communicate and relate well	.520	.315	.558	.180
V623	practice based on own discipline and research tradition	-.067	-.910	.198	.267
V624	practice dependent on knowledge generated by others	.077	.792	-.206	-.420
V626	focus on correction of disorder	-.207	-.824	.293	-.304
V627	oriented to promoting wellness	.776	.386	.409	.071
V628	social sciences / humanities	.065	.322	-.590	.664
V629	biological / social sciences	.406	-.030	.198	.659
V630	physical (incl. chem.) / biological sciences	.087	-.939	.253	.157
V631	independent practitioners	-.287	-.815	.026	-.073
V632	autonomous decision-makers	.651	-.604	.306	-.231
V633	decision-making power	.040	-.962	.213	.142
V634	high prestige / status	.311	-.900	.110	.146
V801	mainly male	.061	-.973	-.074	-.032
V802	high level of responsibility	-.156	-.815	.386	.020
V803	broad range of responsibilities	.476	-.305	.531	.482
V804	think of themselves as an elite group	-.492	-.858	-.049	.098
V805	broadly based knowledge	.614	-.771	.142	.047
V806	adjunct to main work of hospital	-.524	.405	-.203	.418
V807	freedom in how they work	-.811	-.373	-.328	.071
V808	focus on a particular aspect	-.764	.536	-.304	-.130
V809	tend to be patient people	.355	.420	-.484	.640
V811	high level of learning / education	-.473	-.811	.186	.157
V812	communicate / share knowledge with other groups	.831	.213	.395	.044
V813	high standing as health professionals	-.732	-.560	-.342	-.023
V814	powerful group in health system	-.688	-.687	-.223	-.026
V815	autonomy in their practice	-.811	-.373	-.328	.071
V816	follow instructions / procedures initiated by others	.801	.340	.385	-.005
V817	specialised knowledge	-.872	-.105	-.375	-.088
V818	high social standing / class / prestige	-.732	-.560	-.342	-.023
V819	generalists with a wide variety of duties	.840	.064	.373	.016
V820	work hands-on	.785	-.334	-.308	-.420
V821	interact closely with patients	.925	.043	.118	.050
V822	interested in physical wellbeing	.881	.077	.251	.124

V823	interested in emotional wellbeing	.662	-.290	-.648	-.227
V824	interested in mental wellbeing	.384	.403	-.670	.443
V825	interested in social wellbeing	.684	-.226	-.657	-.210
V826	interested in medical wellbeing	.718	-.522	-.127	-.249
V827	accepting / tolerant	.191	.321	-.678	.435
V829	work to routines	.551	-.233	.460	-.491
V831	mainly middle class backgrounds	-.732	-.560	-.342	-.023
V832	interested in people as people / overall person	.839	-.050	-.512	-.153
V833	technical or clinical role	.327	-.581	.208	-.510
V1201	highly trained	-.507	-.708	-.209	.249
V1214	follow instructions / procedures initiated by others	.489	.652	.334	-.178
V1219	roles overlap or crossover with other groups	.114	.740	.016	.115
V1221	primarily talkers or advisors	-.307	.667	-.475	.221
V1222	concerned with medical welfare	.268	-.756	-.129	.391
V1223	concerned with mental or emotional welfare	-.076	.147	-.647	.353
V1224	concerned with personal or social welfare	-.141	-.493	-.619	.209
V1226	spend a lot of time with each patient	.743	.528	.329	.088
V1230	peripheral to the main work of medical treatment	-.381	.476	.196	-.475
V1231	peripheral to the main work of patient care	.231	.086	.354	.409
V1401	well educated or highly trained	-.598	-.589	-.409	.144
V1403	academically oriented	-.494	-.697	-.212	.340
V1405	social science oriented	-.190	.386	-.771	.455
V1406	people oriented	.602	.556	-.439	-.101
V1407	make critical or vital decisions	.277	-.600	-.441	.562
V1408	high level of responsibility	-.486	-.751	-.327	.138
V1409	independent decision-makers	-.451	-.551	-.513	-.378
V1410	arrogant or aloof	-.578	-.602	-.345	.312
V1411	dogmatic with patients	-.639	-.620	-.026	.188
V1412	dogmatic with other groups	-.501	-.718	-.441	-.018
V1413	condescending with patients	-.411	-.595	-.401	.120
V1414	lot of influence on care / treatment decisions	.018	-.976	-.215	.027
V1415	like working with people	.352	.432	-.552	.530
V1416	relate ' on a level' with patients	.411	.698	.038	-.036
V1417	empathetic in their approach	.375	.540	-.648	.155
V1418	accept advice / share information	.418	.766	.023	-.068
V1419	spend a lot of time with each patient	.536	.628	-.477	.098
V1420	direct contact / relate closely	.662	-.290	-.648	-.227
V1421	work ' hands-on'	.749	-.035	.137	-.581
V1422	teaching or instructing role	-.274	-.291	.354	-.209
V1423	advisory role	-.360	-.304	-.072	.785
V1424	high status in health hierarchy	-.437	-.829	-.148	.248
V1427	practical bent	.439	.117	.118	-.662
V1428	work towards physical welfare	.162	-.414	.793	-.158
V1429	work towards emotional welfare	.669	.456	-.408	.370
V1430	lot of variety in their work	.239	-.546	-.608	.346
V1501	care, support, look-after, nurture	.658	-.304	-.644	-.222
V1502	personal style with patients	.658	-.304	-.644	-.222
V1503	relate ' on a level' with patients	.671	-.301	-.636	-.211
V1504	' talk down' to patients	.080	-.935	.006	.026
V1505	there to listen to patients	.658	-.304	-.644	-.222
V1506	there to tell rather than to listen	-.019	-.715	-.229	-.555
V1507	short term involvement / contact	-.566	-.206	-.236	-.035
V1508	long term interest	.426	.689	-.307	.026
V1510	communicate well with other groups	.846	.374	.283	.027

V1511	focus on own job and not interested beyond that	-.807	-.314	-.371	-.055
V1512	take interest in patients as whole people	.658	-.304	-.644	-.222
V1513	' I know everything' attitude	-.206	-.857	.283	.139
V1515	independent - don' t have anyone to answer to	-.881	-.224	-.385	-.081
V1516	their work is part of the nurses' role	.858	.392	.214	.055
V1517	personally involved	.873	.332	.224	.091
V1518	spend a lot of time with patients	.917	.300	.110	.048
V1519	too busy to spend much time with patients	-.713	-.569	-.306	-.111
V1520	high position in health hierarchy	.319	-.922	.001	.127
V1521	interested in mental and social aspects	.930	.103	.188	.160
V1522	interested in physical aspects	.646	-.501	.083	-.527
V1525	oriented to ' fixing' things	.633	-.391	-.608	-.267
V1526	good rapport	.907	.215	.303	.090
V1601	specialised in narrow field	-.645	.077	.417	.361
V1603	prefer not to deal with people much	-.678	.290	.635	.221
V1604	focus on a small area or section	-.741	-.242	.014	-.320
V1605	have a lot of contact with patients	.656	-.315	-.383	-.382
V1611	help people find solutions to their problems	.263	-.203	-.759	.082
V1613	ongoing interest in patients	.513	-.082	-.490	-.190
V1614	willing to listen to patients	.683	.390	-.330	.429
V1615	work from knowledge base and leave care to others	-.884	-.401	.090	.061
V1616	arrogant	-.425	-.588	-.564	-.050
V1617	work to change peoples' attitudes	-.363	.538	-.581	.204
V1618	help people adjust to their daily lives	.113	.561	-.700	.343
V1621	work to improve patients' mental or emotional state	.673	-.291	-.646	-.190
V1622	work to improve patients' personal or social wellbeing	.662	-.279	-.663	-.187
V1623	mostly concerned with immediate medical condition	.631	-.733	.211	.052
V1624	high status in health system	.396	-.884	.060	.117
V1625	deal with the totality of the patient	.735	-.592	.263	.084