

THE VALIDATION OF THE  
FIELD - ENVIRONMENT - DUTY  
OCCUPATIONAL CLASSIFICATION SYSTEM  
AND INTEREST TEST

by

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# THE VALIDATION OF THE FIELD - ENVIRONMENT - DUTY

## OCCUPATIONAL CLASSIFICATION SYSTEM AND INTEREST TEST

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### SUMMARY

Vocational interest is a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and situations already experienced or expected to produce pleasurable feelings. Interest test fields are usually statistically derived from characteristics of individuals. This study develops and validates an interest test based on the perceived occupational structure.

After examining various classification models and occupational classification systems, including work by Holland, Gati and Roe, a new network access model was proposed, based on many-to-many correspondence in set theory. Categories are arranged on levels. Choice of a category on one level precludes access to another category on the same level, but does not restrict access to categories on other levels. It was hypothesised that occupational structure is perceived to consist of the three levels of fields, environments and duties. Each category is a horizontal situs group and includes all vertical status levels. Career choice is based on preferences at each level. 1200 jobs have been classified by allocation to one category on each level, and each is described by a field, environment and duty.

The field-environment-duty (FED) system was operationalised in a ten minute interest test asking testees to choose from each level the three categories that interest them for a job. Extensive use was made of  $\chi^2$  and  $\theta^2$  statistics in analysing nominal measurement scores.

The FED test was applied to 1280 school-leavers in Gauteng, South Africa. Research supports Gati's division of occupations into "soft" (people-oriented occupations preferred by females), and "hard" (not-people-oriented occupations preferred by males), and introduces a third "neutral" division which is preferred equally by both males and females. Construct and concurrent validity was shown with the 19FII, VIQ, SDS and 16PF.

In a four to five year longitudinal study the FED was found to predict future studies (80%) and occupation (86%). Research with working adults found that the FED test predicts concurrent job satisfaction, job tenure and self-assessed performance. Inter-rater reliability in assigning jobs to categories is around 80%. Test-retest reliability was significant to the 0,0001 level using the  $\chi^2$  goodness of fit test.

KEY WORDS: Occupational classification; Job classification; Interest tests; Career guidance; Situs groups; Career choice; Gati; Holland types; Field - Environment - Duty classification; Network access model

## LIST OF ABBREVIATIONS

16PF	Sixteen personality factor questionnaire
19FII	Nineteen field interest inventory
20FII	Twenty field interest inventory
ACT	American College Test
BIS	Basic interest scales of the Strong vocational interest blank
DOT	Dictionary of occupational titles
FED	Field-Environment-Duty occupational classification system and interest test
GSAT	General scholastic aptitude test
HSRC	Human Sciences Research Council
HSIQ	High school interest questionnaire
ISCO	International standard classification of occupations
ILO	International Labour Office
MVII	Minnesota vocational interest inventory
PAQ	Position analysis questionnaire
PVIQ	Picture vocational interest questionnaire
SAVII	South African vocational interest inventory
SDS	Self directed search questionnaire
SVIB	Strong vocational interest blank
SVIB - BIS	Strong vocational interest blank - basic interest scales
VIQ	Vocational interest questionnaire
VPI	Vocational preference inventory

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## CHAPTER 1- INTRODUCTION

### *SCOPE OF THE CHAPTER*

*The need for a link between vocational guidance interest tests and occupational classification systems will be discussed. The reason for this study will be established and a problem statement proposed.*

### INTRODUCTION TO THIS STUDY

In their extensive use of interest tests for career guidance, psychologists assume that interest fields are related to jobs or occupations. Patterns of scores on interest test fields are presumed to reflect the relationship between jobs. An interest test is thus seen as a classification or operationalisation of the perceived occupational structure.

Present interest tests are generally limited to classifying occupations according to fields, each of which is generalised to require a unique set of abilities and to take place in particular circumstances. For example, the legal field is assumed to consist of lawyers who have a law degree and work in a legal practice. It does not include, say, accountants specialising in tax law and working in large corporations.

**This study proposes the use of an interest test based on a multi-level, overlapping structure of occupations which, in addition to classifying jobs by fields, takes into account the environment in which the jobs take place and the duties performed. Existing occupational classification systems and interest tests will be discussed. A new three dimensional model of occupational structure will be presented and validated as both an occupational classification system and as an interest test.**

## A BRIEF HISTORY OF CAREER GUIDANCE

Although man has always engaged in work, there was initially no need for career guidance. Work in pre-historic societies was directed at individual survival. Specialisations arose with time, and in Ancient Rome and Athens people could usually choose their careers. This changed when the ancient world collapsed. Throughout the Middle Ages, Renaissance and Industrial Revolution, choice of career was mainly determined by social class and family occupation. According to Brown and Brooks (1991), it was only after the growth of the humanitarian movement at the turn of the twentieth century that placing workers in the right jobs was emphasised, and there was freedom of individual career choice (Borow, 1979).

Parsons (1909) started a *Vocation Bureau* in Boston in 1908 to help low-income children (14 years and older) decide on suitable occupations after leaving school. According to Brown and Brooks (1991), he wanted to prevent exploitation of workers by industrial monopolists. It is generally accepted that career development theory and practice began with his conceptual framework for career decision making, which involved three aspects:

- information about the individual
- information about jobs, and
- a matching of the two.

Ginzberg (1972) and Gysbers (1984) trace the development of career guidance after the depression of the 1930's. Work became more plentiful and productivity more important. Researchers began to develop measurements to match people's aptitudes to skill requirements for specific jobs.

Differential techniques which statistically identify traits were used by Paterson (1941) and others at the University of Minnesota to develop psychometric instruments and tools for personal analysis. Use of special aptitude and attitude tests became known as the *Minnesota point of view* and *scientific development*. During the Second World War research was extended to placing military staff in the USA armed forces (Weinrach, 1979b).

During the 1950's career development theories began appearing in the literature. Ginzberg (1951) and Super (1951) spearheaded a *psychological development* approach to career guidance, in which values, attitudes, feelings and aspirations became central. The term *vocational development* became popular.

Holland's (1959) *theory of careers*, which classifies people and job environments into six groups, dominated research in the 1960's and 1970's. Dawis and Lofquist (1964) introduced the *psychology of work adjustment*, matching job "reinforcers" to an individual's "work needs". This process has been discussed under various names such as "congruence" (Holland, 1985; Weinrach, 1979b), "matching" (Schein, 1978), and "person-environment fit" (Muchinsky and Monohan, 1987).

In the late 1970's and 1980's minority groups, including women and the disadvantaged became major issues politically and in career guidance. This is reflected in a book edited by Brown and Brooks (1991), where each career guidance method is examined with regard to its effect on these groups. Schein (1978) introduced career anchors, which he described as "*an occupational self-concept broader than the typical concept of job value or motivation to work; an internal force guiding, constraining, stabilising and integrating a person's career*". It was operationalised in the Career Orientation Inventory (Schein, 1985).

Business and industrial organisations began to take an interest in adult-focused career guidance, leading to the concept of career development for adults (Gysbers, 1984). There has since been a proliferation of vocational guidance instruments (Gysbers, 1984), including theory-based and self-assessment instruments, particularly based on Holland's (1959) work. Various career decision making models and theories are described and criticised in Brown and Brooks (1991).

Nearly a century after Parsons (1909) set out the basis for career guidance, the emphasis is still on increasing an individual's chance of job success and satisfaction by using tests, techniques and assessments to describe and fulfil self-concept. Choice of occupation is recognised as involving many personal-social needs such as socio-economic status, friends, self-esteem, the quality of leisure time, and personal and geographic freedom.

### **INTEREST TESTS - THE BACKGROUND**

Research into the interests of different groups of people began in the 1920's. By the mid 1930's, Strong (1943) had developed *Vocational Interest Blanks*, providing interest profiles of men and women in particular jobs. From the early 1940's, after the great depression, research focussed on placing people in the right jobs and activity directed at developing interest tests accelerated.

During the 1950's multi-variate psychometric techniques were applied to studying interests (Guilford, Christensen, Bond and Sutton, 1954). Strong revised his Interest Blanks (Berdie and Campbell, 1968). The Kuder Preference Records (Kuder, 1963) and various derivatives were devised, categorising interests into broad fields.

Holland (1959) presented his *theory of careers*. Development of interest tests to operationalise the theory, particularly with self-assessment instruments, has largely dominated United States research since then, and South African research since the 1980's. Much effort in the USA has also been directed at adapting the Strong Interest Blanks to accommodate women's interests (Hansen, 1992), resulting in the Strong-Campbell Interest Inventory (Campbell, 1974).

A South African adaptation of the Kuder Preference Records was made available in the 1960's (Protea educational services, undated). This was followed by various locally developed interest tests in the 1970's (19 Field Interest Inventory, 1970; High School Interest Questionnaire, 1973; Vocational Interest Questionnaire, 1974). Two widely used interest tests based on Holland's (1959) theory are the Self Directed Search (Gevers, du Toit and Harilall, 1992) and the South African Vocational Interest Inventory (Du Toit, 1992).

### **OCCUPATIONAL CLASSIFICATION SYSTEMS - THE BACKGROUND**

A classification system organises items into categories. In occupational classification systems the items organised are jobs and occupations.

The first official occupational classification systems were introduced in the late 1800's by governments for census information. In the work situation, work study and personnel practitioners have been describing jobs since the early 1900's but it was only in the late 1930's that scientific methods were introduced to classify jobs for career guidance. As part of the movement to get the United States working after the depression, the US Employment Services published the first edition of the Dictionary of Occupational Titles (DOT) in 1939 (Brown and Brooks, 1991).

The DOT gave a broad range of information about the content and characteristics of occupations, for use by USA government employment interviewers (Miller, Treiman, Cain and Roos, 1980, p 18).

The psychology and structure of occupations were extensively researched immediately after the Second World War. Sociologists began querying the traditional classification of workers into status levels, resulting in the proposition of a non-hierarchical, "situs" classification of occupations (Hatt, 1950). Roe's (1956) *psychology of occupations* was the first attempt to classify occupations into groups.

The theory of careers proposed by Holland (1959) is considered a breakthrough in job classification. He proposed six interest/personality types, previously suggested by Spranger (1928) and operationalised in Allport, Vernon and Lindzey's (1931) *Study of values* scale. Holland's contribution was to suggest that most people in a particular occupation fall into one of the types, thus facilitating a match between workers and jobs. In the early 1960's the classification of tens of thousands of jobs into six categories was criticised as simplistic. It was also pointed out that it was more a classification of workers than of jobs. These issues were sidestepped when Holland (1966) suggested that his theory could be represented as a hexagonal model with adjacent occupational types having the highest correlations. This started ongoing research into the structure of occupations during the late 1970's. The latest research, in Israel, is on statistically derived *structural models* (Gati, 1979, 1991).

## THE PRESENT SITUATION

Interest tests fields have not been researched as occupational classification systems. In general, the fields are derived from descriptions of groups of people doing particular work, rather than from the jobs themselves. The fields describe interest factors rather than reflecting peoples' perception of occupational structure. Because the fields are inflexible and insensitive to changes in technology and perceptions of the job structure they tend to go out of date. For example, jobs in the computer industry are covered only by inference in most interest tests. On the other hand, occupational classification research and systems, which have never entirely met the needs of career counsellors, are becoming more mathematical and theoretical, with consequently reduced practical applications in career guidance.

A comprehensive occupational classification system, going beyond interest test fields is needed for matching individuals to jobs. According to Lofquist and Dawis (1969), career counselling is limited by the lack of a systematic system for describing work, its problems and solutions. Without a "psychology of work", career guidance practitioners face the impossible task of knowing in detail about each one of thousands of occupations. An interest test based on the similarity between jobs, rather than the characteristics of people doing the jobs, would assist career guidance practitioners to improve the quality of help given to people with their career choices.

## PROBLEM STATEMENT

This study sets out to develop and validate an occupational classification system and show that it can be used as an interest test. The problem statement to be addressed is:

*Can an occupational classification system  
be devised, operationalised and validated  
as an interest test for career guidance?*

## OVERVIEW OF CHAPTERS

- CHAPTER 2: VOCATIONAL INTEREST TESTS. *The definition and nature of interests. The theory behind interest tests and factors affecting the measurement of interests. Interest tests in use.*
- CHAPTER 3: OCCUPATIONAL CLASSIFICATION SYSTEMS. *A description of classification models. A discussion and criticism of occupational classification systems in use.*
- CHAPTER 4: THE DEVELOPMENT OF THE FIELD - ENVIRONMENT - DUTY OCCUPATIONAL CLASSIFICATION SYSTEM AND INTEREST TEST (FED). *Conceptualisation of the FED occupational classification system. Operationalisation of the interest test to be used as the measuring instrument in this study.*
- CHAPTER 5: RESEARCH DESIGN. *An outline of research to be conducted, including procedures for validating the FED as an occupational classification system and as an interest test.*

- CHAPTER 6: EVALUATION OF THE FED AS AN OCCUPATIONAL CLASSIFICATION SYSTEM. *Evaluation of the FED as an occupational classification system. Scientific basis, comprehensiveness, cohesion and rationality of the system.*
- CHAPTER 7: EVALUATION OF THE FED AS AN INTEREST TEST. *Psychometric evaluation of the FED test. Test rationale, construct validity, predictive validity, concurrent validity and reliability, standardisation and objectivity.*
- CHAPTER 8: DISCUSSION AND SUMMARY. *Summary of the study. The impact of the network access model, the FED occupational classification system and the FED interest test. Areas for further research.*

## CHAPTER 2 - VOCATIONAL INTEREST TESTS

### SCOPE OF THE CHAPTER

*The definition and nature of interests.. The theory behind interest tests and factors affecting the measurement of interest.*

*Interest tests in use..*

### THE DEFINITION OF VOCATIONAL INTEREST

It is generally accepted that interest tests are measurements of sentiment. Nunnally (1970, p 162) distinguishes between *judgments* and *sentiments*. A judgment is either right or wrong because it can be compared with a correct answer. A sentiment is a subjective statement of personal likes, attitudes and reactions, reflecting a positive sensation concerned with an ideal state. When someone is asked whether they are interested in, say, gardening, their answer cannot be judged to be correct or incorrect. It is not right or wrong to have a certain level of interest in gardening. Responses of "yes", "no" or "it depends" are all satisfactory. Interest, or lack thereof, is felt within the individual.

Subjective evaluation of sentiment is shown in definitions of interest. Bordin (1943) describes interest as a measurement of self-concept. Strong (1945) talked of "our awareness and disposition towards an object". Super and Crites (1962) analysed interests as resulting from various individual physiological and socialising factors. Guilford (1959) proposed that interest is a dynamic factor of personality. This is the view taken by developers of South African interest tests (Van Vuuren, 1962; Fouche and Alberts, 1971; Gevers, du Toit and Harilall, 1992).

A common factor in the definition of interest is that an individual makes a decision that something is liked or disliked. This need not be rational or cognitively based, but can arise from vague needs, drives and feelings. As Guilford (1959) points out, interest involves emotions, about previous experiences and beliefs about personal reactions in similar situations. In expressing an interest towards an occupation, an individual draws on personal experience of known related jobs, including ability to handle the work and the interpersonal situations which may arise. The potential is considered of the occupation to satisfy life stage needs (Super and Hall, 1978), work values (Langley, 1992), and career anchors (Schein, 1978). The way the individual relates jobs to each other is his or her *perceived occupational structure*.

A school leaver with no work experience has to rely on stereotypes of occupations in perceiving the occupational structure and in stating a vocational interest. The statement, "I hate desk work" could be based on not enjoying sitting in a classroom, and on complaints overheard from a parent about the boss in the office. As people gain work experience their perceptions of inter-relationships between jobs, working situations and occupational fields become more accurate. This is a factor of *career maturity* (Langley, du Toit and Herbst, 1978) and highlights that interest is dynamic and can be learnt. In full career maturity, the individual's perceived occupational structure should reflect the actual structure of occupations. A comprehensive definition of vocational interest includes all the aspects discussed.

***VOCATIONAL INTEREST*** is a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and situations already experienced or expected to produce pleasurable feelings.

## INTEREST TESTS IN CAREER GUIDANCE

Psychologists use vocational interest tests (with tests of intelligence, abilities, personality, values, career anchors, career maturity and biographical detail blanks) to gain a composite picture of a testee. Intelligence is assumed to indicate scholarship ability. Abilities influence successful performance of work. Personality could indicate the interpersonal situations which will best suit the testee. Values and career anchors may affect the rewards wanted from a job. Career maturity can indicate how much input is needed to make a "rational" choice, and biographical details may give relevant details of personal achievements and parents' occupations. But interest tests are important because they provide a direct link to occupations. It is only when interest is taken into account that a conclusion can be reached regarding career direction.

Table 2.1 gives an example of how knowledge of interests simplifies career guidance. Most jobs could be suggested based on the information given. It is only when it is known that the person has a high tested interest in logic, and plays chess, that computer programming becomes an option. Alternatively, if the person

Test administered	Result
Intelligence	IQ= 113
Abilities	High numerical
Values	Money
Career anchor	Geographical
Personality (16PF)	Low M (indicates precision, low creativity)
Parents' occupations	Father - Salesman Mother - Secretary
School achievement	University entrance, borderline fail, best subject maths

has a high tested interest in working with equipment and spends weekends drawing, engineering draughting is a possibility.

**Table 2.1: Hypothetical test results for career guidance**

This example shows why Nunnally (1970, p 148) suggests that interest tests are second only in importance to intelligence tests as aids to career guidance.

## INTEREST MEASUREMENTS IN USE

According to Lowman (1991, p 37) the most commonly used measures for testing interests in the USA are the Self directed Search (SDS), Vocational preference inventory (VPI) and the Strong Vocational Interest Blank (SVIB). In South Africa, the Human Sciences Research Council (HSRC) advise that the 19 Field Interest Inventory (19FII) is most ordered by psychologists. The South African Vocational Interest Inventory (SAVII), used with the MENTOR computerised career guidance system and available to teachers, has replaced the Self Directed Search (SDS) as the next best selling interest test. Both the SDS and SAVII are based on Holland's (1959) theory of careers. The High School Interest Questionnaire (HSIQ) and Vocational Interest Questionnaire (VIQ) are also in demand.

### Historical perspective - USA

Research into interests began in the 1920's. Berdie and Campbell (1968) discuss the breakthrough that Strong (1943) made in interest measurement when he measured the interests of people in specific occupations against a control group of "men in general". By the mid 1930's he had developed *Vocational Interest Blanks* (SVIB) for both men and women.

From the early 1940's vocational guidance activity increased, aimed at placing people in the right jobs. The SVIB remained the standard interest measurement until the Kuder Preference Scales (Kuder, 1963) were introduced in the 1950's. In contrast to the SVIB, which was *empirically-based*, the Kuder scales were *theory-based*. They measured interest fields and not occupational groups. The Rothwell-Miller Interest Blank (Miller, 1968), based on Kuder's work, was introduced to Australia in the late 1950's, and Britain in the 1960's.

The Minnesota Vocational Interest Inventory (Clarke and Campbell, 1965) and the Career Assessment Inventory (Kapes and Mastie, 1988) were derived from the SVIB. By this time Holland (1959) had introduced his theory of careers. The accompanying Self Directed Search (SDS), Vocational Preference Inventory (VPI) and American College Testing (ACT) instruments appeared in the 1970's. The ACT career planning programme incorporated Roe's (1956) occupational classification (Prediger, 1976). Pressure from the women's liberation movement led to a revision of the SVIB with the Strong-Campbell Interest Inventory (Campbell, 1974) which measured males and females on the same form. In the mid-1980's revised editions of the SVIB, SDS and Kuder Occupational Interest Survey were published. Lesser known tests are discussed in Kapes and Mastie (1988).

### **Historical perspective - South Africa**

A South African adaptation of the Kuder Preference Records was available in the 1960's for vocational guidance (Protea Educational Services, undated). The University Guidance Interest Questionnaire (*Universiteitsvoorligtinghelangstelingsvraelys*) (Van Vuuren, 1962) was not generally used. It concentrated only on study direction and applied only to Afrikaans speaking matriculants and university students (Smit, 1981).

During the 1970's the HSRC developed a number of South African interest instruments, namely the 19 Field Interest Inventory (19FII) (Fouche and Alberts, 1970), the High School Interest Questionnaire (HSIQ) (Wolfaart, 1973) and the Vocational Interest Questionnaire (VIQ) (Coetzee, 1974). The HSIQ was specific to coloured school pupils and the VIQ to black pupils under the Apartheid régime.

The Cape Education Department (in association with Stellenbosch University) published the Kodus Interest test (Psychological and Guidance Studies, 1978). In 1981 the Picture Vocational Interest Questionnaire (PVIQ) (Taljaard, 1981) for "illiterate adults" (sic) was introduced at the request of the Department of Prisons. The latest developments in South African interest measurements are based on Holland's (1959) work. These include validation of the SDS for South African conditions in 1985 and 1988, and MENTOR, a computerised self-assessment career guidance system for schools. The Easy Steps Guide (Pickworth, 1993) uses some of the subdivisions of Holland's categories from the ACT occupational classification (Prediger, 1976). The South African Vocational Interest Inventory (SAVII) was introduced in the early 1990's (Du Toit, 1992) based on the Easy Steps Guide.

### Descriptions of interest tests

General descriptions of the following interest tests are given:

- Strong Vocational Interest Blank (SVIB)
- Kuder Preference Record
- 19 Field Interest Inventory (19FII)
- Vocational Interest Questionnaire (VIQ)
- Holland-based tests: Self Directed Search (SDS)  
and South African Vocational Interest Inventory (SAVII)

### Strong Vocational Interest Blank (SVIB)

The original 1935 version had separate blue and pink interest blanks for men and for women. The tests were developed by comparing interest profiles of successful people in various occupations with profiles for the general population. Fifty occupational scales were given for men and thirty for women. The test is interpreted by matching an individual's profile to the occupational profiles.

Normalised symbols are provided: an A or B+ indicates an occupation is suitable as a job choice. Selected items are used for special scales of interest maturity, occupational status level, specialisation level and masculinity/femininity. Eleven occupational groups were identified by factor analysis.

The SVIB was updated in 1969, 1974, 1981 and 1985. The MVII was an adaptation for 21 non-professional occupations compared with tradesmen in general. Most of the revision work resulted from user suggestions (Hansen (1992)). A major advance was the introduction in 1969 of 22 *basic interest scales*, comprising clusters of items with high inter correlations. Male and female scales were merged and made equivalent in 1974. Later revisions included more non-professional and technical occupations and introduced further special scales.

The SVIB measuring instrument is particularly comprehensive. Twelve indications of preference are included in 400 items. Testees score occupational titles, school subjects, amusements/hobbies, activities/ways to spend time, and peculiarities/mannerisms of people on a scale of "Like, Indifferent, Dislike". They pick their three favourite and three least-liked production stages, values and positions in a social club. Items regarding occupations, activities, characteristics of different work situations, types of people, individual work habits, abilities, personality and emotional reactions are rated.

## Kuder Preference Record

Kuder took different approach, developing a family of tests (including the Kuder Preference Record: Vocational, the Kuder Preference Record: Personal, and the computerised Kuder Occupational Interest Survey) to measure ten general areas of interest.

The testee indicates the most-liked and least-liked of a group of three activities. A verification scale indicates how seriously the testee has treated the test. The resultant individual profile of interests can be used for general guidance to indicate an occupational direction.

The Kuder interest fields are the basis for the Australian Rothwell-Miller Interest Blank, subsequently adapted for British use. Twelve fields of interest are called *stereotype categories of occupations*. Testees are required to rank order lists of twelve occupations according to preference. The test is marketed in South Africa through the Johannesburg HSRC office.

## 19 Field Interest Inventory (19FII)

This test is based on the Californian Occupational Preference Scale (Kapes and Mastie, 1988) and is the most popular interest test in South Africa. It is normalised for pupils in standards 8, 9 and 10, but is also used for adult career guidance and for standard 7 subject choices.

Testees indicate how much they would like to do each of 285 activities, irrespective of ability. Items cover work and leisure activities. Raw scores for each of nineteen interest fields are calculated by adding item scores. A profile is drawn of standard scores which are obtained from norm tables.

Six groupings indicate study direction, namely aesthetic (humanities), social service (social sciences), intellectual/scientific (sciences), practical (engineering and trades), business and law (commerce) and outdoors. Two special scales assess whether interests are work or hobby related, and whether the testee prefers to be active or passive.

The test has never been revised. Many items are out of date and modern occupations in the computer or health/aerobics/human movement industries are not covered. Despite this, the test is popular because of the wealth of information it delivers. Even if a testee has a low interest in all the fields, conclusions can be drawn from preferred items about possible career directions.

### Vocational Interest Questionnaire (VIQ)

The High School Interest Questionnaire and Vocational Interest Questionnaire are very similar. The former was developed for coloured schools in 1973 (Wolfaart, 1973) and the latter for black pupils in 1975 (Coetzee, 1975). Both consist of lists of activities. Testees have to indicate whether they like, dislike or are indifferent to each activity. HSIQ fields are adapted from the 19FII and the VIQ fields are based on Roe's (1956) job classification. Scores are profiled by percentiles. Both tests are used in practice for school pupils and adults of all race groups.

### Holland type tests

The "Holland types" were first identified by Spranger (1928) and operationalised in the *Study of values* (Allport, Vernon and Lindzey, 1931). Holland (1959) used the six values as the basis of his theory of careers.

The self assessment Self Directed Search was developed by Holland in 1970 to operationalise this theory. There are four sections in the test. Testees have to state whether they like to do or think they would like to do an activity (rated as *yes*), or whether they are indifferent to, have never done or do not like to do the activity (rated as *no*). Interest thus cannot be shown in activities the testee has never experienced. Testees then assess their competency in various activities and choose occupational titles that appeal to them from an inventory. Lastly, a self rating of abilities and skills relevant to each of the Holland types is obtained. Additive scores are calculated for each type. A three-digit code of the three types with the highest scores is matched to occupational codes.

The test was adapted to South African conditions in 1985 and 1988. This involved changing the wording of some items and verifying with samples of South African school pupils some of Holland's previous research.

The South African Vocational Interest Inventory (SAVII) (Du Toit, 1992) is based on the Easy Steps Guide (Pickworth, 1993), in turn derived from the ACT occupational classification subdivisions of the Holland categories (Prediger, 1976). Because of its link with the computerised MENTOR career guidance system, SAVII is sold to teachers and outsells the SDS which is only available to psychologists. Testees are asked to indicate their interests in 126 work activity items. Each Holland type is split into three sub-fields represented by seven items. Raw scores for the 21 sub-fields can be compared and directly related to jobs.

## PSYCHOMETRIC QUALITIES OF INTEREST TESTS

### Classification of interest tests

Super's (1949) classification of interest measurements distinguishes the following categories:

○ Expressed interests - *what the individual says he or she is interested in doing.*

The response to the question, "what do you want to do when you leave school?" is an expressed interest. This is a specific case of predicting ability through self assessment of ability (in this case the ability to remain enthusiastic about the interest). Dolliver and Nelson (1975) cite comparative studies showing that expressed interest is more often accurate in predicting future occupation than are other interest measurements. Asking an open question about future intentions does not limit the answer to the list of activities, occupations or interest fields included in an interest test. Career guidance counsellors usually supplement interest tests with a question about expressed interests.

○ Inventoried interests - *what the individual chooses from a list of interests.* The

test developer decides what will be included in the inventory. Items are usually grouped into interest fields. All of the tests discussed in this chapter are measurements of inventoried (listed) interests. The Rothwell-Miller test is a true test of inventoried vocational interests because testees rank order their occupational preferences. Other tests measure the individual's interest in a field by summing scores across the relevant items.

- Manifest interests - *what the individual does to pursue an interest.* A child who spends hours playing the guitar is manifesting an interest in music. Time spent on an interest may predict a higher than normal ability in the area, either due to natural talent and enjoyment of the status that goes with performing well, or because skills improve with practice. The inter-relationship of manifest interests and ability is taken into account in the SDS, where ability/skill in various areas is rated as well as competency/knowledge of specific skilled activities.
- Tested interests - *objectively obtained interest measurements by a third party observing or testing the individual and comparing interest levels to a norm group.* When tested interests can be observed, they are manifested interests. Expressed or inventoried interests are measured in a testing situation. Psychologists do not usually observe interests for career guidance purposes unless they are attached to a school, assessment centre or similar institution. Interest tests using inventories are the most common way of assessing interests, especially for career guidance.

### **Criteria for psychometric tests**

Not every test is a psychometric test. For example, an English essay topic set for the purpose of estimating a person's ability to use the language is not a psychometric test. Psychometric tests are aimed at scientifically observing and describing psychological constructs. To be regarded as scientific procedures, tests have to be systematic, both with regard to application of the test and also as to conclusions which can be drawn.

Smit (1981, pp 20-23), concurring with classical works (Thurstone, 1938; Guilford, 1954; Cronbach, 1970) sets out evaluation criteria for a psychometric test.

○ Rationale - *The basis of the test must be set out.* This includes what is being measured, why it is measured, the theory on which the test is based, and how the measurement will be carried out. The rationale restricts the use of the test. It is closely connected to the development design which describes how items will be chosen, the sample for validating the instrument and the statistical techniques that will be used to determine validity and reliability.

○ Validity - *The test must measure what it is supposed to measure.*

- Tests must have face validity. They must "look right". For example, a mathematics test which aims to evaluate the skill of standard 6 pupils must include work covered in standard 6. An interest test must ask about interest in various activities or occupations. It cannot ask questions about, say, family communication patterns, because there is no public perception of a relationship between these patterns and interests. Without face validity a test lacks credibility and is not accepted by testers or testees. Face validity makes a test usable.
- Construct validity measures whether the the test corresponds with the theory behind it. It does not examine whether the theory is correct. (This is the realm of scientific research which will in time discredit or advance the theory.) Construct validity does control whether the theory is represented by the test. For example, if a personality test is based on a theory which states that there are ten personality factors, then the test must measure all ten factors. If there is another test of the same ten factors, results from the two tests must be compared to determine whether they measure the same constructs.

This critterion related validity indicates whether test items represent the theory and its constructs. It does not include a broad sweep of correlations with all other tests on any subject (this is dealt with later as concurrent validity).

- Logical validity is concerned with whether there are enough items in the test. If a personality trait is shown in five different types of behaviours, there must be at least five items covering the behaviours. Because a testee may not relate to one item, more items may be needed to cover the behaviour. The test should have enough items to discriminate between levels of the characteristic in individuals (discriminability of the test). The logical problem is how many items to include before reaching the point of diminishing returns from including another item.
- Factorial validity is shown in the relationship between each item and the central characteristic it measures. Test items inevitably overlap: they apply to many factors and measure the same things. Ideally, an item should contribute to only one factor. Items for a factor should also be highly related to one another and not to other items. This is termed convergence.
- Predictive validity is the ability to draw conclusions from the test. True predictive validity measures whether the test predicts what it is supposed to predict. For example, if a test measures that a child is aggressive, the test is predictively valid if she actually hits someone. Concurrent validity is a special case of predictive validity and measures how accurately other test results can be predicted from the test in question. Thus, it may be possible to predict that the aggressive child (personality test result) will have an interest in martial arts (although an interest test has not been administered) if there is a known link (high correlation) between aggression and an interest in martial arts.

○ Reliability - *The accuracy of test results must be able to be trusted.*

- Standardisation controls extraneous variables, that is the external circumstances which could influence the result. A written procedure ensures that the test is administered and scored in exactly the same way by different testers. Testing conditions are described to take account of situational factors which could affect results. For example, a mechanical aptitude test may give different results if it is conducted in the dark. Standardisation reduces the chance of a tester influencing results in the administration or scoring of the test.
- Norm tables supplied with most psychometric tests determine the level of the testee's measured characteristic compared with other people. Initial validation or "proof" that the test works is performed on a defined group of people termed the *norm group*. Reliability is increased if the test is not generalised to any person who would not have been included in the norm group. To give an extreme example, if a test has been validated on a group of young male long-term prisoners, the application of the test to a middle-aged female would not produce reliable results.
- Results must not be significantly influenced by the addition or deletion of one item. This is a design problem closely related to logical validity. The reliability of the test can be measured by correlating the scores on two halves of the test, referred to as split half reliability. The standard error of measurement indicates the extent to which differences between the two halves of the test may influence results.

- Some conditions affecting testees cannot be controlled in test development or administration. For example, a testee may score low on an intelligence test because of a bad cold. The effect on the test of what is happening in peoples' lives is statistically estimated by applying the test to the same group of people after an interval of time to determine *test-retest* reliability. Correlations between scores indicate how much the results can be relied on, while the standard error of measurement estimates the extent of introduction of errors into the results from other sources.

○ Objectivity - *This reduces the chance that a testee may lie or "fake" responses to present a favourable or an unfavourable view of him or herself.* There are many ways of handling this, one being to conceal what is being measured from the testee. Thus, if "sociability" is being measured, a better reflection of its true level will be obtained if the testee doesn't know what is being tested, than if it is known that the factor has to do with "how you get on with other people".

### The impact of psychometric tests

A feature of scientific psychometric tests, not dealt with in the literature, is that, when results are communicated to testees, there is an impact on their "selves" and their emotional quality of life. Information about the self is accepted or rejected by an individual, and there is an adjustment of attitude or behaviour to prove or disprove the information. This is the underlying benefit of a self assessment test, where testees communicate their results to themselves.

Psychometric tests, contrasted to other tests which do not have the same impact on individuals, will play an important rôle in the process of helping South Africans in the post-Apartheid era to improve themselves and their qualities of life.

## Evaluation of interest tests

It is possible to compile a non-psychometric interest test. The magazine quiz in

**WHAT ARE YOUR INTERESTS?**

For each question, mark the alternative that best describes your reaction.

1. You are asked away for the weekend by a friend. Would you prefer
  - a) to go to a hotel with many pubs and an entertainment schedule for guests
  - b) to stay in a small town where you can visit historical monuments
  - c) to take up a timeshare option in a game reserve
2. It is Saturday night and you are alone at home. What do you do?
  - a) phone a friend to find out whether she knows of any good parties tonight
  - b) curl up with the cat and a good book
  - c) get an early night in preparation for the big hike tomorrow
3. What kind of conversation do you prefer?
  - a) a lighthearted discussion with a stranger
  - b) an intellectual conversation about the crisis in health services
  - c) a discussion about the weather
4. What kind of people do you relate to best?
  - a) I get on with everybody
  - b) people who have opinions and can contribute to ideas
  - c) nature conservationists
5. What kind of job would you most like?
  - a) interviewing people for jobs
  - b) reading books for a publisher
  - c) managing a farm

**SCORING:** Add your a, b and c responses. Turn to page 1234 for a description of your interests.

figure 2.1 may measure whether readers are interested in social, intellectual or outdoor activities. A self description and suggestion of suitable hobbies could be attached in a table with the key "If you have marked most A's, then you are the kind of person who ....".

**Figure 2.1: Example of a non-psychometric interest test**

At face value this type of test may appear to be useful. It has face validity, discriminates between people, seems to have norms and to predict or explain something about people. Items may be so obscure (and the key on another page) that the reader does not know what is being measured.

Despite these qualities, this test is not a psychometric interest measurement because it has not been scientifically developed. It took less than ten minutes to write. It does not take into account existing scientific research or a theory of interests. It is impossible to show construct validity because there are no constructs involved. Criterion related validity with other measures of social, outdoor and intellectual interests is not established.

The five items do not assess a variety of activities related to each interest. The test is not reliable. Testing conditions are not standardised. Leaving out one item or adding another could change the results. There is no guarantee that readers will not obtain different results if they repeat the test. Most importantly, it makes no difference whether the test is predictive or not, because readers will probably agree with the descriptions given of the different types of people, but not do anything to change themselves or their spare time pursuits. Predictive and concurrent validity are not at issue. The test is meant as an amusement for magazine readers and was never intended to be a psychometric measurement of interests.

### **Psychometric properties of interest tests**

#### **Rationale**

South African interest tests state clear rationales setting out underlying theories and restrictions for use of the test. However, the practical impact of the rationales is questionable. The SAVII is in practice available to teachers who could be using the test for any purpose. Norm groups for the VIQ and HSIQ (black and coloured school pupils) do not apply in the New South Africa and the tests are extensively used by psychologists for all ages and race groups. It is openly acknowledged that the 19FIH is used for groups and purposes other than those stated in the rationale of the test.

Wider use than originally envisaged may indicate that restrictions were too bureaucratic and strict, or that none of the tests fully meets the needs of our unique conditions, with testers using anything and everything that is available in an attempt to obtain a picture of relevant interest patterns in our community.

## Validity

### Face validity

Extensive use of interest tests by South African psychologists suggests that face validity is high. The tests probably "look right" to testers. Certainly the care taken in developing the 19FI ensured face validity, as substantiated by Nicol (1978). The face validity of the VIQ is questionable. According to the manual (Coetzee, 1975), testees did not understand the items in the first application of the questionnaire. Items were subsequently simplified by a panel of white linguists. Subsequent application of the test was characterised by "ruined, unusable answer sheets" which may indicate that testees still could not understand the test. According to the SDS manual (Gevers, du Toit and Harillal, 1992), the test had face validity among the panel who evaluated it. This appears to be a self-serving recommendation.

### Construct validity

The SVIB and Rothwell-Miller tests are directly linked to occupations. Apart from these tests, Lowman (1991, p 16) feels that there is little connection between theories of interests and the empirically tested measures in use. Theorists and empiricists have worked from different viewpoints. Empirical measures are not based in theory, and theoretical models cannot be adequately applied in practice.

This is particularly true of the SDS and other instruments of Holland's (1959) theory of careers. Tests to prove the hexagonal model have consistently failed to support the hypothesis that adjacent occupational types have the highest correlations. For example, in the 1985 validation of the SDS (Gevers, du Toit and Harilall, 1992) the artistic type was out of sequence apparently due to "cultural differences". The 1987 validation of the test left this aspect out.

Independently of the hexagonal model, the construct validity of the six factors has been extensively researched by Holland (1966, 1985) and appears to be satisfactory. It has also been the subject of various South African dissertations and theses (Neethling, 1986; Uys, 1986; Theron, 1991).

Fields of interest of the VIQ were selected to correspond with Roe's (1956) classification of occupations. The manual (Coetzee, 1985) states that "if factor analysis is taken as a criterion for construct validity, the questionnaire in this respect seems to satisfy the requirements". Government intervention, based on what were considered by the Apartheid régime as suitable occupations for the black population, interfered with its statistical validity.

Construct validity of the 19FII is based on extensive item analysis and selection of the items to ensure that the fields are well-defined constructs. The test was also applied simultaneously with the Kuder interest inventory (KII), as the only other interest test adapted for South African use at that time. It was found that all the fields of the KII were covered by the 19FII (the exception being a low correlation between Public Speaking as a field on the 19FII and the Persuasive field of the Kuder), and that the 19FII covers ten fields not covered by the KII.

Applying criterion-related validity can be a disadvantage in measuring interests, especially with fast advancing technology. Few interest tests, for example, include items on computer work. Sundberg (1977, preface) points out that interest tests are static and do not reflect social changes. Because they are based on existing models and fields, they perpetuate the status quo. Dolliver and Nelson (1975) feel that traditional interest measures narrow personality differences within occupations, restricting changes and growth within occupations and individuals.

Ongoing research on South African tests is not coordinated. Researchers move on to new developments instead of consolidating and improving existing instruments. This increases the possibility that test items will become outdated, and construct validity will reduce over time.

Factorial and logical validity

The 19FII was developed from 710 items representing 21 fields of interest. It was applied to 1648 standard 10 pupils and the 20 best items per field selected. Factor analysis including items from the KII led to fields being combined to form 14 fields. Six other fields were added. The 20FII was then applied to 1377 standard 10 pupils. Creativity and thinking were combined in the final inventory, which was compiled by selecting the 15 best items per field from the 20FII. Logical and factorial validity of the 19FII appears to be adequate.

VIQ fields were based on Roe's (1956) work "with due allowance for the particular requirements and occupational possibilities of black men in South Africa and at the specific request of the department of Bantu Education" (Coetzee, 1975, p 2). A trial application of the test in 1972 found that testees did not understand the items. Item analysis reduced the number of items from 240 to 154. No information is given on how this was done, but any procedure must be questionable if the testees did not understand the items in the first place. The comment is made that "an item committee tried (sic) to ensure that items were classified in the fields for which they were intended and did not overlap other fields. An "attempt was made to ensure satisfactory content validity with the aid of factor analysis ... (which) showed that the factors correspond in broad outline to the fields of the VIQ" (p 32).

Intercorrelations of the fields indicated that Office Work (Numerical) and Office Work (non-numerical) should be combined, but "because the Department of Bantu Education specifically requested that both fields be included separately ... it was decided to leave the fields as they were." (p 29). Reading between the lines in the manual, it seems that the designers started their research in good faith and based on a comprehensive research design including lessons learnt from working with the HSIQ. Committees of experts were set up to make decisions on matters that should have been researched. It appears that predetermined and hurried results may have been forced by government department intervention and Apartheid idealism. Factorial validity of the VIQ is suspect.

The South African adaptation of the SDS was based on the American version with some item amendments. A viability study involving 11 139 standard ten pupils in Lebowa and Gazankulu was conducted in 1985. This included vocabulary tests to determine whether the items would be understood by testees with vernacular home languages. In the 1988 study a panel of experts judged logical validity by examining items and their intercorrelations, (Gevers, du Toit and Harillal, 1992, p 43). The criteria for including an item with a factor was a product-moment correlation of 0,20, which is rather low. There are differences  $> 0,1$  between intercorrelations of scores for the two test groups, making factorial validity questionable.

No information is given on logical validity for the SDS. However, a warning is sounded (Holland, 1985) that score differences of less than eight between two fields are within the limits of measurement error. This is more than half the responses on any of the four sections of the test, which have 11 or 14 items. There may be too few items in the test, and logical validity is thus suspect.

*Predictive and concurrent validity*

Predictions of future occupations for the 19FII are suggested by 35 occupational profiles based on average scores of 5 500 adults. Nicol (1978) found that the 19FII accurately predicts subsequent field of study for over 60% of testees, but no research has been done into whether the test predicts occupation. Concurrent validity studies of the SDS found that around 70% of Holland type scores corresponded with envisaged (not actual) occupations. No data is provided on the predictive validity of the VIQ. South African interest tests have not been concurrently validated against personality or ability factors.

*Reliability*

Interest test manuals give standardised instructions for applying and scoring tests. Norms are provided for all interest tests except the SDS, which is interpreted from raw (ipsative) scores. However the control of the tests is inadequate, with non-psychologists having access to the SAVII, and psychologists applying the VIQ, HSIQ and 19FII for groups for which the tests have not been validated.

Reliability coefficients have been calculated for all the tests. Studies on the SVIB gave a split-half reliability coefficient of 0,86 and test-retest coefficients for the occupational scales ranging from 0,48 to 0,79.

The SDS has test-retest reliability indices of mainly between 0,70 and 0,88 for all factors and validation groups. Standard errors of measurement are not given.

Split half reliability coefficients for the 19FII fields range from 0,85 to 0,98. Standard errors of measurement (which appear to be Z-scores although this is not specified in the manual) lie between 0,28 and 0,55.

Although the VIQ manual gives reliability coefficients for interest fields ranging from 0,77 to 0,95 and standard errors of measurement of between 1,15 and 1,75, these cannot be interpreted as no details are given as to the measurement methods.

### Objectivity

Interest tests are generally recognised as being transparent. It is argued that testees tend not to fake interest tests because the results are intended to help them choose careers. Most interest tests therefore make only cursory attempts to reduce transparency and testees can fake results towards a desired outcome. Nunnally (1970, p 419) gives the example of a person who wants a job as an electrician automatically replying "yes" to the question, "Do you like to repair electric motors?". Young people may be unrealistic in stating preferences for occupations if they do not know the jobs and base their decisions on TV-glamourised stereotypes (Nunnally, 1970, p 415). It is generally accepted that interests stabilise in the mid-teens. (Smit 1981, p 284; Costa, McCrae and Holland, 1984).

In the 19FII, every nineteenth item applies to a particular field. The fields are listed on the back of the answer sheet in another order. Testees often notice that the lines across the answer sheet apply to the same field, and can fake their responses.

No attempt is made to reduce transparency for the VIQ and HSIQ. Questions relating to fields of interest are presented to testees in the same order, with responses for each field in a column. The fields are listed on the front of the answer sheet in the order of the columns. Testees can read which fields are being tested and fake their answers.

The SDS, as a self-assessment tool, is particularly transparent. In each section of the test items are grouped under the initial letters of the Holland groups. A testee can thus realise that a particular group is being scored highly, and deliberately continue or change the pattern of responses.

## DISCUSSION

Interest testing is important. Psychologists and other career counsellors spend countless hours applying and interpreting interest tests. The impact of the results on testees' lives is immeasurable. It is small wonder that extensive time and resources are allocated to developing these measurement instruments.

Patterns of developing interest tests are quite different in the USA and South Africa. In the USA efforts have concentrated on refining the SVIB over 60 years, and in the past 30 years operationalising the Holland (1959) categories. South African research is done on a start-stop basis. Since 1970 at least six instruments with totally different formats have been published. Research into a new interest measurement seems to start with a rigorous research proposal. Tests and a manual are issued with strict instructions about who may apply the test and for what groups it applies. The rules are then ignored. Manuals, which should set out enough technical detail to ensure tester confidence, omit or gloss over large sections of validity information, leaving the reader wondering whether the manuals are incomplete or whether unfavourable information was deliberately left out. True predictive validity is not adequately addressed.

No refinement or updating of tests takes place. Even the 19FII, still the most comprehensive and popular test in South Africa, is available in its original form after 25 years, although new norms for teachers' training college students were issued in 1982. Follow-up research is not coordinated and appears to only be conducted in master's dissertations and doctoral theses so that new information is not easily accessible to testers. Instead of consolidating existing research, there is a constant move to develop new instruments. The state of interest tests in South Africa could be described as "so gemaak en so laat staan".

South African research tends to follow USA methodologies. Development of the basic interest scales by factor analysis of the SVIB in the late 1960's was followed by a factor analysis of interest items which resulted in publishing the 19FII in 1970, using the 1966 California Occupation Scale rating scale (Kapes and Mastie, 1988). Roe's (1956) occupational classification was used as the basis for the HSIQ and VIQ. Operationalisation of Holland's (1959) theory in the USA in the early to mid 1970's has become and remained fashionable in South Africa since the late 1970's. Computerised inventories in the USA appeared shortly before the South African MENTOR programme and accompanying SAVII.

This does not imply that the tests are not valuable. The fact that they are extensively used, even if for groups other than those for which they were designed, is testimony to their value. What this may indicate is that none of the tests available in South Africa is adequate in meeting the needs of the market. The time may have come to look at occupational structure as it is perceived in South Africa and develop around it a test to suit our conditions.

## SUMMARY

Interest tests are measurements of sentiment and not of judgment. Vocational interest is a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and related situations already experienced or expected to produce pleasurable feelings.

Vocational interest tests are important because they provide a direct link with occupations for career guidance. The most commonly used test in the USA in the SVIB, devised in 1935 and the forerunner of modern interest measurements. In South Africa the 19FIH is the most popular measurement. Holland (1959) based instruments, including the SDS, are popular in both countries.

Super (1957) classified interest tests as expressed, inventoried, manifest and tested. Psychometric interest tests are scientific procedures using inventories. To qualify as psychometric measures, tests must be based on scientifically thorough research methodology. They must be valid and reliable. When results from tests meeting these criteria are communicated to testees, there is an impact on their perception of themselves and hence on their psychological well-being.

Generally South African interest tests, excluding the VIQ, have been rigorously developed and meet most psychometric criteria. In line with all interest tests they tend to be transparent to testees.

A more serious problem arises from the lack of coordinated follow-up research and refinement of interest tests in South Africa. Researchers tend to come up with a new instrument every few years, based on USA trends, rather than consolidating previous research. Together with use of the tests for unauthorised purposes, this may indicate that none of the available tests meets the needs of the market.

This study sets out to examine occupational structure as it is perceived in South Africa and develop around it a test to suit our conditions. The test must be able to make an impact in post-Apartheid South Africa on individuals who were previously restricted by the use of biased or inappropriate interest test measurements.

**The next chapter will examine occupational structure as described by occupational classification systems, including the fields measured by interest tests.**

## CHAPTER 3 - OCCUPATIONAL CLASSIFICATION SYSTEMS

### SCOPE OF THE CHAPTER

*A description of classification models. A discussion and criticism of occupational classification systems in use.*

### THE NATURE OF CLASSIFICATION SYSTEMS

A classification system results whenever units, items, ideas, things or people are put into categories. There can be a few or many categories in the system. People can be classified by gender (two categories) or by religion (many categories). Citizenship classifies people according to country of nationality. It is a *dynamic* classification system because the categories change constantly with political developments. An example of a *static* classification system is the division of matter into solids, liquids, gases and plasma. These static categories may change if scientists build new matter. The fact that the units change (water is a solid at freezing point, a gas at boiling point and a liquid between these two temperatures) does not affect the static nature of the system.

Categories arise only from item similarity. Classification is the process of organising or arranging units into categories on the basis of their interrelationships. A classification system is the end product of this process. A list of items like an alphabetical book index is not a classification system unless all units are organised under headings.

Organising data into categories is probably a natural human activity. Plural word forms and collective nouns are found in any language. Social groups develop their own categories. For example houses have an "outside" and an "inside", which means different things for different families. *Informal* classification systems are not recorded because they have no impact on society.

Fleishman and Quaintance (1984, p 22) set out the reasons for classifying units into *formal* categories. For illustration, assume that a town's dwelling places are being counted in the categories house/cottage, flat/townhouse and squatter hut. This classification system allows for:

- *easier communication because people can talk about the categories without explaining the words they are using.* Once the definition of "house" is given, it cannot be confused with "townhouse". Despite technical details of definition, when the basic concept of "house" is understood, it can be discussed with non-experts. Experts can discuss theoretical issues.
- *observation and counting without duplication or overlapping of information.* Once a dwelling is placed in one category, it cannot belong to another.
- *recording and easy retrieval of information about the categories.*
- *general statements including descriptions of relationships between categories* (for example, houses are not in the flatlands).
- *comparison of data over time or geographical distance.*

## FORMAL CLASSIFICATION SYSTEMS

Particular needs must be met by formal classification systems used in scientific research. Science seeks new information, generates new concepts, develops new methods and states new truths. All this activity is pointless without classification systems to describe or store the new knowledge.

A university is organised into faculties and departments. The kind of scientific (in a broad sense) truths sought in the physics, archaeology and linguistics departments is unique and different skills are needed. Before research takes place hypotheses are generated about the interaction of the units to be studied, in other words how new knowledge will slot into the established structure. Existing knowledge and inter-relationships are investigated. Scholars from other parts of the world can access knowledge through specialised journals and by using keywords to explore related topics. Construct validity after the research proves that relationships exist between the newly established and existing constructs. The prospect of conducting scientific research without classification systems would be daunting.

### Evaluation criteria for formal classification systems

Fleishman and Quaintance (1984, p 82) set out five criteria for evaluating formal classification systems. They are *scientific basis*, *cohesion*, *comprehensiveness*, *rationality and usefulness*. The first four are similar to criteria used for evaluating psychometric tests, as is shown in table 3.1 overleaf.

Classification system	Psychometric test
Scientific basis	Rationale, predictive validity
Cohesion	Face and factorial validity
Comprehensiveness	Logical validity
Rationality	Reliability

**Table 3.1: Comparison of evaluation criteria for classification systems and psychometric tests**

### Scientific basis

The classification system must be based on previous knowledge. It must take into account the known characteristics of the units being classified, but not necessarily copy previous classifications either in structure or content. Rules for classifying units into categories may be deductive and subjective, but must be stated. Gaps in knowledge, existing and possible relationships among the units and categories should be able to be identified for future research.

### Cohesion

This could also be referred to as the *internal validity* of the system. The system must have a structure and be logical in itself and to the people who use it.

### Comprehensiveness

Powerful classification systems are those where every unit can be put somewhere. The system must provide for mutually exclusive and exhaustive classification. Dynamic systems allow for the addition of new categories or units. Classification takes place either when a natural structure of units is being sought and/or when fitting data to existing classes.

The processes of devising the classification system and assigning units to the classes initially take place at the same time. After the classification system is in place, further units are added to it and, if necessary, more categories are created.

### **Rationality**

Different people should classify units into the same categories under different circumstances and at different times. This is dictated largely by whether adequate definitions are laid down for categories and for differentiating between units.

### **Usefulness**

In the end, there is no need for a formal classification system unless it can be used. Usefulness includes all the communication aspects of informal systems. It is proved when the system is successfully used.

### **Classification models**

McCormick (1979, p 155) listed five classification models. These are teleological, linnaean, Darwinian, statistically derived and co-sociative models. Two that he omitted were numbered category and matrix classification models. A new network classification model is suggested by the author.

### **Teleological model**

This is the oldest type of classification system and involves an *a priori*, subjective judgment about the "essence" (intrinsic property) of the units being classified. It introduced the idea that there is more to informal classification systems than our own choices or points of view. Everything in Ancient Greek experience was classified by its purpose in nature or essence.

Aristotelian science, which divided elements into metals and the others into sulphurs, spirits, salts etc. was based on this precept (O'Hear, 1985). It is seen in classifications based on the usefulness to man of the units. Thus a political scientist might classify systems of government by aims (economic, social upliftment, power etc.)

The teleological classification model was developed when all thought and science was philosophical. Face validity was more important than factorial validity, and depended on philosophical argument. Arguments attempted to include everything, leaving no missing data or space for future research and resulting in exhaustively defined categories. A new unit (for example, a new system of government) meant adding a new category. This could affect the arguments used to define previous categories and result in reclassification of units.

Teleological classification is viewed as ideological by modern scientists. Philosophical argument is more important than scientific proof in establishing relationships between units. It does not provide for future research. Validity is questionable. However, it is still applied in historical classifications and in the social sciences.

### **Linnaean (hierarchical) model**

A major breakthrough came when Carolus Linnaeus, the founder of taxonomic botany published his *Systema naturae fundamenta botanica* (1735), *Genera plantarum* (1737) and *Species plantarum* (1753). He introduced the biological hierarchical classification system. Until then plants had been classified one-dimensionally, according to the nature of the fruit in one system, and whether they had flowers or not in another system.

Linnaeus subjectively (and temporarily) classified plants into genera, classes and orders, according to plant sex organs, and named them by generic (genus) and specific (species) elements. The system has been taken into other biological disciplines. Thus, in zoology, the scientific name of a lion is *panthero leo* and that of a tiger *panthero tigris*. They both belong to the same genus, but are different species.

Face validity is high because people can understand the model in terms of surnames and first names. Every type of animal is its own category, but the interrelationships are clear, just as John and Joan Smith are different, but related.

Linnaeus' work is an example of how a classification system, to be scientifically based, need not depend on the structure and content of previous systems, but does have to take into account observed and known characteristics of the units being studied. Newly discovered species are easily added into the hierarchy without affecting the classification of other units, partly because definition of each unit is exact.

Linnaean models meet all the criteria of formal classification systems except that they are not particularly helpful in generating hypotheses. Identifying minor differences between species in different genera can show where sub-categories could be missing, but this is not a major priority of the system. Excess rationality leads to a static system. Darwin came up against this when he discovered new species in the Galapagos Islands which could not be classified within the system.

### Darwinian model

Faced with this practical problem, Darwin introduced a continuous dimension into classification systems. He hypothesised that units develop through stages to link the theory of evolution proposed in his *Origin of species by means of natural selection* (1859) to a classification system, and then identify and classify new species.

His classification system was scientifically ingenious although face validity was low because of the subject matter. His theories caught the interest of the general public who used ideological teleologically-based, arguments to criticise his work. The debate continues about evolution -vs- creation.

Ideological issues apart, what Darwin did was to build into his classification all known biological science at that point, including his own observations. He allowed for new discoveries to be added into his system. The continuous nature of his classification system identified gaps in scientific knowledge (popularly known as *the missing links*). Reporting of new discoveries is facilitated by the system.

Construct validity is a high priority in the system as similarities and differences to existing units have to be shown. The system is specifically designed to overlap criteria for inclusion of units into categories and to enable these criteria to keep changing. The system is thus dynamic. Totally new categories may emerge. New discoveries slot into existing units and categories, and between units and categories. Darwinian classification systems meet all the evaluation criteria of a formal classification system.

### Matrix model

Sir George Cayley is credited with devising the concept of a matrix of algebraic functions in 1853 (Crystal, 1994). The idea of a matrix was to show, by means of a table, related characteristics both horizontally and vertically. In line with this concept (but possibly with no knowledge of it) Dmitri Mendeleev published the *Periodic table of the elements* in 1869. His classification was based on previous discoveries of triads of related elements, and the octave system which proved that when elements are listed by increasing atomic weight each eighth element has similar properties. He adjusted for heavier elements by creating transitional elements with multiple valencies and split the elements into a table with metals on the left hand side and non-metals on the right hand side.

Elements were arranged by ascending atomic mass, so that each row showed "heavier" atoms. Columns depicted increasing valencies (combining power of the elements). Many valuable groupings and characteristics of elements can be seen. The table was an ordering of facts as they were then known. The table had to wait for the development of the modern theory of atomic structure before it could be explained. The strength of the classification system is shown by the identification of gaps in knowledge and how these predictions can be made about units for empty cells. The properties of Scandium, Gallium and Germanium were predicted fifteen years before they were discovered in Scandinavia, France and Germany respectively. Radioactive elements were described long before their discovery. Scientists are still building elements according to properties classified in the table.

Although matrix classification systems should not all be judged by the periodic table, the scientific basis of a matrix system can be sound depending on the rationality of the categories. The creation of cells facilitates the allocation of units. A matrix has a definite structure and can go beyond two or even three dimensions. Guilford's (1959) structure of the intellect is an example of a three dimensional matrix.

### **Numbered category model**

In this model, categories and subcategories are classified by number. In 1805 Peter Roget, a British scholar and physician, drew up a list of words arranged by ideas.

After his retirement he took up as a hobby the work of expanding his catalogue and in 1852 published the *Thesaurus of English words and phrases classified and arranged so as to facilitate the expression of ideas and assist in literary composition*. It was an instant success and had gone through 28 editions by Roget's death seventeen years later.

Words are grouped according to ideas, rather than alphabetically as in a dictionary. Each idea is treated as a heading and is allocated a number. "Paragraphs" under the heading are identified by the number, followed by a decimal point and another number. The idea of "existence" is category 1, with associated words arranged in paragraphs 1.1, 1.2, 1.3 and so on. Categories and paragraphs are accessed from an alphabetical index which refers the reader to, say, 929.19. The thesaurus is constantly revised to include foreign words, American slang and new technology. By 1972 *Roget's International Thesaurus* included more than 250 000 words in an index of over 600 pages. The number of categories has increased from 1000 to 1040.

The Dewey Decimal System for classifying the subject matter of books is a further example. Devised in 1873 by Melvil Dewey, it recognises 10 main classes of subject matter, each class containing 100 numbers, with decimal subdivisions for unlimited supplementary classes. For example, class 600 is Applied sciences, Medicine, Technology; 612 is Physiology, Human and comparative; and 612.1 is Blood and Circulation. Any number of digits can appear after the decimal point, allowing for an infinite number of subjects to be added into the classification.

The scientific basis of this type of system is reasonable, bearing in mind that it is intended to be a convenient catalogue and not a source of scientific truth. Numbered category systems do not identify gaps in knowledge or predict future research. Characteristics of the units being classified are known and taken into account, even if they are subjective. The systems are cohesive and their logic and structures are used worldwide. Comprehensiveness is ensured by providing for the addition of new categories and subcategories. Categories are defined by their contents, so that different people could allocate units to different categories, depending on their own perception of the relationship between units already in the category. New subcategories can be added.

In psycho-pathology, the *diagnostic and statistical manual for mental disorders* (Carson and Butcher, 1992) is an example of a numbered category system.

### **Co-sociative model**

This model is based on related rather than inherent characteristics of the units. Concurrent validity is important for co-sociative systems. Classification takes into account what is known about apparently unrelated characteristics of the categories, but has to assume or prove that these are important. This model takes into account that people have a perceived structure for classifying units.

Proof of the categories, units and associated characteristics can take so much energy that there is little further attempt to identify missing data or predict where future research is needed, and the systems tend to be static. Should a new unit have to be added, it involves investigating interacting relationships with all other elements of the system, however, definitions of criteria are comprehensive as a result of the extensive research involved.

Fleishman and Quaintance ((1984) consider McCormick's (1979) Positional Analysis Questionnaire to be a co-sociative model of tasks which transcends inherent features of work in classifying the abilities and behaviours required for tasks.

### **Statistically derived model**

This model is based on weighting as many characteristics of a category as possible, as in the 16 Personality Factor scale (Cattell, Ebel and Tatsuoka, 1970). Systems aim at being objective and replicable through the use of stable, objectively derived data. They are derived from careful statistical analyses and reduction of items. Numerical rating scales make possible statistical analysis of the logical validity of the system. Through multiple regression, factor analysis and cluster analysis it is possible to check whether all necessary units and categories are included, whether units or categories overlap and where there are gaps.

Statistically derived classification models, together with inferential statistics, could be considered as providing the mathematical basis of modern scientific psychology. They are, however, not entirely satisfactory. Fleishman and Quaintance (1984, p 44) suggest that psychologists often organise and discuss data without first checking the underlying classification basis. As a result subjective leaps of intuition, based on correlations and factors or clusters, characterise particularly industrial psychological research and conclusions. For example, a psychologist may construct a test consisting of hundreds of items, apply the test to a sample group, and "discover" two main personality factors which can be conveniently depicted on a four-quadrant graph for popular, and lucrative, management training.

On a smaller scale, an industrial psychologist may research common successful management behaviours in an organisation, apply these in a performance appraisal, and derive "performance domains" with weightings which describe company culture. Similarly, training evaluation and selection criteria can be weighted and presented as scientific classifications on which management decisions can be based.

The methodology is discounted by physical scientists who consider mathematical series (where events logically follow one another) as the basis of science. In terms of series, events are numerically predicted by additive, geometric and other rules.

In contrast, statistically derived psychological models can only suggest that "if this, then maybe ..... that". Scientists from other disciplines see psychology as based on intuitive arguments of "this feels right to me". Models and psychological diagnoses appear to outsiders to be grounded in estimations.

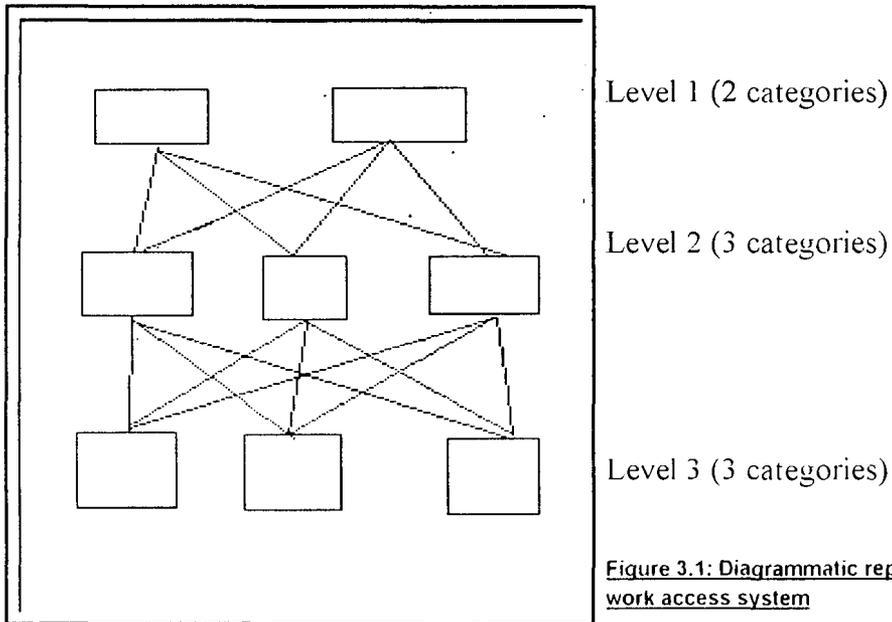
Research in terms of the statistically derived model is based entirely on items included by the individual or team doing the research, and probably excludes anything that does not "feel right" to the researchers. Underlying models are built on estimates. Verification of theories is often qualitative and by replication - the more case studies that show the same features, and the more people who agree with it, the better the system or theory. Holland (1966) capitalised on this by encouraging extensive collaborative research on his six factor theory of careers, leading to an impressive 700 or more studies in less than twenty five years (Hyland and Muchinsky, 1991).

### **The need for a new model**

With the exception of the Darwinian model, all of the above models have been applied to the classification of occupations. None have led to a psychology of work which satisfactorily links perceived occupational structure to an interest test. In terms of the problem statement for this study, a new classification model is needed.

### Network access model

Computerisation has introduced a new way of thinking and making decisions. This is illustrated by a "network access model" which is the original work of the author. The system is illustrated by a number of blocks, or *categories*, arranged on levels of access. Crisscrossing- lines join every block with every other block one level above or below, as shown in figure 3.1.



Each of the two blocks on level one relates to all three categories on level two, but not to the categories on level three. Units are allocated according to level and category within the level. The model is understood by anyone who has used an automatic bank teller, where the first level categories are banking institutions, the second transaction types and the third account types. Access must be possible at a higher level before it is permitted at a lower level and any person can be blocked from access to any categories on any level. The automatic teller can allow access only to banks where an account is held, prevent certain transactions from certain types of account.

The mathematical basis of the model derives from the *correspondence* concept in set theory. According to Shanks, Brumfield, Flaenor and Eicholz (1965), this can be traced back to the geometry of the early Greeks, who identified dependence between two elements. For example, two angles on a straight line always add up to  $180^\circ$ , so that  $angle\ 1 = 180^\circ - angle\ 2$ . They also recognised a one-to-one correspondence between sets of numbers, for instance every number has a corresponding square. This correspondence was mapped in analytic geometry in Descartes' *Discourse de la méthode* (1737), which combined geometry and algebra and made possible for the first time the graphical representation of the correspondence of numbers to each other. Leonhard Euler showed many-to-one correspondence in his number theory and concept of infinite series, propounded in the *Lettres à une princesse d'Allemagne* (1768 - 1772). Further work on series was done by Cauchy and Dirichlet in the 1820's. In the 1880's Georg Cantor worked out a highly original arithmetic of the infinite, which resulted in a theory of infinite sets of different sizes, the units and sets having a many-to-many correspondence with other units and sets.

A simplistic example of many-to-many correspondence is given in figure 3.2.

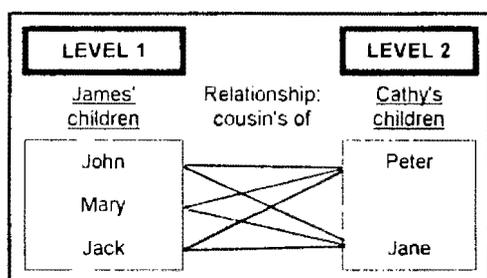


Figure 3.2: Example of many-to-many correspondence

In this example, there are three cousins on one side of a family and two on the other. Two levels are created using the heading "children of". The two sets of cousins are related to each other by the stated concept "cousin of".

This illustrates the following characteristics of the network access model:

- *A model is built on a number of logical levels.* In the example, there would have been more levels had James and Catherine had other brothers and sisters.
- *Relationships between levels can be stated in both directions.* John, Mary and Jack are the cousins of Peter and Jane; Peter and Jane are the cousins of John, Mary and Jack.
- *Categories are logically placed on a level according to a stated rule.* In this instance, the rule is that John and Catherine have the same mother and father.
- *Known characteristics of units are built into the categories.* Family relationships are stipulated. These may include hidden factors such as DNA patterns.
- *Units are classified by selecting from the available categories on each level.* The children are the units classified, with their names used for convenience. Had there been larger families, the children could have been subdivided into categories such as boys, girls, half-brothers and sisters.
- *Gaps are identified where there are no units to fit into a category.* This would have happened, for example, had James had no children.
- *Once a unit is classified into a category at one level, it is denied access to other categories at that level.* John cannot be both son and daughter of James.

- *A unit is described by its allocation to categories and levels.* John is the son of James. In the more complicated example of a bank transaction through an automatic teller, a transaction could be described as a "withdrawal of funds (category in level 2) from a savings account (category in level 3) from Incorporated Bank (category in Level 1). The unit "belongs" to three categories simultaneously, the three categories being on three different levels.
- *The classification of a unit to a category on one level does not restrict the allocation possible at another level.* The selection of Incorporated Bank on level 1 would not limit the types of banking transaction of accounts available. This is in contrast with the hierarchical model, where a choice on one level restricts the choices available at the next level.

The model has internal validity or cohesion simply because it is designed as a system. Face validity is accepted by users because identified patterns are built into the system, and anyone who has studied set theory in school can relate to the underlying mathematical basis. From a psychological point of view, the network access model describes a system of making choices or being allowed to make choices.

**This could illustrate the process of occupational choice. A person could choose a broad category of type of industry or profession (medical, commerce, chemistry), then go on to choose where to work (own business, government service, outdoors) and then choose what tasks will fill the working day (looking after people, working with figures, selling).**

At this stage network access classification models have not been applied in any science. Its use for generating hypotheses and reporting research must still be shown. This study is concerned with the development and validation of this classification system. Before continuing with this, however, existing occupational classification systems will be critically examined.

### OCCUPATIONAL CLASSIFICATION SYSTEMS

The importance and need for a standard occupational classification system was highlighted in June 1993 at the *International Occupational Classification Conference*

"If the labour market is the environment in which we seek, accept and retain employment, occupational classification systems are the "address book" from which the "place" of work is chosen. To survive in a difficult job market, one must select an occupation carefully ... making sure it fits one's personality. An occupational classification system should meet a broad range of customer needs for students, job seekers and employers." (Moss, 1993)

"The purpose of an occupational classification system should be to help in career counselling and improve quality and application of research on occupational and labour market structures and trends." (Drayce, Fleming, Dubinsky and Law, 1993)

"An occupational classification system should match the needs of employees and employers, specify similarities and differences among occupations, diagnose economic needs and outline activities of vocational education. (Bulinska and Witkowski, 1993)

held in Washington D.C., as shown in figure 3.3.

**Figure 3.3: Extracts from papers delivered at the International Occupational Classification Conference in Washington D.C. 1993.**

An occupational classification system depicts the inter-relationship of occupations by organising them into categories. The process is the classification of units into categories, while the product is the occupational categories with associated occupations. The model to be used must be dynamic because categories will change with technological and social advances.

Four major players are interested in classifying occupations, namely commerce, governments, sociologists and career psychologists.

## Commercial applications

Within commerce, occupational classification systems are used on a micro-economic level to organise resources into departments and to facilitate communication within them. Resultant classification systems are *specific* to jobs within an organisation and do not translate to other companies. The main users are personnel and work study practitioners. The Minnesota theory of work adjustment and the Position Analysis Questionnaire are used in staff placement.

### Job analysis by personnel practitioners

Conventional job analysis programs involve collection of job-related information by observation and interviews with workers. Job descriptions are usually prepared in essay form, (McCormick, 1979, p 188), or by checking a job inventory (Gael, 1983). Different types of information, forms, procedures and formats of job description are used, with the result that job analysis by personnel practitioners has not been scientific and systematic (McCormick, Jeanneret and Meham, 1972). Systems derived are largely teleological, subjective and based on the job or occupation as a unique entity instead of on generalised descriptive data. No occupational classification system has emerged from personnel practice due to a lack of scientific method in job analysis.

### Task analysis by work study practitioners

The search for common tasks could lead to constructing a simplified description of the similar tasks, jobs and occupations, according to Miller, Treiman, Cain and Roos (1982). Bennett (1971) found that more than 80% of work study practitioners develop task analyses. They are more concerned with productivity than with scientific research.

Berliner, Angell and Shearer (1964) classified tasks into processes for military jobs. Farinha and Wheaton (1971) classified task characteristics into task components such as goal, response and procedures. Lists of common tasks have been suggested by Bennett (1971) and Miller (1973). Landau and Rohmert (1989) found that work content varies constantly with technological changes.

### Minnesota theory of work adjustment

This theory includes work and individual attributes (Dawis and Lofquist, 1959). Originally meant for placing people in jobs, it was not intended to be an occupational classification system. The theory is that individuals have *needs* which, if met by occupational *reinforcers*, lead to job satisfaction, job performance and perseverance with a job. Twenty reinforcer dimensions are measured for a job to obtain a profile which can be matched to an individual's profile. By 1980 there were standard profiles for 148 occupations. Dawis and Lofquist (1987) statistically identified six clusters of occupations. Ten years later 1161 occupations had been described. The latest version of the system (Dawis and Lofquist, 1991) describes occupations in terms of a two-dimensional matrix comprising ability requirements (for work with data, people and things) and reinforcer system characteristics.

Continued use and development of this theory over half a century attests to its value to psychology. However, it has no scientific basis as an occupational classification system. No underlying theoretical structure was given for the system. The developers are undecided about whether it would be better as a matrix or a statistically derived system, and a decision will not affect its commercial or academic use.

The structure came after the theory, in order to facilitate future hypotheses. Although some occupations can be classified within the (subsequently discovered) clusters it is important to realise that every statistical analysis by multiple regression, factor analysis or cluster analysis does not necessarily result in a classification system.

The allocation of occupations to categories appears to be difficult. Less than one occupation per month was classified in ten years. Adequate definitions for allocation may be in place, but the collection and analysis of data may be too complex.

### The Position Analysis Questionnaire (PAQ)

McCormick (1979, p 94) had a special interest in analysing jobs. He felt that task analysis could be taken beyond the simple description of activities. As a result, he developed the PAQ in 1976, analysing jobs according to the human behaviours involved. The PAQ is a co-sociative classification system with worker characteristics used as common denominators between the jobs of various technologies. PAQ questions are in six divisions, concerning the input of information, mental processes, activities performed, relationships with others, physical and social work context and "other". The PAQ is usually applied to analyse a particular job and so establish ideal characteristics for a job incumbent. It can also be used for establishing job classifications in terms of the applicable co-sociative characteristics.

As with all co-sociative classification systems, the system tends to be static once comprehensive definitions of criteria are established. Shortly after its introduction, the PAQ was fully developed, and research concentrated on proving its usefulness (see for example McCormick, Jeanneret and Mecham, 1972) or adapting its language to other countries. There was no need to identify missing data or predict future research. Should any new categories be added to the system, interacting relationships with all other elements of the system will have to be researched.

## Government applications

Occupations are classified on a macro-economic level for census purposes, to plan legislation, public service and economic policies. Before 1880 the US Bureau of the Census began grouping, instead of listing, job titles according to work performed.

### The Dictionary of Occupational Titles (DOT)

In 1927 the Great Britain Ministry of Labour compiled a *Dictionary of Occupational Terms*. In the early 1930's the USA government financed a project to organise "occupations" (performed with minor variations in many establishments) into groups according to the demands placed on workers (job content), or in which workers with specific qualifications or characteristics were likely to find satisfactory employment.

According to the introduction to the dictionary (US Department of Labour, 1982), the first version was published in 1939 and contained almost 17 500 alphabetically arranged occupational titles. Occupations were defined and broken down into categories, divisions and groups.

Blocks of jobs were assigned 5- or 6- digit codes which placed them into 550 occupational groups and indicated if the jobs were skilled, semi-skilled or unskilled. The revised second edition was issued in March 1949. It incorporated over 6 100 new occupations from the many supplements issued during the war period and was expanded to include new technologies in the plastics, paper and pulp, and radio manufacturing industries. A secondary occupational coding system, the *entry occupational classification structure* grouped jobs in terms of factors that could indicate an applicant's readiness and preference for specific jobs. The third edition in 1965 eliminated designations by status, substituting a classification by nature of work performed and the demands of work activities. Extra digits were added to codes.

The 1977 edition revised some occupational codes. Rapid technological advances since then have significantly changed the characteristics and job requirements of many occupations. The fourth edition of DOT in 1977 dealt with these changes by adding more than 2 100 new occupations and deleting 3 500.

Many thousands of descriptions have been subsequently modified or combined to eliminate overlapping and duplication, and to reflect the restructuring of occupations.

The latest version was published in 1982 (US Department of labor, 1982) and there have also been subsequent supplements.

DOT has served as a model and provided basic data for other important classifications, including the *International Standard Classification of Occupations* (ISCO) (International Labour Office, 1992).

### The International Standard Classification of Occupations (ISCO)

The International Labour Office in Geneva maintains statistics of countries' active working population in a matrix format of industry group and status in employment.

7 MANUFACTURE
71 <b>Manufacture of vehicles</b>
75381 Manufacture of motor vehicles
75382 Manufacture of bodies for motor vehicles
75383 <u>Manufacture of motor vehicle parts and accessories</u>
7538201 <i>Manufacture of radiators</i>
7538202 <i>Activities of specialised automotive engineering workshops working primarily for the motor trade</i>

(ILO, 1994, p 34).

Job titles are arranged into numbered categories as shown in figure 3.4.

**Figure 3.4: Extract from the International Standard Classification of Occupations**

Statistics of population numbers in major groups of occupations are maintained for global comparisons. There are seven major groups (for example, "professional, technical and related workers"), 83 minor groups (for example, "physical scientists and related technicians") and 284 unit groups (for example, chemists; physicists).

### Comment on DOT and ISCO

Both DOT and ISCO are numbered category classification systems. They are convenient catalogues of job titles with definitions. Characteristics of units are known but have changed over the years, particularly for the DOT which includes worker attributes and job demands. The systems are cohesive and logical. New categories and sub-categories are added as needed to ensure comprehensiveness.

These systems are difficult to maintain. Adding a category means changing the allocation of existing units. Comprehensiveness becomes a problem instead of a benefit.

Although DOT is used extensively in career counselling and guidance (Miller, Treiman, Cain and Roos, 1980, p 32), it is cumbersome and quickly goes out of date. DOT has served as a model and provided basic data for other important occupational classifications, including *The International Standard Classification of Occupations* (ISCO) (International Labour Office, 1992).

### Sociologists

Sociology studies individual characteristics and behaviour patterns typical of similarly socialised groups of people. People are categorised according to the behaviour of the group members to each other, or towards the social and natural environment. Work is studied in terms of its meaning to society and groups, occupational mobility and career patterns.

## Status systems

Status group is considered important for analysing relationships between people at work. The systems are based on a traditional classification into *proprietors and managers*, *white collar workers*, and *blue collar workers*. Sub classifications used over the years are given in table 3.2 overleaf. Blau and Duncan (1967, p 3) consider each of their categories as a meaningful social mobility grouping with members sharing life chances and social experiences and tending to stay in the same category all their lives. As early as 1921 the terms *white-collar and blue-collar workers* came into use in the USA, according to the Oxford English Dictionary. Origins of these terms are obscure but they may reflect the British class system of titled people and proprietors, white shirted salaried workers, and wage-earners who wore blue overalls.

Status systems are co-sociative. They are also teleological because people are classified according to economic contribution to society. Hatt (1950) pointed out that status is a classification by working conditions when considered from a work environmental rather than a personal point of view. In either case the rationale is clear. The systems are dynamic and new categories have been added over the years, for example, a category for unpaid family workers for third world countries was introduced in the ISCO classification. Existing and possible relationships among people and jobs can be described and hypotheses drawn up for future research. The scientific basis of status systems is strong although Morris and Murphy (1959) felt that using only status levels as categories is restrictive and leads to research findings which are rough approximations.

Table 3.2: Comparison of categories in status systems

Traditional	Roe (1956)	Blau & Duncan (1967, p 23)	Hall (1986, p 40)	ISCO	
Proprietors & managers	Professional & management (self employed)	Professional self employed	Professional	Proprietors & own account workers	
	Semi professional & small business	Proprietors Farmers			
	Employed managers	Professional (salaried) Managers	Managers, officials & administration		
White-collar (salaried)		Clerical	Clerical	Employees	
		Retail salesmen Other salesmen	Sales		
Blue collar (wage earners)	Skilled	Craftsmen- Manufacturing Craftsmen- Construction Craftsmen- Other	Skilled		
		Semi-skilled	Operatives- Manufacturing Operatives- Other		Semi-skilled
			Unskilled		Service
	Labourers- Manufacturing Labourers- Other Farm labourers	Farm			
					Unpaid family workers

Status classification systems have cohesion and face validity. Individuals instinctively place people into status groups. The systems are comprehensive and dynamic, and new categories are added as needed.

### Situs systems

An alternative classification for work was suggested by Benoît-Smullyan (1944). He differentiated between *stratum* and *situs* groupings of individuals or positions. A stratum category is placed above or below other categories in a hierarchical classification. A situs grouping places individuals or positions together with other categories on the same level without evaluation. Scottish clans and sex differentiation were used as examples of situs classifications. Hatt (1950) devised a situs occupational classification system based on work environments.

His idea was to have categories consisting of all status levels with all categories equally socially desirable. He suggested eight categories, namely political, professional, business, recreation and aesthetics, agriculture, manual work, military, and service.

Morris and Murphy (1957) considered that the professional, manual work and service categories could be interpreting as reflecting status. However, bearing in mind that the categories describe work environment, it is possible to consider both a civil engineer and a carpenter as involved in manual work, a lawyer and a legal secretary as being in a professional field, and Director of an electricity utility and a street sweeper as working in the service industry.

Roe's (1956) introduced a *psychology of occupations*, a two dimensional matrix, classifying jobs by status level (as shown in table 3.2) and situs categories (table 3.3 overleaf) based on <sup>1</sup>*relationship function* and institutional setting. Flanagan, Shaycoft,

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1 Relationship function: relationship between childhood environment, need development, personality and job choice.

Richards and Claudy (1971) noted that Roe's classification stresses type of work done. Inconsistent criteria for inclusion of jobs in categories resulted in the categories not being mutually exclusive. Splits between groups arose because of the type of work done. For example, university lecturers are in both Science and General Culture groups, teachers are assigned to Arts and entertainment, and practical nurses are classified in the service group while other nurses are in the science group.

Despite these minor drawbacks Brown (1991) states that the occupational classification system was a major contribution to the understanding of work.

Hatt (1950) Work environments	Roe (1956) Focus of work done	Morris and Murphy Contribution to society	Flanagan et al (1971) Kind of education or training
Political		Legal authority	Law
Business	Organisation and administration	Finance and records	Business administration Secretarial, clerical, office
	Business contact		Proprietors, Sales
Recreation and aesthetic	Arts and entertainment General culture	Arts and entertainment	Fine and performing arts
Service	Service	Education and research	General teaching, Social service
		Health and welfare	Medical and biological Humanities, social sciences
Manual	Technology	Manufacturing	Mechanics and industrial trades Technical
	Science	Building and maintenance Extraction	Engineering, science, maths, architecture Construction
Agriculture	Outdoor		
Military		Transportation	
Professional			

**Table 3.3: Comparison of *situs* occupational classification categories**

Morris and Murphy (1959) suggested that *situses* are characteristic sub-cultures expressing common values, norms, understandings and attitudes, and reflecting the way occupations are perceived (thus people talk of the "medical field" and the "manufacturing industry"). They applied *stratum* and *situs* concepts for a two-dimensional occupational classification system. Each *situs* category contained occupations from the lowest to highest status. "Contribution to society" was chosen as the basis for *situs* categories although they made the point that any non-status aspect such as task complexity or involvement with people could have been used.

Flanagan, Shaycoft, Richards and Claudy (1971) conducted a follow up of the national TALENT survey for the USA department of education, based on the similarity of high school profiles of abilities and interests of people in different occupations five years after high school. They used a *situs* occupational classification system stressing kind of education or training. Twelve categories, similar to those of Roe (1956), were used. The classification worked well, except for a vagueness in the service/teaching/medical categories. It was difficult to allocate jobs to categories where the actual tasks performed were not known.

Samuel and Lewin-Epstein, 1979 most recently used *situs* levels to research work values. They concluded that occupational *situs* better predicts values than does status or background variables such as ethnicity, social class and education level.

Apart from this study, Hall (1986, p 131) points out that work on *situs* classification stopped with popularity of Holland's (1966) typology. There has been no work since then on conceptualising the horizontal dimension for an occupational classification.

Situs classification systems are either teleological and co-societive, depending on the criteria for selecting categories. Categories are similar even when different criteria are used, indicating that researchers are careful to follow previous research, and/or that the categories are basically sound. The scientific basis, internal validity and comprehensiveness of the systems are good. The systems are dynamic. Exclusion of categories from some situs systems could be a function of the type of research being performed, for example high school graduates may not enter into transportation jobs.

The time and place of research also influence categories. Occupations in agriculture and outdoor work may have been more prevalent in the USA up to the mid 1950's, when commercial technology took a leap forward as war research became available. Certainly, the expansion of the manual/technology group from 1950 to 1971 is in line with technological advancement, and it is interesting to note that added categories are almost subcategories of those originally suggested in 1950. Rationality of the systems also appears to be sound.

### **Career psychologists**

Psychologists are concerned with how people make career choices and with matching people to the correct jobs. Classifications usually rely on descriptions of individual characteristics rather than characteristics of work. Interest tests are examples of efforts to create occupational classification systems for career psychology.

Holland's (1959) classification of people and jobs into six types was an important advance in career psychology. Research into his hexagonal model has led to the suggestion that the perceived structure of occupations is hierarchical (Gati, 1991).

## Interest tests

The fields of an interest test can be considered as occupational classification systems. Table 3.4 overleaf sets out interest fields from the various tests.

The fields measured by the different instruments are similar. Every test since 1950 has used fields from the SVIB and/or Kuder with a few name changes and sub-divisions. Factor analysis of the SVIB in 1969 resulted in the discovery of 21 *basic interests*. Factor analysis of interest items applied to South African school pupils for the 19FII led to 19 fields, of which some are unique and school-related, for example break time (sociability), after school activities (sport) and holidays (travel). The Kodus test goes so far as to break language down into reading and writing, which reflects an educational perception based on subjects taught at school. The "clean hands" field in the MVII is unique and could measure a negative interest in machinery, blood, and work behind a desk. SVIB basic interests include religious activities, teaching, recreational leadership, military and adventure scales which may have resulted from special attention paid to traditionally male and female interests and occupations. Holland's (1959) factor analysis of all known interest tests resulted in six main interest factors, which corresponded to the work-values factors previously proposed by Spranger (no date), operationalised by Allport, Vernon and Lindzey (1931) and confirmed as the six main interest domains by Guilford, Christensen, Bond and Sutton (1954).

With the exception of the SVIB, interest tests are classifications of interests and are not intended to classify occupations. Instruments were all derived from data on personal attributes obtained from individuals completing questionnaires about themselves. It cannot be assumed that the structure of human interests is the same as the structure of occupations.

Table 3.4: Comparison of interest test fields

1935 SVIB	1950 Kuder	1958 Rothwell-Miller	1965 MVII	1969 SVIB- BIS	1970 19FII	1973 HSIQ	1974 VIQ	1978 Kodus	1985 SDS
Technical & skilled trades	Mechanical	Practical Mechanical	Electronics	Technical supervisory	Practical - male	Technical	Technical	Machinery	Realistic
			Mechanical	Mechanical					
Medical	Outdoor	Practical	Carpentry	Agriculture Nature	Practical - female	Nature	Outdoor	Handwork	Investigative
			Food					Outdoors	
Engineering & Physical science	Scientific	Medical	Health	Medical services	Science	Science	Natural science	Science	
Accounting	Computational	Scientific		Science	Science	Science			
Verbal/ Linguistic	Literary	Computational		Mathematics	Numbers	Office work -numerical		Computational	
				Problem solving	Creative thought				
Artistic & Professional	Artistic	Literary	Clean hands	Law/politics	Law History		Language	Reading Writing	
Music	Musical	Aesthetic		Writing	Language	Language	Language		
Social service/ welfare	Social service	Musical		Art	Fine art	Fine arts	Art		
				Musical	Performing art	Entertaining Music			
		Social service		Social service	Social work Service	Social services	Social services	Social - group - individual	
				Religious activities Teaching					
				Recreational leadership	Sociability Sport				
				Military Adventure					
Sales/ Business contact				Merchandising	Business	Business	Commerce	Business	Enterprising
President Manager				Business management					
	Persuasive	Persuasive (personal contact)	Office sales	Sales	Public speaking				
Business detail/ Administration	Clerical	Clerical	Office	Office practice	Clerical	Office work -non numerical			Conventional
					Travel				

This would imply that new occupations arise if there are people interested in going into them. The resultant prediction for someone seeking career guidance could be, "you will do best in a job that hasn't been invented yet". The idea is interesting from both metaphysical and scientific points of view. Philosophy would argue whether people are created in anticipation of society's needs (for example, were ultra logical, introverted people born twenty years before the need for computer programmers?). Science must consider whether gaps in the known occupational structure are being filled by new jobs. Interest tests, being co-sociative and hence static in nature, cannot predict where new jobs will be created and do not meet the criteria of having a scientific basis as occupational classification systems, although they may be ideal as psychometric tests.

### Holland's occupational types

Holland's (1959) typology consists of the following six types: realistic, investigative, artistic, social, enterprising and conventional. They are arranged in a hexagon and it is assumed that types that are closest are more similar to each other than those which are further away. Having established the six types from factor analysis of interest tests, Holland (1959) set out to establish the concurrent validity of the factors with patterns of personality and ability, as well as to find out what types of people characterise particular occupations. His *theory of careers* sought to describe types of people and occupations in the same terms, so that people could be matched with work environments.

The type of person found most often in an occupation determines the occupational type. Thus there is a "social type" of person and greater numbers of this type of person is found in, say, public relations, so the public relations occupation is categorised as "social". A subsequent development was to allocate a 3-digit code comprising the three most common types of people found in each occupation. Moos (1987) describes Holland's model as describing how the aggregate characteristics of people in a work environment interact.

By 1991 there had been over 700 studies on various aspects of Holland's theory. (Hyland and Muchinsky, 1991) These included research into the structural validity of the hexagon model and assessments of the predictive validity of placing people into occupations. Research focussed on college students. Holcomb and Anderson (1977) found that 43% of all studies on Holland's theory used school, college and university students as subjects, a further 14,9% used children and adolescents, 5,9% used counsellors. Only 5% used employed people as subjects and only 2,9% of studies concerned job description and classification.

Generalisation to an occupational structure is questionable. As a statistically derived classification of interests, the theory is scientifically sound. It classifies the individual occupational preferences of youngsters in educational institutions. Existing and possible relationships among categories are represented in the hexagonal model. However, it does not describe processes and has not added to knowledge of how environmental factors such as work climate affect work outcomes.

Adler and Aranya (1985) found that job satisfaction of accountants is related to life stage irrespective of Holland type. Only 1% of employed men belong to the Holland group appropriate to their jobs and job satisfaction or job stability is not increased (Hughes, 1972). These findings raise questions about the predictive and concurrent validity of Holland types.

Cohesion of the system is also questionable despite its neat hexagonal shape. Because measurement of occupations is indirect, with little attention paid to work performed or the skills required, strange equivalent job combinations are grouped together. An example in the *Manual for the SDS* (Gevers, Du Toit and Harilall, 1992, p 59) suggests draughtsman, scientific glass blower, forester, theatre technician, anthropologist and geologist as equivalent occupations. These jobs cover many study fields, work environments and duties. It is difficult to imagine what they have in common other than the Holland type 3-digit code. Examples like this reduce face validity and indicate that the six types do not differentiate different occupations well. The major problem could be that the use of only six categories is simplistic. Classifying thousands of jobs into 120 categories (6 x 5 x 4) inevitable leads to incongruous groupings. Rationality is also affected. The manual (Gevers, Du Toit and Harilall, 1992, p 59) points out that the occupational codes in the *Dictionary of Holland occupational codes* (Gottfredson, Holland and Owega, 1985) and *The South African Dictionary of Occupations* (Taljaard and Mollendorff, 1987), do not always correspond.

### Comment on Holland's types

The Holland system has a rationale and is comprehensive. Its extensive use and value derive from its simplicity. The small number of categories affect validity and reliability. Despite these criticisms, Lowman (1991, p 16) considers Holland's integration of theory and empirical measures to be the best available for career guidance as it accounts for the factor structure of occupational preferences. He suggested that the six factors refined and expanded before they can be considered as an occupational classification system, as in ACT and SAVII, as shown in table 3.5 overleaf.

The ACT subcategories are an instinctive compromise between thousands of occupations in the DOT, Holland's six types and Roe's (1956) eight categories. Subcategories are not without problems. For example, is a degreed computer programmer working in a networking environment classified under C (operation of business machines, including computers), R (engineering and related occupations e.g. computers), or I (Natural sciences including computer sciences)? To be empirically useful, subcategories will have to be derived more scientifically than has been done so far.

<b>Holland Category</b>	<b>ACT</b>	<b>SAVII</b>
<b>R</b>	<p><b>TECHNICAL</b></p> <p>Rendering of personal services to others</p> <p>Growing/breeding of and caring for plants and animals</p> <p>Repairing, servicing and installation of home and office equipment. Construction and maintenance of roads buildings pipelines etc.</p> <p>Operating heavy vehicles and machinery</p> <p>Manufacturing, repairing and servicing machinery</p> <p>Engineering and related occupations e.g. surveyors, pilots, technicians, programmers</p>	<p><b>PRACTICAL-REALISTIC</b></p> <p>Human services and crafts</p> <p>Nature: plants and animals</p> <p>Construction, service and maintenance, repair, engineering and technology</p>
<b>I</b>	<p><b>SCIENCE</b></p> <p>Natural sciences e.g. biologists, chemists, statisticians, geologists, laboratory technicians</p> <p>Medical and related occupations</p> <p>Social sciences and legal services</p>	<p><b>SCIENTIFIC/INVESTIGATING</b></p> <p>Physical, biological, mathematical and computer sciences</p> <p>Medical and related fields</p> <p>Social, legal and economic sciences</p>
<b>A</b>	<p><b>CREATIVE ARTS</b></p> <p>The creative arts e.g. authors, musicians, actors and related</p> <p>Applied arts where language is the main component</p> <p>Applied or visual arts e.g. architects, photographers and related</p> <p>Popular entertainment, e.g. DJ, popular singers and musicians</p>	<p><b>ARTISTIC</b></p> <p>Language</p> <p>Creative design</p> <p>Entertainment</p>
<b>S</b>	<p><b>SOCIAL SERVICES</b></p> <p>Welfare, education and teaching e.g. counsellors, librarians, clergymen</p> <p>Rendering of personal and household services</p> <p>Nursing and caring for others</p> <p>Law enforcement and the protection of persons and property</p>	<p><b>SOCIAL SERVICE</b></p> <p>Education and personal services</p> <p>Nursing and caring</p> <p>Law enforcement and protective services</p>
<b>E</b>	<p><b>BUSINESS CONTACT</b></p> <p>Promotions and direct sales</p> <p>Management and planning</p> <p>Retail sales in particular and rendering related services</p>	<p><b>BUSINESS and MANAGEMENT</b></p> <p>Business - buying and selling</p> <p>Management</p> <p>Promotion and persuasion</p>
<b>C</b>	<p><b>BUSINESS DETAIL</b></p> <p>Clerical and secretarial</p> <p>Money e.g. paying and receiving money, bookkeeping</p> <p>Operation of business machines, including computers</p> <p>Storage, dispatching and delivery of goods</p>	<p><b>CLERICAL and ADMINISTRATION</b></p> <p>Clerical routine</p> <p>Numerical routine</p> <p>Office machine operation</p>

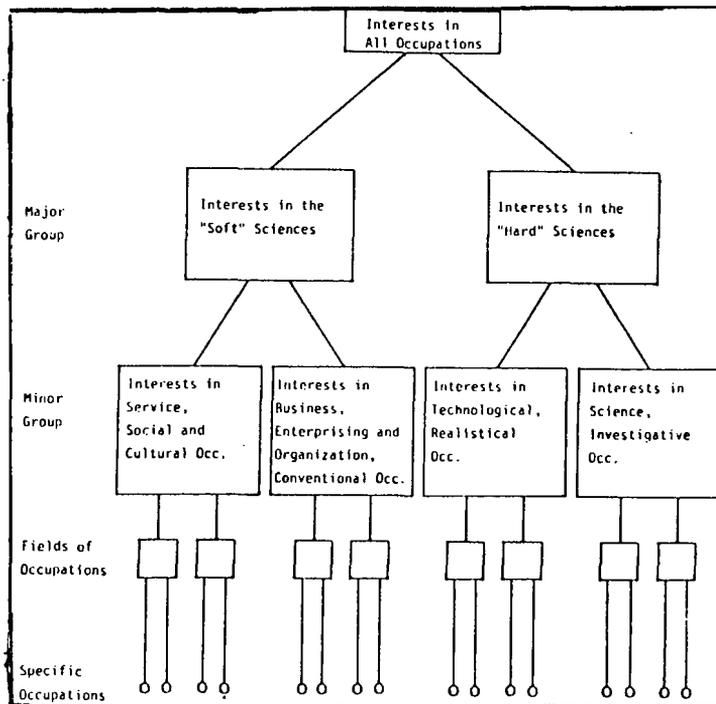
**Table 3.5: Comparison of the sub-categories of ACT and SAVII**

### Gati's structure of occupational interests

Gati (1979) pointed out that major theorists attempt to illustrate their perceptions of how occupations relate to each other. Thus, Roe (1956) hypothesises a circular relationship among work focus groups based on intensity and nature of interpersonal relationships. Holland's (1966) model is depicted as a hexagon, in which the geometric distance between the types is inversely related to the psychological similarity between them. Gati (1991) describes both systems as circular-dimensional models of occupational structure and identifies their common problems.

- Occupations may be too diverse to be described by the two dimensions of the models (Lunneborg and Lunneborg, 1977).
- There are occupations which cannot be classified into the categories. Gati (1991) suggests that they "fall into a hole in the middle of the circle".
- The order in which occupational groups are shown is not always supported by research and expected predictions of the relationships between the groups do not always occur. In particular, Holland types I, A and S pull the hexagonal out of shape.

As an alternative to circular models, Gati (1979) proposed a hierarchy of occupations, shown in figure 3.5 overleaf. The basis is that there are two major groups of occupations: *Orientation towards others* (soft sciences) and *orientation not towards others* (hard sciences).



**Figure 3.5: Diagrammatic representation of Gati's hierarchical model of occupational structure (from Gati, 1979)**

Each group is subdivided into smaller groups, then partitioned into fields which are organised into occupations. Occupations develop specialised skills, leading to finer distinctions by type of work done. According to this model, classification is carried out in a number of steps, with each step based on increasingly finer distinctions. The pattern is reflected in the first three digits of the DOT code, which progressively classify jobs by categories, divisions and groups. Gati and Nathan (1986) proposed that people make career decisions in a step-by-step process. At each step criteria for selection and alternatives lacking in the aspect are eliminated.

Gati and Winer (1987a) suggested that perceived occupational structure is universal in Western cultures, is similar to the structure of interests, and is a central factor in the career decision making process. This argument is used to justify the hierarchical model as the basis for an occupational classification system.

Despite his criticisms of two-dimensional systems Gati chose to analyse occupations with the two-dimensional ADDTREE clustering technique. Gati's analysis was based on only 24 occupations (Gati and Winer, 1987b). His model shows glimmerings of a network access classification system. The difference between the two models is that in the hierarchical model a choice at a higher level limits the choice at the next lower level, whereas in the network-access model all categories are available at all levels irrespective of choice of categories on another level.

A criticism of Holland's work and a direct comparison between Holland's hexagon and Gati's model using the six Holland types (Gati and Nathan, 1986) sidetracked the issue into a statistical debate. Counter-arguments are having to be found for criticisms such as that of Tracey and Rounds (1993), who showed convincingly that Holland's model proves Holland's model better than does Gati's model. It is unlikely that the major issue of occupational structure will be resolved while Gati continues to use Holland's types as input into his own model, and does not find a more popularly understood and less statistically cumbersome way of applying his structure to as many occupations as possible.

## DISCUSSION

There are different models available for classification systems. The power of new classification systems is a major moving force in science. Scientific advances and breakthroughs follow the introduction of each new model, as shown in table 3.6.

Classification model	Science advanced
Teleological	Philosophy
Linnaean	Botany
Darwinian	Paleontology
Matrix	Chemistry
Numbered category	Literary
Statistically derived	Psychology
Co-sociative	Sociology

**Table 3.6: Disciplines advanced by new types of classification systems**

New methods of classifying give impetus to scientific thought. Researchers should not necessarily try to copy existing models.

Gati's (1979) work appears to be a breakthrough in thought about occupational classification systems. He argues that interests indicate a "perceived structure" of occupations. His use of ADDTREE has led him to hypothesise that this is hierarchical, with an individual choosing a career, for example, by first wanting not to work with people, then showing an interest in business, followed by a choice of working with numbers and ultimately choosing to be an accountant. The hierarchical structure cannot be reversed to accommodate a school leaver who first decides to do book-keeping to earn money, then chooses to work in a computer environment and thus decides to do BCom Informatika. It also does not explain the perceived occupational structure of a person who has joined a bank, tried various departments and finally decided to work in the public relations department editing the company magazine.

These patterns of occupational structure and choice can only be handled by a network

access classification system. Gati's work is in danger of being sidetracked into a statistical debate since he published a direct attack on the popular Holland hexagonal model.

The popularity of Holland's theory appears to have stopped further work on occupational classification systems. Hall (1986, p 131) points out that work on sociological situs systems stopped when Holland's (1965) typology became popular and there has been little advance since then in conceptualising a horizontal dimension for occupational classification.

The similarity between situs occupational categories and interest fields is interesting to note, bearing in mind the different starting points of the two systems of classification. Sociological systems have both teleological and co-sociative bases and tend to be dynamic. Occupational categories in interest tests are static and statistically derived from interests of individuals generalised to reflect an occupational structure.

Interest test categories often depend on the group used to validate the test, and the instructions for test administration. The 19FII was tested on school pupils and does not differentiate between work and leisure interests. Fields related only to school and not to working life have therefore emerged and been accepted as vocational interests (for example sociability, history, travel). This is one of the dangers of statistically derived classification models.

Fleishman and Quaintance, (1984, p 44) point out that occupational classification systems are typically statistically derived. They are developed by examining sets of tasks/activities/interests, then subjectively creating words or phrases to describe them.

This results in purely conceptual, fragmentary and isolated attempts at classification that make generalisation and prediction difficult. The network access model, with its underlying basis in set theory mathematics, provides an alternative methodology.

### SUMMARY

A classification system results whenever units, items, ideas, things or people are put into categories. These categories derive from the similarity of units with each other and, if the system is dynamic, change with circumstances. Informal classification systems facilitate communication between people and are not recorded.

Formal classification systems prevent duplication of information and also allow for easier communication, recording, retrieval and comparison over data over geographical distances and time.

Innovations in classification models lead to scientific advances. Scientific classification systems must have a scientific basis and include all previous knowledge about the units being classified. Gaps in knowledge, existing and possible relationships among units should be predicted by a classification system. The system should have cohesion and be logical. It should be comprehensive and exhaustive so that every unit can be allocated somewhere. Different people should be able to rationally classify units into the same categories under different circumstances and at different times.

The following models are applied:

Teleological models are used by social scientists and classify units in terms of their "essence" or intrinsic nature.

Linnaean models are hierarchical and used in the biological sciences.

Darwinian models are continuous and dynamic. The theory of evolution is described in a Darwinian model.

Matrix models show related characteristics of units both horizontally and vertically. The periodic table of the elements is an example.

Numbered category models arrange lists of units so that they are related by number, as for example in Roget's Thesaurus.

Co-sociative models are based on related, rather than inherent characteristics of units. McCormick's (1979) Position Analysis Questionnaire classifies tasks by behaviours required.

Statistically derived models are artificially built from careful analysis and reduction of items, using techniques such as multiple regression, factor and cluster analysis. Trait personality theories are examples.

Network access models are based on mathematical set theory, and have not yet been scientifically applied. Categories are arranged on levels. Choice of a category on one level precludes the choice of any other category on the same level, but does not restrict access to categories on other levels.

Occupations are classified by commerce, governments, sociologists and career psychologists. In commercial applications, personnel and work study practitioners develop company-specific systems. The *Minnesota theory of work adjustment* and the *Position Analysis Questionnaire* are used for placing individuals in jobs.

The USA government funded development of the complex, comprehensive and often revised *Dictionary of Occupational Titles*. Variations of the *International Standard Classification of Occupations* are used by governments around the world for census purposes.

Sociologists use status and situs classifications to study how work affects groups of people. Status categories place individuals and occupations above or below each other in a hierarchical classification. Situs categories divide occupations into categories, each of which includes status from the highest to the lowest levels. Roe (1956) combined the two systems in her matrix classification.

Situs categories are similar to interest test fields although sociologists tend to use teleological and co-sociative models and interest tests are statistically derived. Interest fields are based on individual characteristics rather than occupational attributes and have not changed much since 1935. Holland (1959) identified six basic interest types. Since his theory was operationalised in 1970, there has been little other research into the structure of occupations. The ACT Programme (adapted for South African use in the Easy Steps Guide and SAVII) is an instinctive compromise between thousands of occupations listed numerically in the DOT, and the six Holland types.

Gati (1979) criticised Roe's (1956) circular model and Holland's (1966) hexagonal model, on the grounds that they are not exhaustive, are not always supported by research and that their two dimensionality does not reflect the multi-dimensionality of job characteristics. He proposed a structural hierarchical structure of occupations. Work on his theory has been slow with only 24 jobs classified. The use of Holland's types in research has led to a statistical debate on the merits of the two systems. Despite this, his work appears to be the forerunner of the development of a network access classification system for occupations.

There is presently no adequate method for career counsellors to understand and explain relationships between occupations. Holland's (1959) theory is the best available, but like other interest measurements it is static and assumes that structures of interests and of occupations are the same.

This study is concerned with the development and validation of a new system for classifying occupations. The next chapter will develop the system in terms of the network access model.

**CHAPTER 4 - DEVELOPMENT OF THE**  
**FIELD - ENVIRONMENT - DUTY (FED)**  
**OCCUPATIONAL CLASSIFICATION SYSTEM**

**SCOPE OF THE CHAPTER**

*Conceptualisation of the FED occupational classification system.*

*Operationalised of the interest test to be used as the measuring instrument in this study.*

**INTRODUCTION**

Interest tests are extensively used for career counselling and guidance. However, no direct link has been established between the structure of interests and the structure of occupations. Interest tests are developed by asking people about their interests because it has been shown that people in particular occupations tend to have the same interests. This is misinterpreted as showing that the inter-relationships between interest fields are the same as between occupations.

Lofquist and Dawis (1969, p 18) state that there has been little progress in developing a psychology of work to enable career counsellors to describe occupations. Information given to clients is often instinctive (Bordin, 1968). Crites (1981) found in a survey of major approaches to career counselling that occupational information is the most neglected aspect. Clinicians are not trained in occupational information (Lowman, 1991, p 1). Systems used by career psychologists for matching people to jobs are inadequate because they rely on descriptions of individual characteristics rather than on characteristics of work (Miller, Treiman, Cain and Roos, 1980, p 203).

Holland's (1959) theory of careers is the best system available. His six types were developed from a factor analysis of interest tests and instinctively linked to particular occupations (Holland, 1985). The typology is convenient because a person's interests are matched to occupations where it is assumed that the majority of workers have the same interests. The remarks above were made after his model was published. It falls short because it does not describe how people perceive the structure of occupations. Rusalem (1954) suggested that an individual's career choice reveals personal perceptions of jobs and the world of work, however imperfect or distorted they may be. Systematic methods are needed to relate occupations to each other and individual interests to occupational information, and to understand how careers are chosen.

Instead of following the methodology of exploring interest patterns and then applying them to occupational structure, this study proposes to reverse the process. An occupational classification system will be developed and operationalised as an interest test. After application to a test group, analysis of the results will be carried out to assess the extent to which the system reflects the group's perception of the structure of occupations and meets the criteria for evaluating classification systems. Lastly, test results will be analysed to determine whether the classification in itself meets the criteria to be psychometric test. This chapter discusses the background to, the operationalisation and development of the new FED occupational classification system.

## THE DEVELOPMENT OF THE FED CLASSIFICATION SYSTEM

Stages for developing a classification system are set out by Fleishman and Quaintance (1984, p 44). These are:

1. Identify the purpose of the system
2. Choose and organise the subject matter
3. Define the method and criteria for allocating units to categories
4. Seek to ensure throughout the process that the criteria for a sound classification system (Fleishman and Quaintance, 1984, p 82) are built into the system, namely:
  - scientific basis
  - cohesion
  - comprehensiveness
  - rationality.

### Identifying the purpose of the system

The following questions are addressed to ensure the *scientific basis* of the system:

- Is the purpose of the system to interpret, predict or control information?
- What are the known, relevant characteristics of the subject matter?
- Should the system be static or dynamic?
- What classification model will be used?

### Choosing and organising the subject matter

To ensure the *cohesion* of the system, the following questions must be answered:

- What will be the basis of choosing the categories?
- How many categories will there be? There must be enough not to lose information about the classified units, but not so many that the system is unwieldy.
- How will the subject matter be translated into units for classification?

*Comprehensiveness* of the system depends on having access to an extensive list of units, and showing that each unit can be classified under the categories.

### **Defining the method and criteria for allocating units to categories**

This is an essential step for ensuring the *rationality* of the system.

- In what way are categories compatible with how users think? This reduces classification errors and increases data accuracy (Conrad and Tomm, 1993).
- How should categories be defined to be understood by users of the system?
- What provisions will be made for the overlapping of categories and for allocating units belonging to more than one category?
- To what extent can a unit be included in an existing category and at what stage can a new category be added to a dynamic system?

### **ENSURING THE SCIENTIFIC BASIS OF THE SYSTEM**

#### **The purpose of the system**

An occupational classification system relates occupations to each other in categories (Baer and Roeber, 1964, p 167). All jobs should fit into the categories and be easily described in terms of characteristics common to the categories. This study develops a system for career guidance and is concerned with how current and potential workers perceive jobs and the occupational structure, so as to predict suitable occupations for individuals.

#### **Characteristics of jobs**

Many volumes have been written about the characteristics of jobs. These range across ideological explanations of the value of work to society and the individual's feeling of self worth; control mechanisms, economic considerations, accounting principles; production and productivity; descriptions of work done, of the people who do the work and of the ways in which people and work are organised.

This study examines how current and potential workers perceive the structure of occupations. To begin with, it must be considered what people actually know about jobs. Obviously they have a different, less complex, more subjective perception than that held by management, specialists, researchers or government agencies.

The characteristics which people associate with jobs can be hypothesised as:

- Different training (education or work experience) is needed for different types of jobs. It is easier to learn something and be good at it if it interests you. Early training gives a background for a group of related occupations (Super, 1957, p 29). Training does not transfer easily from one field of work to another. People become specialists, and it is then difficult for them to switch jobs. This perception is reflected in interest test fields.
- People "go to work". People with certain attitudes and values are likely to be attracted to particular job environments (Super 1957, p 29). The place where you work becomes a social outlet where you associate with a particular type of co-worker, boss and customer. Place of work restricts freedom, with different environments making different demands on workers. Factors such as pace of work, type of supervision, security benefits and social life vary with the environment (Super, 1957, p 44). Lowman (1991, p 10) describes the differences in working environments between a surgeon and paediatrician (both in the medical field) or a trial lawyer and corporate attorney (both in the legal field). He suggests that individuals can improve work satisfaction by moving to another work environment with different working conditions, while staying in the same field of work.

Working environments can involve extreme heat or cold, humidity, exposure to the elements, noise and vibration; danger, fumes, bad ventilation and dust. (US Department of Labour, 1977). Physical working conditions can determine an individual's career choice with, at the extreme, health and physical condition excluding certain working environments (Baer and Roeber, 1964, p 181).

- Money is earned for doing work. Usually, the better you are at "doing your job" and "performing your duties", the more money you will earn. People have set tasks, functions and things to achieve during the day. Baer and Roeber (1964, p 162) point out that the most important part of a job description is a list of duties. Different duties use different tools, techniques and skills.

The importance of job duties has been recognised in the DOT, where jobs are described in terms of their involvement with data, people and things.

- Many people are unhappy at work. Some are not interested in what they are doing because they are in the wrong field. Others are in the wrong environment, have interpersonal problems with the people they work with or feel their freedom is too restricted. Still others are bored with or cannot cope with their duties.

*Among other causes for job satisfaction, it is important to be in a **field** of work for which one is trained and which matches one's interests, in an **environment** which meets one's needs, and doing **duties** which match one's capabilities.*

### The classification model

There is more than one dimension involved in the perception of organisational structure. People see jobs as being related to one another on at least three levels:

- Field of work determined by specialised training needed
- Work environment associated with various restrictions and social opportunities
- Duties involved in the performance of the job.

The network access model describes inter-relationships between the three levels of field, environment and duty. Access to a category on one level precludes access to other categories on the same level, but does not affect access to any categories on another level, as shown in figure 4.1.

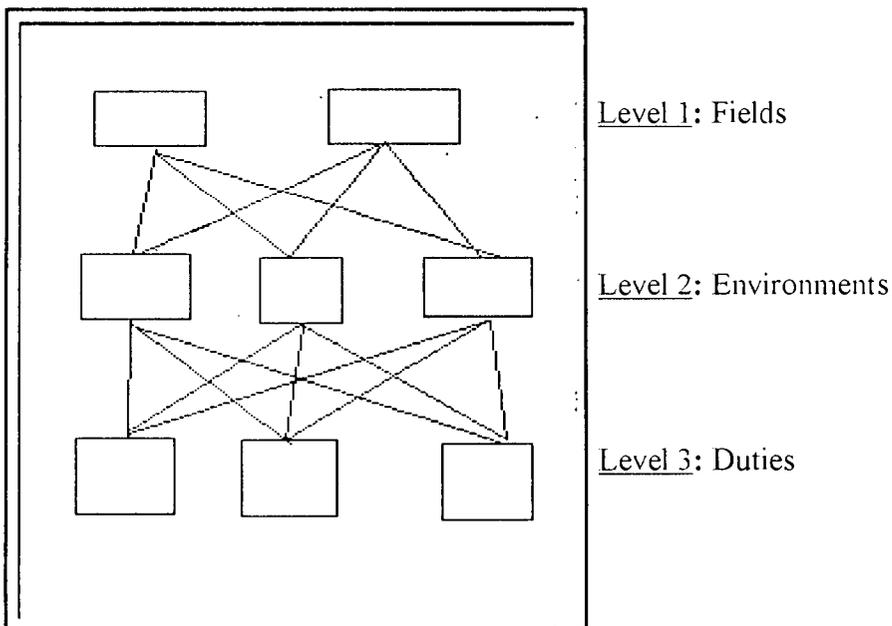


Figure 4.1: The basic FED system according to the network access model

The use of fields, environments and duties for an occupational classification system is in line with suggestions in the literature. Fine and Heinz (1957) distinguished fields, work environments and worker functions as the main types of work variable. Lindhart (1979) suggested that jobs are chosen according to interests, workplace and activity. Erez and Schnoerson (1980) showed that academics and professionals with the same occupational discipline (field) had different personalities and were motivated by different drives. They concluded that people with different personalities search not only for matching occupational fields, but also for characteristic organisational settings (environments) and job activities (duties).

A job classified in the FED system is assigned to three categories: one field, one environment and one duty. Gaps in knowledge could be located where there is a combination of field, environment and duty which does not describe any occupations. Up to now, classification of occupational structure has been attempted in teleological and co-sociative models by sociologists, the matrix model for Roe's (1956) classification, the numbered category model for the DOT, the Linnaean model for Gati's (1979) hierarchical structure, and statistically derived systems in interest tests including Holland's (1959) theory. Only the Darwinian model has not been used, possibly because processes of changes in occupational structure have not been identified.

Within the FED, different processes can be followed to reach a final career decision:

- decide on an educational specialisation (a degree course), then choose where to work, and according to ability, land up doing a particular duty (field -environment - duty process),
- learn about a field, specialise in a duty (such as organising) and then choose an environment for practising the duty (field - duty - environment process),
- choose to work in a particular environment (like a mine), qualify as required and then do the work involved (environment - field - duty process),
- choose an environment (like working from home), find a duty that can be done in the environment (like secretarial/clerical work) and accept any field offering suitable work (environment - duty - field process),
- identify a skill and the best suited duty (for example bookkeeping), find a work environment to apply the skill and, through work experience within an industry, be tied to particular field (duty - environment - field process),
- choose a field because a particular skill (working with people) combines with an interest of the individual (medicine), and find the most suitable environment by trial and error (duty - field - environment).

**The FED system takes account of perceptions about work, identifies where there are gaps in knowledge about occupational structure, and provides a model for a theory of career choice.**

## ENSURING THE COHESION OF THE SYSTEM

### Choice of fields

Fields were selected where possible according to common language usage: "working in the medical profession", "in the beauty industry", "working with children", "working in business". Altogether 27 fields were used. They are listed in table 4.1 overleaf with short definitions provided for school-leavers.

It was found that the fields are similar to interest test and situs system categories. The "source" of each field is given in table 4.1. Interest fields excluded are history (a school subject from the 19FH which does not have many associated occupations), music (which it was felt could be covered by the creative and/or imaginative fields), performing and clerical work (which appear to be duties rather than fields) and military and social welfare (which may be environments). The transportation field from Morris and Murphy's (1959) situs classification was also excluded as it was felt that it may be covered by travel, following Cattell, Ebel and Tatsuoka (1970, p 189). Two new fields were included: *systems* to take into account computer and related industries, and *beauty* to include jobs in the emerging "health and beauty" business as well as occupations such as clothing production manager and beauty therapist which did not fit comfortably into any of the other categories.

<i>Field of work</i>	<i>Source</i>	<i>Definition</i>
Adventure	SVIB - BIS	Physical danger. Possible death
Animals	KODUS	Contact with and use of knowledge about animals
Beauty	-	Cosmetics, skin, hair, health products and clothes
Business	SVIB; 19FII; HSIQ; VIQ; KODUS;Hatt	Commerce or finance
Chemistry	KUDER	Properties and reactions of substances
Children	SVIB-BIS; Flanagan	Contact with and watching the growth of children
Creative	20FII; Roe	Contact with and helping imaginative people
Electronics	MVII	Blueprints, transistors, circuits
Food	MVII; 19FII	Planning and preparing meals and events around eating
Imaginative	SVIB;KUDER;Situs systems;Holland	Thinking up new and unique ideas
Language	SVIB;KUDER;19FII; HSIQ; KODUS	Contact with written words, reports, books
Legal	SVIB-BIS; 19 FII; Morris and Murphy; Flanagan	Interpreting and putting into practice society's rules
Marketing	SVIB;Roe;Flanagan	Putting together products and advising people about them
Medical	SVIB;MVII;Flanagan	Helping others to feel healthy
Movement	19FII; HSIQ	Body use to show emotion, physical skill or strength
Natural Forces	Morris and Murphy	Knowledge of the land, weather and rocks
Numbers	SVIB;KUDER;19FII;KODUS	Applying formulae, manipulating figures
People	19FII; KODUS; Holland	Contact and verbal communication with adults
Physics	SVIB; Flanagan	Changes of matter and energy
Plants	KODUS	Planting, watching and using trees and flowers
Politics	SVIB-BIS; Hatt	Making and explaining decisions that affect society
Property	Morris and Murphy;	Buildings, construction works, building materials
Service	19FII; Hatt; Roe	Doing things for others
Systems	-	Using procedures and finding new ways of doing things
Trading	SVIB-BIS; Flanagan	Buying and selling goods
Travel	19FII	Moving from place to place
Work with hands	All interest tests and situs systems	Using materials and equipment to make or fix things

**Table 4.1: Fields, related interest and situs classifications and definitions**

### Choice of environments

The environments chosen were based on the author's observation of different jobs and work behaviour in many organisations. Although the basis on which environments were chosen was not systematic, the list was found to be comprehensive enough to include all of the jobs and occupations listed in the *A-Z of careers* (Nelson, 1989).

The environments are listed according to the contact that workers have with other people. This follows Landau and Rohmert's (1989, p 1) opinion that human work is performed in a social work environment. Super (1957, p 30) states that every worker is a member of a group, and feels a need to be like and be accepted by the group, either taking on the dominant values of the work environment or seeking another job. Attraction to or leaving an organisation and selection or rejection results in certain kinds of persons working in organisations and determining organisational behaviour. Schneider (1979) suggested that environments are a function of persons behaving in them.

The 23 environments, their classification by social contact and the definitions for school leavers are given in table 4.2 overleaf.

Environment	Contact with people	Definition - surrounded by
Isolation	<i>Nil</i>	Seeing no other people
Academic	<i>Minimum</i>	Books and papers
Data processing		Computer hardware and VDU screens
Laboratory		Laboratory equipment
Mining		Rock faces, dust
Consultancy	<i>Team, some customers</i>	Project team of people in a similar job, committees
Corporate		Levels of management, procedures
Dynamic		Temperamental people, many changes
Factory		Machines, noise, grease
Government		Bureaucracy, rules and regulations
Kitchen		Food, cooking utensils and ingredients
Nature		Open space, fresh air, no buildings
Regimental		Uniforms, authority figures, organisation
Small office		Office equipment, files, contact with business owner
Storeroom		Boxes, crates, spare parts
Behind counter		<i>Client centred.</i>
Client premises	Samples and quotes	
Craft workshop	Ideas and artistry, hand held tools	
Home	Your own possessions, family and pets	
Indoors	Walls, loose furniture, gatherings of people	
Outdoors	The elements, activity, sensation	
Professional	Certificates of education, confidentiality	
Religion	People in need, meditation, spirituality	

**Table 4.2: Environments, social contact and definitions**

### Choice of duties

Work oriented descriptors for characterising jobs, in other words *duties*, are made up of lists of verbs. If the list is complete and the verbs are mutually exclusive, it can serve as a classification system (McCormick, 1979, p 177).

Bennett (1971) explains the difficulty of setting limits in describing a task or duty. For example, driving could be a whole job for a delivery person, or part of the job of a salesman, or a perceptual-motor activity for a machine minder.

McCormick (1979, p 92) solves this problem by defining a task as "a set of related activities directed towards a goal, which may include a mixture of decisions, perceptions and activities and results in a meaningful tangible or intangible product".

Duties were chosen using Bennett's (1971) four factors which he found in a factor analysis of 25 work-oriented tasks, namely:

- procedural (paperwork)
- social (talking)
- cognitive (thinking)
- physical (action).

An additional factor of "thinking" is included.

The 32 duties and definitions are given in table 4.3 overleaf. These duties have been used by the author for job analyses in large corporations.

Duty	Related to	Definition
Bookkeeping	<i>Paper</i>	Adding up figures, balancing totals
Calculating		Doing complicated sums
Clerical work		Filing, filling in forms, office work
Drawing		Art and design with a drawing instrument
Writing		Correspondence, reports, articles, paying attention to grammar and spelling
Advising	<i>Talking</i>	Passing on knowledge as suggestions
Buying		Negotiating prices, finding good deals
Counselling		Helping people with personal problems
Disagreeing		Brainstorming, giving your own opinions
Microphone		Talking to strangers at a distance
Motivation		Delegating, influencing others to do what you want
Organising		Giving orders, coordinating activities
Selling		Demonstrating products and getting people to buy
Teaching		Passing on knowledge and testing people
Composition	<i>Thinking</i>	Arranging parts into a whole
Investigating		Research, analysing a whole into parts
Judgment		Choosing between things with little information at your disposal
Prediction		Working out strategies and trends for the future
Cash handling	<i>Action</i>	Counting money, giving change
Cleaning		Keeping things neat and tidy
Driving		Controlling a vehicle
Equipment use		Watching gauges, using levers and pressing keys to control a machine
Measurement		Using rulers and tapes, calculating angles and distances
Protection		Looking after the property of others or of society
Tool use		Using hand-held instruments to change something
Walking		Moving on foot over a distance
Weapon use		Aiming at targets, killing
Caring	<i>Feeling</i>	Looking after the needs of the sick
Interpreting		Drawing conclusions about someone else's work
Performing		Appearing before an audience
Practicing		Striving to improve by doing the same thing over and over again
Taking risks		Playing the odds, "Gut-feel" decisions

**Table 4.3: Duties, classification by type of work and definitions**

### **Units for classification**

The units for classification are occupations or jobs as known to the general public. Job titles specific to a particular organisation are not used. To illustrate the difference, a person would respond to the question, "What job do you do?" with the answer "insurance broker" (job) and not "deputy manager: corporate sales" (job title).

### **ENSURING THE COMPREHENSIVENESS OF THE SYSTEM**

Occupational titles were taken from the *A-Z of Careers in South Africa* (Nelson, 1989), from job advertisements in national, local and classified newspapers, from training course titles, and from interviews with people in jobs. This resulted in an inventory of 1200 jobs classified by fields, environments and duties (Holman, 1991). Three independent judges classified each job. In the case of disagreements the jobs were further researched. No jobs were found which could not be classified in terms of the categories. According to Fleishman and Quaintance (1984, p 44) it is an acceptable procedure in exploratory research to develop criteria and allocate units simultaneously.

Examples of classifications from the inventory of 1200 jobs are given in table 4.4 overleaf.

Occupation	Field	Environment	Duty
Traffic officer	Adventure	Outdoors	Driving
Dog clipper	Animals	Craft workshop	Caring
Ramp model	Beauty	Dynamic	Performing
Actuary	Business	Corporate	Prediction
Pathologist	Chemistry	Laboratory	Investigating
School principal	Children	Indoors	Motivation
Mother	Children	Home	Caring
Disc jockey	Creative	Dynamic	Microphone
Hardware engineer	Electronics	Data processing	Equipment
Bartender	Food	Indoors	Composition
Craft teacher	Imaginative	Welfare	Teaching
Proof reader	Language	Isolation	Judgment
Private investigator	Legal	Outdoors	Investigating
Telesales	Marketing	Small office	Microphone
Optometrist	Medical	Professional	Equipment
Karate instructor	Movement	Indoors	Teaching
Land surveyor	Natural forces	Outdoors	Measuring
Cashier	Numbers	Behind counter	Cash handling
Psychologist	People	Professional	Counselling
Mechanical engineer	Physics	Factory	Composition
Forester	Plants	Nature	Walking
State president	Politics	Government	Taking risks
Bricklayer	Property	Outdoors	Tool use
Street cleaner	Service	Outdoors	Cleaning
Mine safety officer	Systems	Mining	Protection
Warehouse manager	Trading	Storeroom	Organising
Pilot	Travel	Regimental	Driving
Fitter	Work with hands	Factory	Tool use

**Table 4.4: Example of classifications of occupations by field, environment and duty (Sample taken from the inventory of 1200 jobs in Holman, 1993).**

## ENSURING THE RATIONALITY OF THE SYSTEM

The aim in developing the classification was to have a descriptive tool for relating occupations to each other, which can be used in career guidance by counsellors and also for individuals exploring different career options. The people who will use the system are mainly school leavers and their career counsellors.

An effort was made to ensure that the definitions of categories would be understood by school pupils down to standard 7 level. This may have resulted in simplistic definitions and category names not being considered comprehensive by personnel practitioners and other researchers. However, it was felt that broad generalisations, understood by school pupils, would be more useful than scientific definitions.

Where an occupation could be allocated to more than one category on the same level, the following rules were used:

- Where two or more fields applied, the occupations for which similar training or skills would be needed were consulted, and the field used which applied to the most related occupations
- Where two or more environments applied, the popular conception of where the occupation is performed was used
- Where two or more duties applied, the one taking up most time was used.

The system is intended to be dynamic. Thus new categories can be added as the occupational structure changes. For example, before the Industrial Revolution there were no factories. Examination of the lists of fields, environments and duties shows, however, that most categories have always been part of the occupational structure. This suggests that occupational structure may not alter very often, but changes may occur with technology advances and new lifestyles.

The problem exists of when to include a new category. This cannot be done for an occupation which is a passing fad (perhaps unique to one person or community), but it must take place before a field, environment or duty becomes a major force in the economy. At this stage nothing is known about how people perceive the development of the structure of occupations. By the end of this study, which should indicate whether any of the categories should be combined, a rule should emerge for creating new categories.

### **OPERATIONALISING THE INSTRUMENT**

In order to operationalise the FED into an instrument that can be used for research, the format for presentation to testees must be decided. This includes the rating method and the instructions for administering the test.

#### **Rating method**

Owen and Taljaard (1988, p 411) state that the two main methods applied to interest test rating are the *forced choice* and the *free choice* methods.

#### **Free choice rating scale**

The testee has to indicate a score on a rating scale a degree of interest for each of a list of activities. Nunnally (1970, p 163) refers to these rating scales as absolute measures. Kerlinger (1973, p 503) points out that rating scores are independent of each other, with the score on one item not affecting the scores on other items. Norm tables can be derived for comparing an individual to the population using parametric statistics in relation to the normal population curve. This means that free choice rating scales are useful for comparing individuals (Nunnally, 1970, p 163). Conover (1980, p 65) adds that interval scales can be analysed using any statistical techniques which also apply to the "weaker" ordinal and nominal scales.

Usually in interest tests a two, three or four point scale is used. An odd numbered scale permits "uncertain" feelings to be expressed. The wider the range of the rating scale the fewer items are needed and the fewer problems are experienced in statistical analysis. However, it becomes more complicated to explain to testees.

### Forced choice rating scale

The testee has to choose one or more out of a number of possible choices. Usually in interest tests activities are presented in groups of two or three, according to Owen and Taljaard (1988, p 411). The testee has to indicate the most and least preferred activity from the list. Theoretically the testee could be presented with any number of items and asked to indicate any number of most liked or least liked activities (nominal measurement), or to rank order all the items (ordinal measurement). The rating scale gives ipsative scores for the individual, not related to a norm population, but Kerlinger (1980, p 505) points out that composite rank orders are easily compared or correlated. Nunnally (1970, p 164) points out that these rating scales suit interest tests because interests, as sentiments, are inherently comparative.

Kerlinger (1980, p 502) explains that ratings are dependent on each other, with the rating of one item affecting ratings of subsequent items (because fewer items remain to choose from or to rank). This makes forced choice rating scales useful when categories rather than individuals need to be compared. Reliability is high and faking reduced.

However, specialised non-parametric analysis has to be used. Low correlations can be expected between interest categories, but this tends to increase differentiation and to highlight similarities between categories.

### Decision on rating method

The measurement scale used to operationalise the field - environment - duty system (FED) as an interest test must meet four criteria:

- It must be simple to use and understand as an interest test for school pupils.
- It must highlight high interests.
- It must fit in with the network access model. Choices from any of the three levels of the model must not restrict choices on the other levels.
- It must throw into relief the relationships between fields, environments and duties, in other words any overlaps, synonyms and lack of relationships.

A free choice scale using interval measurements was rejected for the measuring instrument on two grounds:

Firstly, final scores will have to be additive which will involve a very long test given 81 FED categories to be measured. Administration could be complicated and it could be difficult for testees to choose interests at each level.

Secondly, a halo rating effect can be expected, particularly if the rating scale is limited to three or four choices. This will give high inter-correlations and conceal relationships between fields, environments and duties.

A forced choice ordinal scale, asking for ranking, is also complicated to administer and has the disadvantage of having a reducing marginal return as lower interests are chosen. Choice of the highest three or four categories will be quick, but speed will drop as choices have to be made from remaining categories which are of minor interest to a testee. Lower interests will tend to obscure relationships between categories.

A forced choice rating using a nominal measurement would ask testees to choose or not choose a category as an interest. This type of scale meets all four criteria given above. It is easy to administer. The simple instruction to "choose from this list the three that you are most interested in for a job" will ensure that high interests are identified. Independent choices will be obtained for all three levels of categories, thus fitting in with the network access model. Relationships between categories will be highlighted. This measurement method will not necessarily prejudice results towards the network access model; if the occupational classification system model should be hierarchical, the necessary relationships will be identified and the network access model rejected. The disadvantage of using this type of scale is that parametric statistics such as correlations and t-tests cannot be used. However, there are non-parametric statistical methods available, although they are not as powerful. Low correlations can be generally expected between categories, but this means that any high relationships will be meaningful.

**Test administration**

The test takes less than ten minutes to administer. The tester gives the following instructions to testees:

*You have in front of you lists of fields of work, environments in which work takes place and duties involved in work. I am going to read the list of fields to you. While I am reading you must circle the three fields that you are most interested in for a job. There are definitions on the right hand side if you are not sure what a field involves. (The tester then reads the list). You have to choose three fields. You may not choose two or four fields . Circle the three fields you are most interested in for a job. (After a few minutes the tester asks whether everyone is finished, and continues) Now I will read the list of environments. Again, please circle the three that you are most interested in for a job. (The tester repeats the procedure for the duties).*

Definitions were intended to assist with classification of jobs and are not specifically included as part of the test, although they may be consulted by testees.

**SUMMARY**

There is presently no adequate method for career counsellors to understand and explain relationships between occupations. Holland's (1959) theory appears to be the best available, but like other interest measurements it is static and assumes a direct link between structure of interests and perceived structure of occupations.

This study reverses the usual methodology of exploring interest patterns and then applying them to occupational structure. An occupational classification system is developed and evaluated as both a classification system and an interest test. The classification system thus serves as the measuring instrument for this study.

People see jobs as being related to one another on at least three levels:

- Field of work determined by specialised training needed
- Work environment associated with various restrictions and social opportunities
- Duties involved and making up the job.

These three levels are used for the occupational classification system.

A job classified by the system is assigned to three categories: one field, one environment and one duty. The network access model describes inter-relationships between the three levels. Access to a category on one level precludes access to other categories on the same level, but does not affect access to any categories on another level

The FED occupational classification system has been developed according to the stages set out by Fleishman and Quaintance (1984). Care was taken to build into the system a scientific basis, cohesion, comprehensiveness and rationality.

Gati's (1979) model is unique among existing occupational classification systems in that it describes multiple dimensions of occupations, a process of career choice and has a potential for adding categories to meet the dynamic nature of occupational structure.

All of these features are addressed in the FED system, which is dynamic, takes into account public perceptions about work being on three levels, identifies where there are gaps in knowledge about occupational structure, and provides a model for a theory of career choice.

Altogether 27 fields were selected according to common language usage. The fields are similar to interest test fields and situs system categories. 23 Environments were identified according to the contact that workers have with other people.

A list of 32 duties was drawn up, broken down according to paper-work, talking, thinking, action or feeling.

With a few exceptions (for example, factories did not exist before the Industrial Revolution) the categories have always been part of the occupational structure. This suggests that the structure does not alter often, but that changes may occur with technological advances and new lifestyles.

Units for classification are occupations and not job titles. Occupational titles were taken from the *A-Z of Careers in South Africa* (Nelson, 1989), from job advertisements in national, local and classified newspapers, from training course titles, and from interviews with people in jobs. This resulted in an inventory of 1200 jobs classified by fields, environments and duties.

A forced choice rating using nominal measurement is used for the interest test used to operationalise the FED. Testees are instructed to "choose from each list the three that you are most interested in for a job". This method has the following advantages:

- It is simple to use and understand as an interest test for school pupils.
- High interests are highlighted.
- It fits in with the network access model. Choices from any of the three levels of the model does not restrict choices on the other levels.
- The relationships between fields, environments and duties are thrown into relief.

The next three chapters deal with:

- a) research to be carried out into the inter-relationships of FED categories,
- b) the evaluation of the FED system as an occupational classification system,  
and
- c) the use of FED as a psychometric interest test.

## CHAPTER 5 - RESEARCH DESIGN

### SCOPE OF THE CHAPTER

*An outline of research to be conducted, including procedures for validating the FED as an occupational classification system and as an interest test.*

### INTRODUCTION

The previous chapter dealt with the conceptualisation of the FED occupational classification system and its operationalisation as an interest test. This chapter sets out the research to be carried out to evaluate it as both a classification system and as an interest test.

### STATISTICAL METHODS

All statistical analyses in this study will be performed using the personal computer version 2.0 of the *Statistical Package for the Social Sciences* (Norusis, 1988).

When using nominal measurement, in which there are two or more subsets of the objects being measured (Kerlinger, 1973, p 39), the following techniques are used:

#### $\chi^2$ (Chi square) test

For each item on the list there are two possibilities: either it is chosen or it is not chosen. In nominal measurement all the members of a set are assigned the same number and each set has a different number. Members of the sets are then counted and compared in cross-break analysis of variance as quantifiable variables (Kerlinger, 1973, p 436). This is an analysis of "contrast groups" (Smit, 1981, p 56).

An example of a cross-break (contingency) table is given in figure 5.1.

CATEGORY 2	CATEGORY 1	
	Chosen	Not chosen
Not chosen	n1	n4
Chosen	n2	n3

Figure 5.1: Example of a contingency table

$n_1$ ,  $n_2$ ,  $n_3$  and  $n_4$  are the number (frequency) of cases chosen in each cell.

The total  $N = n_1 + n_2 + n_3 + n_4$ .

The  $\chi^2$  test is used to analyse whether two populations have the same or different proportions of cases in each category. It measures whether frequencies in each cell are different from those expected by chance. The null hypothesis is that the probability of an event is the same for both categories. (Conover, 1971, p 144). For figure 5.1 the test could be applied to determine whether more people who choose category 1 also choose category 2.

$\chi^2$  is calculated as follows:

$$\chi^2 = \frac{N (n_1 n_4 - n_3 n_2)^2}{(n_1 + n_3)(n_2 + n_4)(n_1 + n_2)(n_3 + n_4)}$$

The value of  $\chi^2$  starts from 0, which indicates no departure of obtained from expected frequencies, through increasing values. The level of statistical significance which indicates how often a chance result has occurred (Kerlinger, 1973, p 168) depends on the degrees of freedom (determined by the number of cells).

The independence of fields, environments and duties will be examined using the Pearson  $\chi^2$  test for independence (Conover, 1980, p 158). It is calculated by summing over all cells the squared residuals divided by the expected frequencies.

The test statistic is compared to the theoretical  $\chi^2$  distribution to estimate how likely the combination is, if the variables are independent.

In order to strengthen the relationship for a meaningful examination, cases can be excluded if neither of the two categories are chosen. The resultant empty block of the contingency table (top right hand corner in figure 5.1) is then set to 1.

### $\theta^2$ (Phi square) coefficient

The  $\theta^2$  coefficient indicates relationships for nominal measurements (Conover, 1980, p 184).  $\theta^2$  lies between 0 and 1, with 0 indicating that there is no relationship between the variables. The formula is:

$$\theta^2 = \frac{\chi^2}{N}$$

## AIM OF THE INVESTIGATION

Following from the problem statement, the aim of the investigation is to validate the FED model as an occupational classification system, and the measuring instrument as an interest test.

### Validation as an occupational classification system

The following aspects will be covered by the research:

- The scientific basis of the model, in particular whether it reflects a difference between occupations perceived as "male" and those perceived as "female", and whether fields represent different educational directions.
- Cohesion, namely the structure and logic of the system.
- Rationality, namely the ability of different people to assign occupations to the correct categories.

## Validation of the measuring instrument as an interest test

The following aspects will be covered by the research:

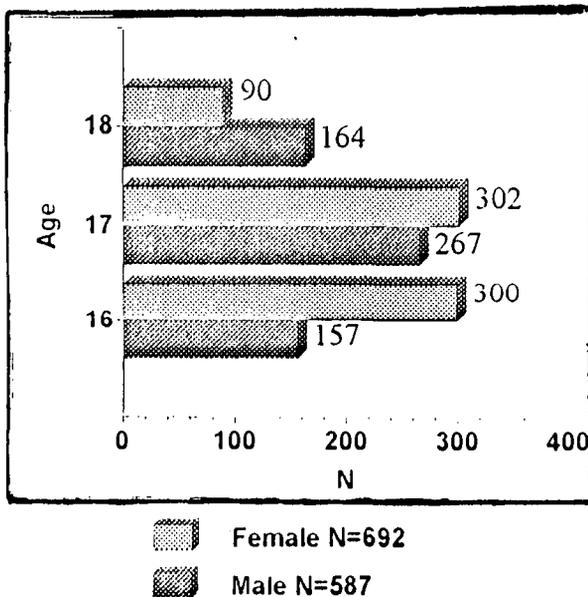
- Construct validity - the relationship between FED categories and similarly named fields in the 19FII and VIQ.
- Factorial validity - identifying overlapping and synonymous categories.
- Predictive validity - the ability of FED to predict study and career choices, job satisfaction and performance.
- Concurrent validity - The relationship between the FED and the 19FII, VIQ, SDS and 16PF.
- Test-retest reliability.

## THE RESEARCH DESIGN

### Validating the occupational classification system

#### Sample

The test will be administered to 1280 school leavers in Gauteng as part of a career guidance battery. A



breakdown by gender is given in figure 5.2. The sample includes school pupils of all race groups. Data on race group was not collected due to political sensitivity.

Figure 5.2: Breakdown of test group

### The scientific basis of the system

One of the best known perceptions of occupations is that they are either "male" or "female". Owen and Taljaard (1988) concluded from a study of literature that males tend to centre their career interests around physical activities, equipment and problem solving, while females show more interest in people. This is essentially the first breakdown in Gati's (1979) hierarchical model of occupations into "soft" (people related) and "hard" (not people related) categories. Both the hierarchical and network access models are based on levels, although the two models assume different relationships between the levels. They should agree that the first breakdown of occupations is into hard and soft categories.

An analysis of the number of males and females choosing each FED category will indicate which fields, environments and duties are perceived as "male" or "female".

### The study and research to be performed

#### Study 1

Means of scores for males and females on each category will be compared using the t-test to determine whether males and females choose different occupations.

**The proposition will be proved if the means of categories chosen by males and females can be shown using the t-test to be significantly different for categories involving people, physical activities, equipment and problem solving.**

#### Study 2

It was suggested in conceptualising the instrument that fields are differentiated by study direction. A qualitative examination of education and training opportunities in South Africa will be compared with the fields of the FED to establish whether they correspond with available education and training opportunities.

Course categories and the lists of university, technikon and informal training in *A guide to further education in South Africa* (Holman, 1996) will be used.

**The proposition that fields are structured around knowledge requirements will be proved if each field can be matched to a university degree, a technikon national diploma (or equivalent) and an informal training course.**

### The cohesion of the system

The underlying structure of the FED is hypothesised to be:

- a) mutual exclusivity of fields from one another and similarly of environments from one another and duties from one another,
- b) high relationships of each field to many environments and duties, and of each environment to many duties.

If these conditions are met, it can be assumed that people perceive jobs in a network access model with interacting levels of fields, environments and duties.

### The study and research to be performed

A value of 9 will be allocated to each category chosen, and a value of 1 to each category not chosen. A cross break analysis will be performed to obtain the  $\chi^2$  test of independence value for each pair of categories. The  $\theta^2$  coefficient will be calculated from these values.  $\chi^2$  significance levels below 0,005 will be assumed to indicate that there is uncertainty about the numerical value of the relationship.

Contingency tables will be obtained showing the relationship of fields to fields, fields to environments, fields to duties and environments to duties. It is expected that the  $\theta^2$  coefficients will be small, and that most of the relationships will be found to be significant. Where many relationships are significant it is customary to set a cut-off value for including data in research (for example McCormick, 1979).

An arbitrary cut-off of  $\geq 0,400$  will be considered as indicating a high positive relationship, while a value of  $< 0,400$  will indicate a low or negative relationship.

**The proposition will be proved if relationships of  $< 0,400$  are found among fields, among environments and among duties, and if a relationship of  $\geq 0,400$  is found between fields and environments, fields and duties, and environments and duties.**

### The rationality of the system

Career guidance testees should identify with a system which purports to reflect their perception of occupations. Definitions given for fields, environments and duties were provided for classification. Testees are encouraged to ignore the definitions "because the categories are self explanatory". Names of FED categories should be powerful enough to enable people with some experience of actual working conditions to assign correct fields, environments and duties to jobs.

### The study and research to be performed

Study 1: Data from administering FED to 1280 school leavers will be examined to determine whether any of the categories are interpreted ambiguously. **The proposition that categories are not ambiguous will be proved if  $\theta^2$  coefficients of  $> 0,400$  can be explained.**

Study 2: A group of 40 adults with no previous experience of the system, but with experience of work, will be asked to assign the fields, environments and duties to a list of 40 jobs. The adults will also be asked to allocate fields, environments and duties to their own jobs. Answers will be checked against the predetermined listing in the inventory of jobs (Holman, 1992). **The proposition will be proved if correct allocations are made. It will be assumed that adults are unable to allocate occupations into the categories if less than an arbitrary 60% are allocated correctly.**

## Validating the interest test

### Construct validity

The FED has categories with similar names to interest test fields. There should be significant correlations between the relevant scores on the tests.

### The study and research to be performed

The FED will be administered simultaneously with the VIQ and SDS to a sample of 134 school-leavers. It will also be administered simultaneously with the 19FII to 1280 school leavers. Pearson product moment correlation coefficients will be computed for the categories and fields in table 5.1.

Scores for the VIQ and 19FII are expressed as stanines. In other words, raw

FED category	Equivalent field	Interest test
Legal	Law	19FII
Business	Business	19FII
Language	Language	19FII
Numbers	Numbers	19FII
Performing	Performing arts	19FII
Service	Service	19FII
Travel	Travel	19FII
Nature	Nature	19FII
Outdoors	Outdoors	VIQ
Service	Social service	VIQ
Book keeping	Office work - numerical	VIQ
Clerical	Office work - non numerical	VIQ
Business	Commerce	VIQ
Investigating	Investigative	SDS

scores are translated into 9 categories according to the normal distribution curve. In order to correlate FED choices to VIQ scores the dichotomous nominal values will have to be transformed into categorical variables.

**Table 5.1: Equivalent FED categories and interest test fields**

To bring the FED in line with stanine scores, a selected FED will be considered as a high interest and represented by 9, and an unselected, low interest by 1. Raw scores for the SDS are not standardised. The FED values of 9 and 1, representing high and low interests, will be correlated to these raw scores.

The proposition that there is construct validity will be proved if significant correlations are found between the FED categories and the relevant interest test fields given in table 5.2.

### Predictive validity

There are two aspects involved:

- a) Do school-leavers follow interests as indicated by chosen FED categories?
- b) What job outcomes result when FED choices are followed, in other words, are job satisfaction and job performance higher for people who work in occupations which match their FED choices?

### Occupational satisfaction

Smith, Kendall and Hulin (1969, p 12) define job satisfaction as the feelings a worker has about a job. Dawis and Lofquist (1984) describe satisfaction as an internal indicator (self rating) representing an individual's appraisal of the extent to which the work situation meets his or her requirements.

Job satisfaction can be measured using multiple questions covering different factors, or by asking a single question about the degree of satisfaction. To bring out long-term factors and behaviours a summary evaluation (one question only) is suggested by Smith, Kendall and Hulin (1969, p 163). This is particularly appropriate in research using job satisfaction as a dependent variable, as in this study. Job satisfaction can also be inferred from a question about job tenure - how long the person intends to stay in the job (Smith, Kendall and Hulin 1969, p 165).

### Job performance

No evidence has been found that job performance is associated with interests. However, the matter is continually raised due to the commercial implications of placing people in the correct jobs. Job performance can be self-rated or assessed by a person's supervisor. While both methods are subject to problems of rater bias, self rating is by definition more subjective.

Matsui and Tsukamoto (1991) use the summary question, "How confident are you to do your job?" to overcome the problem. They suggest this question for research where information is not needed about component work tasks in a job.

**The study and research to be performed**

The current career direction of people who have previously been tested on the FED will be obtained, together with self assessment of their job performance and satisfaction with their occupations. Similar research will be performed with currently employed adults.

To determine whether school-leavers follow their interests as indicated by choices of FED categories, a telephone survey will be conducted among 650 students tested in 1989 and 1990. The questions to be asked are given in figure 5.3.

<p><b><u>TELEPHONE INTERVIEW</u></b></p> <p>I am doing a survey about the career guidance you had when you left school. May I ask you a few questions?</p> <p>Are you working or studying at the moment?</p> <p><b><u>IF WORKING:</u></b></p> <p>What is your job/occupation?  All in all, are you happy with your occupation?  How capable do you feel of doing what is expected of you?  How long have you been in this occupation?  How long do you think you will stay in this occupation?</p> <p><b><u>IF STUDYING:</u></b></p> <p>What are you studying?  All in all, are you happy with your course?  How well are you doing?  What do you intend doing afterwards?</p>	<p>Summary questions on occupational satisfaction, tenure and confidence to perform the job are included.</p>
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Summary questions on occupational satisfaction, tenure and confidence to perform the job are included.

**Figure 5.3: Questions for follow up telephone survey**

### Does the FED predict future study and working directions?

From the survey it will be determined what percentage of school leavers who study after matriculating follow a course in a field chosen from the FED. The same exercise will be done for school leavers who are now working, in respect of the fields, environments and duties they originally chose. Actual percentages will be compared with expected percentages using the  $\chi^2$  goodness of fit test.

**The proposition that the FED predicts future work and study direction will be proved if the  $\chi^2$  goodness of fit test is significant.**

### Does the FED predict study and work outcomes?

For working respondents the current occupation will be assigned to fields, environments and duties according to the inventory of occupations (Holman, 1992), and compared with choices originally made. For every matching choice a score of 3 will be allocated. Thus if all three categories followed were originally chosen, a score of 9 will be given, if only two of the three, a score of 6, if only one a score of 3, and if none a score of 0.

For respondents who are currently studying, the same procedure will be followed in respect of current studies and intended occupation.

A sample of forty working adults (not previously exposed to the FED) will be asked the questions in the first part of the survey in figure 5.3. They will also be asked to choose their three preferred fields, environments and duties. Current occupations will be coded as above and compared with chosen FED.

Responses for all three groups to the questions about occupational satisfaction, tenure and job performance will be coded as 0, 3, 6 or 9. A 3 x 3 cross break analyses will be performed with the  $\chi^2$  test (4 degrees of freedom) to determine whether the FED can be used to predict:

**a) For tested school leavers now studying**

- satisfaction with their course of study
- performance on the course
- intended career direction after finishing the course

**b) For tested school leavers now working**

- occupational satisfaction
- job tenure
- self-rated job performance

**c) For currently working adults**

- job satisfaction with current occupation
- intended job tenure
- self-rated job performance.

It is proposed that all of these will be predicted by the FED. **The proposition will be proved if significant relationships are shown by the  $\chi^2$  test.**

### Concurrent validity

It should be possible to make predictions about a person based on the results of one test, even if other tests are not applied. For example, if a testee chooses to work with people, he or she would be expected to have a high interest in sociability on the 19FII and a high A factor (warmth towards others) on the 16PF. There are too many possibilities to hypothesise separately, but the basic idea is that any relationships found between the categories of the FED and constructs measured by other tests should be logically explainable.

### The study and research to be performed

To determine the construct validity of the FED, it will be administered simultaneously with the VIQ, SDS, 19FII and 16PF. For the VIQ and SDS the sample will be made up of 134 school leavers, and for the 19FII and 16PF the sample will be 1280 school leavers.

Psychometric qualities of the VIQ, SDS and 19FII tests were discussed in chapter 2, and for the 16PF they will be discussed with the results of this research. Nominal scores of 1 and 9 for the FED will be used to obtain Pearson product moment correlations. Stanine scores will be used for the 19FII. Percentile scores for the VIQ will be transformed to stanines according to the table given by Smit (1981, p 113). Norms for first year university students will be used to obtain stan scores for the 16 PF. SDS raw scores will be used. It is expected that the correlations will be low because of the loss of continuous scores 2 to 8 for FED scores.

**The proposition will be proved if significant Pearson product moment correlation coefficients between the FED categories and fields and factors of the VIQ, SDS, 19FII and 16PF can be logically explained.**

**Reliability**

The FED should measure consistency of individual interests. If testees choose fields, environments and duties from the lists at random, the test will not give the same results when it is administered to the same people at different times.

**The study and research to be performed**

The FED will be re-administered to 134 school leavers after a 3 month interval. This time period should be sufficient to guard against memory playing a part in similar choices. The probability of a testee randomly choosing the same one, two or three fields in both tests is calculated according to probability theory as:

Probability of choosing 1 of 27 fields the same  
 $= 3/27 \times 3/26 \times 3/25 = 0,15\%$

Probability of choosing 2 of 27 fields the same  
 $= 3/27 \times 3/26 \times 2/25 = 0,11\%$

Probability of choosing 3 of 27 fields the same  
 $= 3/27 \times 2/26 \times 1/25 = 0,03\%$

Probability of choosing 0 of 27 fields the same  
 $= 100\% - (0,15\% + 0,11\% + 0,03\%) = 99,71\%$

The  $\chi^2$  goodness of fit test will be used to compare the expected and actual percentages of identical fields, environments and duties chosen.

**The proposition that the FED test is reliable will be proved if the  $\chi^2$  goodness of fit test is rejected at a significance level of 0,001.**

## SUMMARY

The development of the measuring instrument to be used in the research was described in chapter 4.

The following aspects will be researched to validate the FED as an occupational classification system:

- The scientific basis of the model, in particular whether it reflects a difference between occupations perceived as "male" and those perceived as "female", and whether fields represent different educational directions.
- Cohesion, namely the structure and logic of the system.
- Rationality, namely the ability of different people to assign occupations to the correct categories.

The following aspects will be researched to validate the FED as an interest test:

- Construct validity - the relationship between FED categories and similarly named fields in the 19FII and VIQ.
- Factorial validity - identifying overlapping and synonymous categories.
- Predictive validity - the ability of FED to predict study and career choices, job satisfaction and performance.
- Concurrent validity - The relationship between the FED and the 19FII, VIQ, SDS and 16PF.
- Test-retest reliability.

Psychometric qualities of the VIQ, SDS and 19FII were discussed in chapter 2, and for the 16PF will be dealt with when giving the research results.

Data from four sources will be analysed in the research.

- The FED will be simultaneously administered with the 19FII and 16PF to 1280 school leavers to test the scientific basis and cohesion of the classification system, and the factorial and concurrent validity of the interest test.
- The FED will be simultaneously applied with the FED, SDS and VIQ to 134 school leavers. This will test the construct and concurrent validity of the interest test. The FED test will be reapplied to the same sample 3 months later to test the reliability of the instrument.
- A telephone survey of 650 school leavers tested on the FED in 1989 and 1990 will be carried out to find out what work and study career choices have been made. This will determine the predictive validity of the interest test.
- Interviews will be conducted with 40 employed adults to determine the rationality of the occupational classification system and the concurrent validity of the FED for job satisfaction and performance.

Nominal measurement restricts the range and power of statistical techniques which can be used in the analysis of results. Extensive use will be made of  $\chi^2$  and  $\theta^2$  tests. Pearson product moment correlations will be used to establish relationships between FED choices and other tests where scores are available in sten and stanine form. VIQ percentile scores will be transformed to stanine scores for this purpose. SDS raw scores will be used.

The next two chapters discuss the results of the research.

## **CHAPTER 6 - EVALUATION OF THE FED AS AN OCCUPATIONAL CLASSIFICATION SYSTEM**

### **SCOPE OF THE CHAPTER**

*Evaluation of the FED as an occupational classification system. The scientific basis, cohesion, comprehensiveness, rationality and usefulness.*

### **INTRODUCTION**

Although the FED was developed according to Fleishman and Quaintance's (1984, p 44) criteria for a sound classification system, it remains to prove that it is adequate in practice. In particular the classification system must be shown to have a scientific basis, cohesion (structure and logic), comprehensiveness and rationality. Research was performed during 1995 according to the research design presented in the previous chapter. The results will be presented and discussed in this chapter. Aspects which could not be statistically researched will also be discussed.

### **THE SCIENTIFIC BASIS OF THE SYSTEM**

#### **Study 1**

The proposition tested is that occupations are perceived as being female (involved with people) and male (not involved with people). It is considered as proved if the means of categories chosen by males and females are significantly different at the 0,05 level for categories involving people, physical activities, equipment and problem solving.

### Research conducted

The test was administered in multi-racial schools in the Gauteng province of South Africa to 1280 school leavers, made up of 692 females and 588 males aged between 16 and 18 years. The mean age of females was 16 years and 8 months, and of males 16 years and 9 months. Testees were asked to select from lists the three fields, three environments and three duties that interested them most for a job. A score of 9 was allocated to each category chosen, and 1 to those not chosen. Means of scores for males and females were compared using the t-test.

### Results

A breakdown of the number who chose each field, environment and duty, by gender and in total, is given in table 6.1. Means and t-values are also given in the table. Significant differences between the choices of males and females are indicated by ° (for differences significant at the 0,05 level) and °° (for differences significant at the 0,01 level). Fields, environments and duties where means are significantly different for males and females are highlighted in bold print.

### Categories perceived as "male"

The categories chosen significantly more by males were:

Fields: Adventure, Business, Electronics, Imaginative, Marketing, Natural forces, Numbers, Physics, Property, Systems, Trading, Work with hands.

Environments: Data processing, Factory, Isolation.

Duties: Buying, Calculating, Driving, Equipment, Measurement, Prediction, Risk taking, Selling, Tools, Weapons.

Table 6.1: Breakdown of choices of fields, environments and duties by gender

FIELD	CHOSEN			MEAN		Deg of frdm	T value	ENVIRON MENT	CHOSEN			MEAN		Deg of frdm	T value	DUTY	CHOSEN			MEAN		Deg of frdm	T value
	Male	Fem	Total	Male	Fem				Male	Fem	Total	Male	Fem				Male	Fem	Male	Fem	Total		
Adventure	141 <sup>oo</sup>	64	205	2.92	1.74	1006	7.08	Academic	43	47	90	1.59	1.54	1230	0.36	Advising	108	152	260	2.47	2.76	1266	-1.62
Animals	72	117 <sup>e</sup>	189	1.95	2.35	1276	-2.38	B Counter	30	26	56	1.41	1.30	1169	1.15	Bookkeep	60	71	131	1.62	1.62	1246	-0.04
Beauty	5	110 <sup>oo</sup>	115	1.05	2.27	791	-10.44	Clen prem	50	69	119	1.68	1.80	1267	-0.91	Buying	70 <sup>oo</sup>	23	93	1.95	1.27	883	5.71
Business	250 <sup>oo</sup>	189	439	4.40	3.19	1194	5.71	Consult	185	248	433	3.52	3.87	1256	-1.67	Calculating	61 <sup>oo</sup>	44	105	1.83	1.51	1119	2.56
Chemistry	38	36	76	1.52	1.44	1209	0.72	Corporate	115	121	237	2.56	2.40	1224	1.01	Caring	71	265 <sup>oo</sup>	336	1.97	4.07	1213	-11.48
Children	37	215 <sup>oo</sup>	252	1.50	3.49	1076	-12.24	Craft wsh	86	126 <sup>e</sup>	212	2.17	2.46	1270	-1.74	Cash H	47 <sup>e</sup>	33	80	1.64	1.38	1106	2.33
Creative	62	107 <sup>oo</sup>	169	1.84	2.24	1277	2.64	Data Proc	82 <sup>oo</sup>	35	107	2.12	1.2	868	6.47	Cleaning	10	19	29	1.14	1.22	1270	-1.26
Electronic	114 <sup>oo</sup>	5	119	2.55	1.06	633	11.22	Dynamic	86	120	206	2.20	2.39	1264	-1.16	Clerical	9	26 <sup>e</sup>	35	1.12	1.30	1194	-2.52
Food	26	33	59	1.35	1.38	1257	-0.30	Factory	39 <sup>oo</sup>	2	41	1.53	1.02	634	6.06	Compose	57	52	109	1.77	1.60	1187	1.37
Imagine	107 <sup>oo</sup>	74	181	2.45	1.86	1119	3.76	Govern	31	37	68	1.42	1.43	1247	-0.07	Counsel	59	235 <sup>oo</sup>	294	1.80	3.71	1186	1.37
Language	23	49 <sup>e</sup>	72	1.31	1.57	1260	-2.52	Home	95	122	217	2.29	2.41	1257	-0.71	Disagree	68	64	132	1.93	1.74	1197	1.34
Legal	60	70	130	1.81	1.81	1243	0.04	Indoors	33	83 <sup>oo</sup>	116	1.45	1.96	1237	-4.10	Drawing	105	111	171	3.08	2.94	1224	0.93
Marketing	112 <sup>e</sup>	101	213	2.52	2.17	1193	2.10	Isolation	39 <sup>oo</sup>	20	59	1.53	1.23	1001	3.09	Driving	43 <sup>oo</sup>	17	60	1.59	1.20	922	3.96
Medical	73	148 <sup>oo</sup>	221	1.99	2.71	1273	-4.35	Kitchen	22	35	57	1.30	1.41	1277	-1.16	Equipment	46 <sup>oo</sup>	11	57	1.63	1.13	801	5.16
Movement	41	46	87	1.56	1.53	1236	0.22	Labor	57	71	128	1.78	1.82	1254	-0.35	Interpret	36	39	75	1.49	1.45	1228	0.36
Nat Force	34 <sup>oo</sup>	19	53	1.46	1.22	1027	2.64	Mining	5	2	7	1.07	1.02	913	1.3	Investigate	108	109	217	2.47	2.26	1217	1.23
Numbers	48 <sup>e</sup>	36	84	1.65	1.42	1127	2.09	Nature	155	163	318	3.11	2.89	1229	1.14	Judgement	50	42	92	1.66	1.49	1163	1.65
People	68	235 <sup>oo</sup>	303	2.56	3.79	1217	-9.98	S Office	158	188	338	3.15	3.08	1240	0.33	Measure	19 <sup>oo</sup>	7	26	1.26	1.08	894	2.69
Physics	44 <sup>oo</sup>	18	62	2.10	1.28	933	3.92	Outdoors	208	256	464	3.83	3.95	1246	0.57	Microph	22	18	40	1.30	1.21	1150	1.15
Plants	18	22	40	1.24	1.25	1251	-0.13	Profess	171	202	373	3.33	3.34	1265	-0.06	Motivation	56	71	127	1.76	1.82	1256	-0.45
Politics	31	42	63	1.42	1.37	1217	0.53	Regiment	37	35	72	1.50	1.41	1194	0.94	Organising	103	151 <sup>e</sup>	254	2.40	2.75	1270	-1.95
Property	40 <sup>oo</sup>	10	50	1.54	1.12	808	4.72	Religion	17	33	50	1.23	1.38	1269	1.77	Performing	41	67	108	1.56	1.78	1277	-1.77
Service	25	52 <sup>e</sup>	77	1.34	1.60	1263	-2.51	Storerm	4	0	4	1.05	-	-	-	Practicing	86	84	170	2.17	1.97	1208	1.29
Systems	46 <sup>oo</sup>	15	61	1.63	1.17	871	4.56								Prediction	44 <sup>oo</sup>	11	55	1.60	1.13	809	4.97	
Trading	62 <sup>oo</sup>	26	88	1.84	1.30	947	4.64								Protection	34	40	74	1.46	1.46	1244	0	
Travel	121	228 <sup>oo</sup>	349	2.65	3.64	1277	-5.07								Risks	113 <sup>oo</sup>	56	169	2.53	1.65	1019	5.76	
W hands	88 <sup>oo</sup>	34	122	2.20	1.39	934	5.95								Selling	67 <sup>oo</sup>	33	100	1.91	1.35	996	4.29	
															Teaching	31	107 <sup>oo</sup>	138	1.42	2.24	1171	-6.16	
															Tools	47 <sup>oo</sup>	9	56	1.64	1.10	760	5.58	
															Walking	25	27	52	1.34	1.31	1227	0.31	
															Weapons	49 <sup>oo</sup>	8	57	1.67	1.09	736	6.92	
															Writing	16	49 <sup>oo</sup>	65	1.22	1.57	-3.69		

Owen and Taljaard (1988) suggested that male interests favour physical activities, equipment, and problem solving. Gati's (1991) structure of occupations identified a first level of "hard" occupations not related to people. In terms of these two hypotheses, the fields, environments and duties chosen predominantly by males should be:

Physical activities: Adventure, Risk taking.

Equipment: Electronics, Natural forces, Physics, Work with hands, Factory, Driving, Equipment, Measurement, Tools, Weapons.

Problem solving: Imaginative, Numbers, Systems, Calculating, Data processing, Prediction.

Not involved with people: Isolation.

The remaining categories which males preferred were Business, Marketing, Property, Trading, Buying and Selling. They appear to make up an area of "active" business which may be perceived as dominated by males in South Africa.

It appears that Owen and Taljaard's (1988) suggestion of an area of "physical" male activities applies only to risk taking, adventurous, "rough" activities and not to activities like Movement, Performing and Walking, which were selected equally by males and females.

Chemistry and Laboratory categories were chosen equally by both genders. More females chose Craft workshop. These categories involve working with "clean" equipment. Females may tend to avoid "dirty" equipment while males do not mind it.

The Isolation environment was chosen more by males than females as were the Storeroom and Mining environments, which may involve solitary work. Unfortunately samples for the latter two categories were too small for analysis.

Possible problem solving categories not identified as male choices are Bookkeeping, Disagreeing, Interpreting and Judgment. These may involve immediate decision making while categories chosen by males have longer term and strategic implications

**Males tend to choose fields, environments and duties related to adventurous, rough activities, long term strategic problem solving and active business and do not avoid working with "dirty" equipment.**

*Categories perceived as "female"*

Categories chosen by significantly more females than males were:

Fields: Animals, Beauty, Children, Creative, Language, Medical, People, Service, Travel.

Environments: Craft workshop, Indoors.

Duties: Caring, Clerical work, Counselling, Organising, Teaching, Writing.

Owen and Taljaard (1988) suggested that female interests favour working with people. Gati (1991) identified this as a major category of "soft" occupations. The categories chosen by females tend to support the proposition that "female" interests and occupations are involved with working with people. Elements of humanitarianism and aesthetic appreciation also appear to be involved.

People-oriented categories chosen equally by males and females are the Behind counter, Dynamic and Religion environments. This may involve impersonal contact with others.

**Females tend to choose fields, environments and duties involving personal contact with people and related to aesthetic, humanitarian activities.**

*Categories perceived as "neutral"*

Some fields, environments and duties were chosen equally by males and females.

**There may be "neutral" occupations in addition to the traditionally "hard" and "soft" distinctions.** This raises the possibility that occupations should be represented in three main categories, namely "hard" (attracting more males), "soft", (attracting more females) and "neutral" (attracting both), as shown in figure 6.1 overleaf. This supports the suggestion that occupations are perceived in a network access model.

It can be hypothesised that "hard" occupations are not perceived as linked with "soft" environments or duties, but may combine with a "soft" duty by access through a "neutral" environment. Thus it is difficult to think of a job in, say, the "hard" Business field, "hard" Data processing environment and involving a "soft" Counselling duty, but there are jobs in the Business field, the "neutral" Consultancy environment and the Counselling duty. The intermediate neutral environment makes the combination of a hard field and a soft duty possible.

**There are "neutral" as well as traditionally perceived male and female occupations.**

A breakdown of fields, environments and duties in hard, soft and neutral categories is given in figure 6.1 overleaf.

	Hard	Neutral	Soft
F I E L D S	Adventure	Chemistry	Animals
	Business	Food	Beauty
	Electronics	Legal	Children
	Imaginative	Movement	Creative
	Marketing	Plants	Language
	Natural Forces	Politics	Medical
	Numbers		People
	Physics		Service
	Property		Travel
	Systems		
S E N V I R O N M E N T S	Trading		
	Work with hands		
	Data processing	Academic	Craft workshop
	Factory	Behind counter	Indoors
	Isolation	Client premises	
	Mining?	Consultancy	
	Storeroom?	Corporate	
		Dynamic	
		Government	
		Home	
D U T I E S	Buying	Advising	Caring
	Calculating	Bookkeeping	Clerical
	Cash handling	Cleaning	Counselling
	Driving	Composition	Organising
	Measurement	Disagreeing	Teaching
	Prediction	Drawing	Writing
	Risk taking	Interpreting	
	Tools	Investigation	
	Weapons	Judgement	
		Microphone	
S		Performing	
		Protection	
		Walking	

**Figure 6.1: Breakdown of fields, environments and duties into hard, soft and neutral categories**

## Study 2

The study was conducted to determine whether each field could be matched to a university degree, a technikon national diploma or similar diploma and an informal training course. The FED classification system is essentially based on sociological situs systems and educational status should not be an issue within each category.

### Research conducted

A qualitative examination of education and training opportunities in South Africa was carried out to determine whether the fields of the FED correspond with areas of knowledge required. Lists of university, technikon and informal training in *A guide to further education in South Africa* (Holman, 1996) were consulted.

### Results

Table 6.2 overleaf relates each field to a degree course, technikon (or similar) diploma and an informal training course available in South Africa. Suggestions below the bold line are for areas not covered by the fields of the FED, but which have training available at all three levels. Major university subjects that are not degree courses in themselves are given in brackets.

It was hypothesised that fields do not exist if training is not available at university, diploma and informal levels. Beauty, Children, Service, Trading, Travel and Work with hands do not therefore qualify as fields, and possible combinations with other fields should be sought. There is a case for including education, media and religion as fields of the FED. With these exceptions, **fields exist with related university degree, diploma, and informal course education and training available.**

FIELD	DEGREE	DIPLOMA	TRAINING COURSE
Adventure	BMil	Fire service technology	Security
Animals	BVSc	Equine studies	Dog training
Business	BComm	Business management	Small business practice
Beauty	-	Beauty technology	Hairdressing
Chemistry	BPharm	Analytical chemistry	Plastics technology
Children	-	Residential child care	Au pair
Creative/ Imaginative	BFine arts/BMus	Graphic art/Light music	Signwriting/Singing
Electronics	(Computer science)	Information technology	PC engineer
Food	BHuishoudkunde	Catering management	Blockman
Language	BJour	Language practice	Business English
Legal	BProc	Registration of deeds	Tax law
Marketing	(Markbestuur)	Marketing management	Sales
Medical	MChB/BCur	Chiropractic	First aid
Movement	(Human movement)	Ballet teaching diplomas	Tennis coach
Nat forces	(Geology)	Metalliferous mining	Mine surveying
Numbers	BCompt	Cost accounting	Bookkeeping
People	BSoc Work	Personnel management	Personnel practice
Physics	BEng	Mechanical engineering	Welder
Plants	BAgric	Horticulture	Floristry
Politics	BAdmin	Local government	Public administration
Property	BArch	Building management	Bricklaying
Service	-	-	-
Systems	(Industrial engineering)	Organisation and methods	Work study
Trading	-	Retail	Cashier
Travel	-	Travel and tourism	Travel agency
Work w hands	-	-	Carpentry
Education	BEd	Technical teaching	Training
Religion	BTh	from denominational colleges	Lay ministry

Table 6.2: Education and training related to fields

## Discussion

The classification system succeeds in depicting the inter-relationship of occupations, is supported by research, is based on previously identified characteristics of occupations and is capable of generating hypotheses about the relationship between categories and units. The use of the three dimensions (*field, environment and duty*) is in line with past suggestions made by other researchers. The use of the network access model appears to be justified, particularly as it supports previous thinking that occupations are divided into "hard" and "soft" categories. A third category of "neutral" occupations has been identified. Fields are differentiated by education and training available, although some do not have specific degree courses. **The scientific basis of the system appears to be sound on these points.**

## THE COHESION OF THE SYSTEM

### Research conducted

The underlying structure of the FED is hypothesised as:

- mutual exclusivity (low relationships) of fields from one another, of environments from one another and of duties from one another, and
- high relationships of each environment and duty to many fields, and of each environment to many duties.

*If this structure is shown, it can be assumed that people have a three dimensional perception of jobs as divided into fields, taking place in environments and consisting of various duties.*

To test this proposition, 1280 school leavers were asked to select from the FED lists the three fields, three environments and three duties that most interested them for a job. Each category was thus chosen or not chosen by each testee and nominal measurement applies. The  $\theta^2$  relationships among the fields, environments and duties were calculated. Significance of the relationships was determined with the  $\chi^2$  test for independence.

### **Results**

Contingency tables showing the numerical relationships among fields, environments and duties are given in appendix 1. The large majority of relationships were found to be significant, and an analysis of significant relationships will as a result not be meaningful. For practical purposes, then, an arbitrary cut-off relationship of 0.400 was applied and relationships above this are summarised in tables 6.3 to 6.5. Significances (according to the  $\chi^2$  test of independence) of 0,005 are indicated by °. There is thus some uncertainty about the relationship between variables for any field, environment or duty indicated with °.

Three separate stages were followed in the investigation.

#### **Stage 1**

Tables 6.3 to 6.5 were qualitatively examined to see whether the model has face validity. In other words, fields should be highly related to more environments and duties than fields (table 6.3), environments to more fields and duties than environments (table 6.4), and duties to more fields and environments than duties (table 6.5). A cursory examination of the fullness of the columns appears to support this.

Stage 2

This stage examined whether fields are mutually exclusive from each other, and also for environments and duties. Where there were significant relationships with  $\theta^2 > 0,500$  (an arbitrary cut off) they were considered synonyms if they were related to the same other fields, environments and duties in tables 6.3 to 6.5 and were perceived as belonging to the same section of soft, hard or neutral occupational categories.

Subsets were identified where the related fields, environments and duties were part of another category. Weaker subsets, not included in the statistical cut-off, were also considered from the tables in appendix 1. The possibility of a category subset was rejected if the pattern of relationships to fields, environments and duties was different.

Stage 3

An examination of the tables was carried out to determine whether any of the categories should be reclassified at another level. Exceptionally high significant relationships ( $\theta^2 > 0,700$ ) between fields and environments, fields and duties, and environments and duties could indicate a path of increased access in terms of the model. (In other words, if a person works in a particular field then they will be most likely to work in the associated environment). Alternatively, the high relationship may indicate a synonym at a different level if, say,  $\theta^2 < 0,300$  for other categories on the same level. Weaker effects were also investigated as before.

**Fields to fields (table 6.3)**

It can be seen that Business is related to many other fields, but not as many as it is related to environments and duties. The same applies for Travel and Children. In table 6.4, Consultancy, Outdoors and Office follow the expected pattern. The Dynamic environment is an oddity, with an equal number of related fields, environments and duties. Caring, Counselling and Drawing in table 6.5 are related to many other duties, but these are less than the number of related fields and environments. Bookkeeping is related to the same number of environments as other duties, and Clerical is related to the same number of fields as other duties. It has already been established that the former is perceived as neutral and the latter as a female category; if they are otherwise synonymous, the pattern is as expected, with a duty of Clerical/Bookkeeping being related to fewer other duties than to fields and environments.

The following fields were significantly related, with  $\theta^2 > 0,500$  :

Business - Marketing ( $\theta^2=0,765$ ); Business - Trading ( $\theta^2=0,770$ )

Trading - Marketing ( $\theta^2=0,550$ ); Business - Numbers ( $\theta^2=0,632$ )

Children - People ( $\theta^2=0,566$ )

Imaginative - Creative ( $\theta^2=0,549$ )

Animals - Plants ( $\theta^2=0,703$ )

Business, Trading and Marketing appear to make up a field cluster, with Marketing and Trading as subsets of Business. Numbers is not part of the cluster because it is related to different fields, environments and duties from the other three fields.

It has already been established that Children is not an independent field, but it also does not appear to be a subset of People because of different relationship patterns.

Children includes a medical aspect and People an office/business dimension.

° Significance below 0.005  
 Table 6.3: Summary of relationship between fields, environments and duties

FIELD	RELATED FIELDS	RELATED ENVIRONMENTS	RELATED DUTIES
Adventure	Travel	Mining, Outdoors, Nature, Regimental	Weapons, Risk taking, Driving, Investigating
Animals	Plants, Natural forces	Nature, Outdoors, Mining	Caring, Walking
Beauty	Travel	Craft workshop, Consultancy	Caring, Counselling
Business	Trading, Marketing, Numbers, Legal, Property, Travel, Systems	Office, Corporate, Data processing, Consultancy, Professional, Client premises, Government, Outdoors	Bookkeeping, Buying, Cash handling, Clerical, Selling, Prediction, Calculating, Organising, Advising, Motivation, Risk taking, Judgement, Disagreeing
Chemistry	Medical, Physics	Laboratory, Data processing, Professional	Investigation
Children	People, Service, Medical	Indoors, Religion, Consultancy, Outdoors, Professional, Nature	Counselling, Teaching, Caring
Creative	Imaginative	Craft workshop, Dynamic, Consultancy, Outdoors	Drawing, Writing, Performing, Composition
Electronics	Systems, Physics	Data processing	Tools, Equipment
Food	-	Kitchen	Judgement, Caring
Imaginative	Creative	Craft workshop, Dynamic, Outdoors, Consultancy	Drawing, Composition, Organising
Language	-	Consultancy	Writing
Legal	Business, Politics	Professional, Government, Consultancy, Office	Judgement
Marketing	Business, Trading	Office, Consultancy, Corporate, Client premises	Selling, Buying, Organising, Bookkeeping, Cash handling, Clerical
Medical	Chemical, Children	Professional, Laboratory, Consultancy, Outdoors	Caring, Counselling, Advising, Investigating
Movement	-	Outdoors	Performing
Natural forces	Animals	Nature, Outdoors	Walking, Investigation
Numbers	Business	Office, Academic, Corporate	Calculating, Bookkeeping
People	Children, Travel	Consultancy, Outdoors, Professional, Religion, Dynamic, Indoors, Office	Investigation, Counselling, Advising, Caring, Organising, Teaching, Performing
Physics	Chemistry, Electronics	Laboratory	Calculating, Investigation
Plants	Animals, Natural forces	Nature, Outdoors	Caring, Walking, Investigation
Politics	Legal, Business	Government, Consultancy	Caring, Calculating, Advising
Property	Business	Consultancy	Drawing
Service	Children	Counselling, Religion	Caring, Counselling
Systems	Electronics	Data processing	Organising, Calculating
Trading	Business, Marketing	Office, Behind counter	Buying, Selling, Bookkeeping
Travel	Business, Beauty, Adventure	Outdoors, Nature, Office, Behind counter	Microphone, Counselling, Organising, Caring, Driving, Practicing, Risk taking, Performing
Work with hands	-	Factory, Outdoors, Craft workshop, Mining, Nature	Tools, Equipment, Drawing

Imaginative and Creative are chosen differently by gender and also have different patterns, Imaginative including organisation and Creative including writing and performing. Neither is specifically allied to art or music.

Animals and Plants meet the criteria to be synonyms, but it cannot be determined which is the major field. Together they appear to make up a weak cluster with Natural forces, but this is a male (hard) category, whereas Animals/Plants are neutral. Other weak synonyms are Adventure/Travel, Beauty/Travel, Chemistry/Medical, Chemistry/Physics, Electronics/Systems, Electronics/Physics, Legal/Politics, Business/Property. These were all rejected as subsets because of different relationship patterns. Service was however found to be a subset of Children, but neither can be regarded as a field.

### **Fields to environments (table 6.3)**

The following reclassifications were indicated:

The environment Kitchen is a subset of the Food field ( $\theta^2=0,733$ ), Food having been established as a field with all three levels of education available in South Africa. In countries that do not offer degree courses in Home Economics, Food could be a subset of the Kitchen environment.

The field Work with hands is a subset of the Factory environment ( $\theta^2=0,734$ ), Work with hands not being a field with training available at all levels.

The field of Systems appears to be a weaker subset of the Data Processing environment, Systems having been rejected as a field without all levels of education available.

Medical/Professional, Movement/Outdoors, Language/Consultancy, Property/Consultancy, Physics/Laboratory and Electronics/Data processing were not reclassified because the environments were reasonably related to many other fields.

**Fields to duties (table 6.3)**

The field of Children was reclassified as a subset of the duty Caring ( $\theta^2=0,684$ ), Children having been rejected as a field. Writing was accepted as a subset of the Language field ( $\theta^2=0,500$ ). There were also high relationships between Caring and the fields of Animals and Medicine, but these were rejected for reclassification because the fields were related to many other duties.

Reclassification of the field of Business with Clerical, Prediction, Selling and Buying was rejected on the same basis. Weaker relationships accepted for reclassification were Movement as a subset of Performing, and Beauty as a subset of Caring. Neither field could be classified as a field because there were not three levels of education available for them.

**Environments to environments (table 6.4)**

The following environments were significantly related with  $\theta^2>0,500$  :

Corporate/Office ( $\theta^2=0,595$ )

Mining/Nature ( $\theta^2=0,933$ )

Nature/Outdoors ( $\theta^2=0,661$ )

Storeroom/ Corporate ( $q^2=694$ )

Although few people chose Mining and Storeroom there are indications that Storeroom is a subset of Corporate and Mining a (male) subset of Nature. If Nature is a subset of Outdoors, it could follow that Mining is a (male) subset of Outdoors.

ENVIRONMENT	RELATED FIELDS	RELATED ENVIRONMENTS	RELATED DUTIES
Academic	Numbers	-	-
Behind counter	Business, Trading	Office	Buying, Selling
Client premises	Business, Trading	Office	Counselling, Selling
Consultancy	People, Business, Marketing, Children, Medical, Travel, Imaginative, Creative	Professional, Office, Corporate, Dynamic	Advising, Counselling, Organising, Prediction, Clerical, Motivation, Interpreting, Caring, Disagreeing, Investigation, Practicing, Selling
Corporate	Business, Marketing, Travel, Numbers	Office, Consultancy	Buying, Selling, Cash handling, Organising, Clerical, Bookkeeping, Advising, Calculating
Craft workshop	Creative, Imaginative, Work with hands, Beauty, Travel	-	Drawing, Disagreeing, Performing, Tools, Composition
Data processing	Chemistry, Electronics, Business, Ssystems	-	Calculating
Dynamic	Imaginative, Travel, People	Outdoors, Craft workshop, Consultancy	Drawing, Performing, Organising
Factory	Work with hands	Outdoors	Tools, Equipment
Government	Politics, Legal, Business	-	-
Home	Children, Business	Outdoors, Professional	Performing, Caring, Counselling, Advising
Indoors	Children, People	-	Teaching
Isolation	-	-	-
Kitchen	Food	-	Caring
Laboratory	Chemistry, Physics, Medical	-	Investigation, Caring
Mining	Adventure, Natural forces, Work with hands, Animals	Nature	Walking, Tools, Equipment, Weapons
Nature	Animals, Natural forces, Plants, Adventure, Travel, Children, Work with hands	Mining, Outdoors, Religion	Cash handling, Walking, Caring, Risk taking, Weapons, Protection, Investigation, Practicing, Tools, Teaching
Office	Business, Marketing, Trading, Numbers, Travel, Legal, People	Corporate, Consultancy, Professional, Behind counter, Client premises	Clerical, Bookkeeping, Cash handling, Buying, Selling, Calculating, Organising, Prediction, Advising, Judgement
Outdoors	Adventure, Travel, Movement, Animals, People, Natural forces, Plants, Children, Imaginative, Business, Medical, Creative	Nature, Regimental, Home, Religion	(>0,5) Risk taking, Caring, Driving, Counselling, Walking, Investigation, Performing
Professional	Medical, Business, Legal, People, Chemistry, Children	Consultancy, Office, Home	Counselling, Caring, Advising, Practicing, Investigation, Judgement, Organising, Motivation, Bookkeeping, Interpreting
Regimental	Adventure	Outdoors	Calculating, Caring, Weapons
Religion	Children, People, Service	Nature, Outdoors	Counselling, Caring
Storeroom	-	-	-

° Significance below 0.005  
 Table 6.4: Summary of relationships between environments, fields and duties

Weaker indications are that Regimental is also a subset of Outdoors, with Behind counter and Corporate subsets of Office. Apparent weak subsets which were rejected because of different relationship patterns were Client premises/Behind counter, Consultancy/Professional and Corporate/Consultancy.

**Environments to duties (table 6.4)**

There were no relationships above the cut-off of  $\theta^2 > 0,700$ . Only Work with hands/Tools and Craft workshop/Drawing had  $\theta^2 > 0,600$ . Both duties were related to many other environments and reclassification was rejected. Weaker relationships of Behind counter/Selling and Data processing/Calculating were rejected. The Indoors environment could be a weaker subset of Teaching.

An unresolved oddity is the neutral Dynamic environment, which is related ( $\theta^2 > 0,400$ ) to the same number of fields, environments and duties and therefore does not appear to belong to any of the three levels. Had there been other categories which appeared to belong to all the levels equally, it would have indicated that another level is required in the classification system. The fact that there are none could mean that there are only the three levels of fields, environments and duties.

It is possible to qualitatively examine the relationships with Dynamic to form a hypothesis about what may be occurring. Dynamic has a high significant relationship with the duties Drawing, Performing and Organising, the fields of Imaginative, Travel and People, and the environments Outdoors, Craft workshop and Consultancy. This combination may relate to the otherwise undefined Media field which was found in examining educational opportunities (table 6.2).

This raises the possibility that new work environments become supported by education and training, leading to new fields of work, which may begin to explain a dynamic process in the development of perceived occupational structure. This appears to be true for Outdoors - Animals/Plants, Factory - Physics (or Manufacturing), Office - Business, Regimental - Adventure, Laboratory - Chemical, and Kitchen - Food. *Work may start in an environment, with fields following as education becomes available at the levels of degree, diploma and training course.*

### **Duties to duties (table 6.5)**

The following duties were significantly related with  $\theta^2 > 0,500$  and were accepted as subsets:

Buying a subset of Selling ( $\theta^2 = 0,615$ )

Cleaning and Protection subsets of Caring ( $\theta^2 = 0,505$  and  $\theta^2 = 0,503$  respectively).

Weaker relationships accepted were:

Protection a subset of walking

Walking a subset of Caring

Teaching a subset of Counselling

Composition a subset of drawing

Certain duties appear to be subsets but are perceived differently as regards being male, female or neutral:

Bookkeeping/Clerical/Calculating/Cashhandling

Advising/Counselling

Measurement/Drawing

Organising/Motivation

Rejected subsets with differing relationship patterns were:

Counselling/Caring ( $\theta^2 = 0,505$ )

Clerical/Investigation ( $\theta^2 = 0,698$ )

Tools/Equipment

DUTY -	RELATED FIELDS	RELATED ENVIRONMENTS	RELATED DUTIES
Advising	People, Business, Politics, Medical	Consultancy, Office, Home, Outdoors, Corporate	Counselling
Bookkeeping	Business, Numbers, Marketing, Trading	Office, Professional, Corporate	Cash handling, Calculating, Clerical
Buying	Business, Marketing	Office, Corporate, Behind counter	Selling
Calculating	Numbers, Politics, Business, Physics	Office, Data processing, Regimental, Corporate	-
Caring	Animals, Medical, Children, Politics, Plants, Service, People, Beauty, Travel, Food	Nature, Outdoors, Religion, Kitchen, Professional, Home, Consultancy, Laboratory, Regimental, Indoors	Counseling, Walking, Teaching, Protection, Cleaning
Cash handling	Business, Marketing	Nature, Office, Corporate	Bookkeeping
Cleaning	Children	Outdoors	Caring
Clerical	Business, Marketing	Office, Consultancy, Corporate	Investigation, Bookkeeping
Composition	Imaginative, Creative	Craft workshop	Drawing
Counselling	People, Children, Service, Travel, Beauty	Client premises, Consultancy, Religion, Outdoors, Professional, Home, Indoors	Caring, Advising, Teaching
Disagreeing	Business	Craft workshop, Consultancy, Outdoors, Dynamic	-
Drawing	Creative, Imaginative, Property, Work with hands	Craft workshop, Dynamic, Outdoors	Measurement, Composition
Driving	Adventure, Travel	Outdoors	-
Equipment	Electronics, Work with hands	Mining, Factory	Tools
Interpreting	-	Professional	-
Investigation	People, Chemistry, Physics, Natural forces, Medical, Adventure, Plants	Laboratory, Outdoors, Nature, Consultancy, Professional	Clerical

\*Significance below 0.005

Table 6.5: Summary of relationships between duties, fields and environments. (continued overleaf)

% significance below 0.005  
 Table 6.5: Summary of relationships between duties, fields and environments (continued)

DUTY	RELATED FIELDS	RELATED ENVIRONMENTS	RELATED DUTIES
Judgement	Food, Legal, Business	Professional, Office	-
Measurement	-	-	Drawing
Microphone	Travel	Outdoors	-
Motivation	Travel, Business, People	Consultancy, Professional, Outdoors	-
Organising	Business, Marketing, Imaginative, People, Travel	Consultancy, Office, Outdoors, Dynamic, Corporate, Professional, Client premises	-
Performing	Movement, Creative, People, Travel	Home, Outdoors, Dynamic, Craft workshop	-
Practicing	Travel	Professional, Outdoors, Consultancy, Nature	-
Prediction	Business	Consultancy, Office	-
Protection	-	Outdoors, Nature	Caring
Risk taking	Adventure, Business, Travel	Outdoors, Nature	-
Selling	Business, Marketing, Trading	Office, Corporate, Client premises, Consultancy, Behind counter	Buying
Teaching	Children, People	Outdoors, Indoors	Caring, Counselling
Tools	Work with hands, Electronics	Factory, Mining, Outdoors, Craft workshop	Equipment
Walking	Natural forces, Animals, Plants	Nature, Mining, Outdoors	Caring
Weapons	Adventure	Nature, Mining, Regimental, Outdoors	
Writing	Language, Creative		

## Discussion

According to the network access model, occupations are perceived as three dimensional: divided into fields, taking place in environments and consisting of duties. Certain occupations are seen as hard (preferred by males), certain as soft (preferred by females), and certain are neutral (preferred equally by males and females). The modifications to the model which result from examining inter-relationships are given in figure 6.2.

The notation used indicates overlapping of fields, environments and duties from the original lists. Thus "Animals/Plants (Walking/Protection) shows that the fields of Animals and Plants are seen as synonymous or subsets, and the duties of Walking and Protection may not exist separately but are included under the field.

Broken lines joining, for example, Motivation and Organising, indicate that the two concepts may be seen as synonymous excepting that they are preferred by different genders. These may in fact be neutral categories separated by semantics, which should be neutrally renamed, for example Cash handling/Calculating/Bookkeeping/Clerical could be called Office work, but information would be lost.

Joined categories may represent occupations in transition. Thus, Measurement/Drawing/Composition could be neutral due to the introduction of computer graphics packages into technical drawing. Natural forces may be moving from a male preserve to a neutral category to do with the environment as a result of the modern humanitarian emphasis on conservation and the preservation of the environment. This may be the beginning of a new field, bearing in mind that Natal University has introduced BSc - Environmental Sciences and BAgric - Wildlife Management degrees for 1996.

	Hard	Neutral	Soft
F	Natural forces	Animals/Plants	Creative
I	Adventure	Chemistry	Education
E	Business/Trading/ Marketing	Food/ (Kitchen)	Language/(Writing)
L	Electronics	Legal	Medical
D	Imaginative	Politics	People
S	Numbers		Religion
	Physics/manufacturing		Travel
	Property		
E	Factory/ (Work w hands)		Craft workshop
N	Storeroom	Office/Corporate/ Behind counter	
V	Mining	Outdoors/Nature/ Regimental	
I	Data processing/ (Systems)	Client premises	
R	Isolation	Academic	
O		Dynamic	
N		Government	
M		Home	
E		Consultancy	
N		Laboratory	
T		Professional/ (Interpreting)/ (Practicing)	
S			
D		Advising	Counselling Teaching/(Indoors)
		Motivation	Organising
U	Cash handling Calculating	Book keeping	Clerical
	Measurement	Drawing/ Composition	Caring/ Cleaning/ Protection/Walking/ (Children/Service/Beauty)
T	Tools	Equipment	
	Prediction	Disagreeing	
I	Selling/Buying	Investigation	
		Judgment	
E	Driving	Microphone	
	Risk taking	Performing/ (Movement)	
S	Weapons		

**Figure 6.2:**  
**Modified**  
**FED model,**  
**showing**  
**combined**  
**categories**

The suggestion that categories can move between levels, combined as subsets of other categories or added, as the real structure of work changes and educational facilities are opened for new fields supports the argument that the model is dynamic.

In the model, the fields of Travel, Electronics and Natural forces have been retained because there seems to be nowhere else to put them at this stage, although they do not have the necessary three levels of education available. Education and Religion have been added as fields because they have the three levels of training available. The Physics category name could change to Manufacturing because of its high relationship with Factory and Work with Hands.

### **Conclusion**

The classification system has an underlying structure and cohesion. The use of the three levels of field, environment and duty appears to be correct. Relationships of  $<0,400$  are found among fields, among environments and among duties, and relationships of  $\geq 0,400$  between fields and environments, fields and duties, and environments and duties. Overlaps and synonyms have been identified. In particular, there are categories which appear to be synonymous excepting for their "hard", "soft" or "neutral" connotations.

These may indicate where the occupational structure is changing. This strengthens the FED's scientific basis as hypotheses can be generated about gaps and future changes in the occupational structure.

**Not only has the cohesion of the FED as an occupational classification system been shown, but there is further evidence of the scientific basis of the model.**

### THE COMPREHENSIVENESS OF THE SYSTEM

More than 1200 jobs were considered in the development of the system and have been made available in an inventory (Holman, 1992). Occupational titles were taken from the *A-Z of careers in South Africa* (Nelson, 1989), from job advertisements in national, local and classified newspapers, from training course titles, and from interviews with people in jobs.

This total exceeds the 1161 occupations described in terms of the *Minnesota theory of work adjustment* (Dawis and Lofquist, 1991) and the mere 24 jobs included in Gati's hierarchical structure (Gati and Winer, 1987), although it includes fewer occupations than the *Dictionary of Holland occupational codes* (Gottfredson, Holland and Ogawa, 1982) and the *SA Dictionary of occupational codes* (Taljaard and Von Mollendorf, 1987). The *Dictionary of Occupational Titles* (US Department of Labour, 1977) and the *International Standard Classification of Occupations* (International Labour Office, 1992) include over 10 000 entries, but these are of job titles rather than occupations.

**The FED occupational classification system appears to be sufficiently comprehensive for practical and research purposes.**

## **THE RATIONALITY OF THE SYSTEM**

Different people should classify occupations into the same categories under different circumstances and at different times. This depends on whether adequate definitions are laid down for category names which are not intuitively understood. The danger with self-explanatory terms is that people attach their own meanings to them, and the terms become ambiguous. An effort was made to ensure that definitions attached to each category would be easily understood by school pupils, the main intended users of the system. It has been found in practice that very few users of the system read the definitions as all the category names are self-explanatory.

### **Study 1**

#### **Research conducted**

Data obtained from administering the measuring instrument to 1280 school leavers was used to generate matrices (appendix 1) of relationships among the fields, environments and duties. An examination of  $\theta^2$  values  $>0,400$  which appear illogical at first reading was carried out to determine whether any categories are perhaps being interpreted ambiguously, or whether the relationships can be logically explained.

#### **Results**

The Academic environment is closely related to the Numbers field ( $\theta^2=0,442$ ), which may reflect the perceived importance of matric mathematics for university studies.

Politics has a high, but not significant, relationship to Calculating ( $\theta^2=0,656$ ), which may indicate that people understand the word as relating to number-use as well as shrewdness in dealing with people and situations. This could be corrected by changing the name of the duty to Calculations.

The high relationship between Food and Judgment is logical in view of what happens when adjusting spices and flavours of food.

The many high relationships of fields, environments and duties to the Outdoors environment (table 6.4) may simply reflect the South African way of life.

Travel has a high relationship with Practicing ( $\theta^2=0,416$ ). No explanation can be found for this and it may be spurious.

The relationships of the Laboratory and Regimental environments to the Caring duty (table 6.4) could indicate the popularity of the jobs of laboratory technician and National Service medic during the period of the study. It can be hypothesised that the perception of "popular" jobs, with their particular combination of categories, will show up in the choice of fields, environments and duties. This is a further indication of the dynamic nature of the classification system.

## Study 2

### Research conducted

A group of 40 adults with no previous experience of the system were asked to assign fields, environments and duties to a list of 40 jobs. Answers were marked according to a predetermined listing from the inventory of jobs (Holman, 1992). In addition, the adults were asked to allocate fields, environments and duties to their own jobs.

### Results and discussion

Correct allocations were made as follows:

Fields	81,9%;	Environments	85,1%;	Duties	78,9%
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These percentages indicate a high inter-rater reliability which **supports the proposition that the system is rational.**

## THE USEFULNESS OF THE SYSTEM

Ultimately the criteria of scientific basis, cohesion, comprehensiveness and rationality come together in the practical consideration of whether a classification system is usable. It should be able to be taken into common usage without ongoing large scale training of academics, practitioners and the general public.

This means that it must be based on a model which is culturally acceptable. Categories must appear natural and there should be minimal rules for allocating units to them. Statements such as "America is a capitalistic society", "The panther is a member of the cat family", and "Helium is a gas" are readily accepted (or argued) because of the power of the underlying classification models and categories. In contrast, the statistically derived systems can only be used and understood after special training. The 16PF and Holland's theory of careers are examples. Statements such as "His serious approach to life shows a minus F-factor" and "Factory work is realistic" do not make sense to the person in the street.

For the FED to be useful, it should provide for easy communication, enabling people to talk about the categories without constantly explaining the words they are using. It should be possible to talk about a "manufacturing job", working in an "office", doing work involving "Caring". *People talk about their work in these terms all the time.*

The FED classification system enables the three components can be put together to form an easily interpreted job description for a job title. Instead of trying to explain a job in detail, the system provides for quick identification of what type of skills are needed, what the working conditions are and what work is involved. From this point of view the system is not only useful for career guidance professionals, but can also assist personnel practitioners.

The fields, environments and duties may also provide divisions and subsets needed to clarify Holland's (1965) types and a method to classify the DOT numbered categories for easy use by career counsellors.

Observation and research of jobs can be facilitated by the system. For example, research into the characteristics of lawyers can control for the different environments and duties involved in the Legal field. Conversely, sub-cultures within a particular type of organisation (for example a mining house), can be described according to environments and duties within the company.

Categories (such as Legal field, Factory environment, Book-keeping duty) can be used as key words to record and retrieve research information. Use of categories can also facilitate the comparison of data over time or geographical distance, so that accurate generalisations can be made about the categories and their inter-relationships.

The system is already being used extensively by guidance teachers in the Gauteng province, training having been sponsored for underprivileged areas by the Community Development Trust. It has been applied in the career counselling of more than 5 000 school leavers in Gauteng and the Western Cape.

The system is available to the general public in *But will I LIKE my job?* (Holman, 1992) and *The A-Z of careers in South Africa* (Nelson, 1995, p 21). It also forms the basis of *The guide to further education in South Africa* (Holman, 1996 - in print) and the Periscope computerised career guidance system used in the Western Cape. (Van Heerden, 1995). **The system can be said to be useful, particularly for career guidance purposes, and also for applications in the personnel field and organisational research.**

## EVALUATION OF RESEARCH

The FED system is a new way of, inter alia, representing relationships between occupations. Based on a network access model, it aims to take into account the perceived occupational structure. Closest in nature to Gati's hierarchy of occupations, it is anchored in sociological situs models which allow for the whole range of status in each category.

The research carried out tends to support the proposition that the FED is a sound occupational classification system. However, the adequacy of the research itself must be considered. The questions to be answered are:

- Will people understand the network access model?
- Has the research supported the model?

As previously discussed, the network access model is grounded in set theory, which has been part of the school syllabus since the 1960's. It could also be understood in terms of computer systems. The first exposure that anyone has to computers is through automatic bank tellers, which are available even to small children. The network access classification system reflects the way in which people have been taught mathematics and see computers working.

The research carried out tends to support the use of the model for an occupational classification system. Low relationships were identified within levels and high relationships across levels. Some synonymous categories have been found, and there are a few categories which fit better into another level. Overall, however, the original categories appear to have been correctly identified. An interesting development has been the classification of categories into "hard", "soft" and "neutral" divisions.

This supports previous findings that jobs are perceived as male or female. Introducing a neutral dimension leads to a hypothesis that certain fields, environments and duties combine more readily than do others, with the neutral dimension (particularly environments) providing a bridge between hard and soft fields and duties. The possibility of predicting shifts in perceptions about occupational structure also arises.

In all except one respect the model appears to have a sound scientific basis. The exception is that no attempt has been made at this stage to tie it into other occupational classification systems. This would necessitate analysing the FED categories together with Holland's (1959) types by factor analysis, and Gati's hierarchical structure with ADDTREE cluster analysis. Relationships have not been hypothesised with the Minnesota theory of work adjustment nor with the PAQ. Personnel management issues involving job analysis, such as placement, training needs analysis, performance appraisal and job evaluation, have not been taken into account. Future research will have to provide these links for the system to be empirically useful.

This will include extending the research into adult perceptions of occupations. The study has been based on the opinions of school leavers, who do not have much experience of the working world. While this may be adequate as a basis for career guidance, the results cannot be generalised as yet to include the perceptions of working adults, personnel practitioners and career guidance counsellors.

The same methodology can be used for research with working adults, but research will have to be differently structured for the other groups. Asking personnel practitioners to indicate their top choices from the lists will probably result in selections of the People field and no data for analysing the other fields. The answer may lie in researching each field, environment and duty separately.

Also as regards generalisation, it must be pointed out that the study was performed in the Gauteng province of South Africa. This is a highly industrialised and commercially based centre. There may be different perceptions in rural areas and coastal towns (where agriculture or shipping may be important). National shifts, too, can be expected. For example, people from wet climates may not place the same emphasis on the outdoor environment.

Any research that is done must take into consideration the dynamic nature of the system. It is not expected that categories will remain the same forever. Technologically explainable shifts in the perception of whether occupations are male or female have already been identified. Hypotheses about future new categories can already be made a few months after the research. For example, language and writing are seen as female occupations, while data processing is male; the combination of the two into a neutral *information* field is a fast approaching possibility with the Internet.

### **SUMMARY**

Research was carried out to determine whether the field - environment - duty occupational classification system has a scientific basis, cohesion and rationality. The test was administered to 1280 school leavers in the Gauteng province of South Africa. Means of categories chosen by males and females were compared using the t-test.

It was found that males favour occupations which are adventurous, rough, involve risk, relate to active business activities and long term strategic problem solving. They do not avoid "dirty" equipment. Females tend to choose people oriented, humanitarian and aesthetic categories.

There is a large neutral area, particularly as regards environments. In terms of the network access model it is hypothesised that "hard" occupations are not perceived as being linked with "soft" environments or duties, but may combine with a "soft" duty by access through a "neutral" environment. The system is shown to have a sound scientific basis in that it is supported by research, is based on previously identified characteristics of occupations and is capable of generating hypotheses about the relationship between categories and units. However, links to other occupational classification systems still need to be proved, and research is needed into adult perception of occupations, as opposed to that of school leavers.

The structure of the system was shown as

- mutual exclusivity of fields from one another and similarly of environments from one another and duties from one another
- High relationships of each environment and duty to many fields, and of each environment to many duties.

From this it can be assumed that people have a three dimensional perception of jobs as divided into fields, taking place in environments and consisting of various duties.

Overlapping categories were identified, as were categories which are synonymous but are chosen differently by males and females. It was hypothesised that these *joined* categories may represent occupations in transition due to technological advances. It was also suggested that new fields may originate from new working environments. These hypotheses tend to support the contention that the model is dynamic.

The system is also more comprehensive than previous occupational classification systems, with over 1200 occupations classified.

Studies were conducted into the rationality of the system. Ambiguity of category names was tested by examining high relationships among fields, environments and duties. Unexpected relationships could be logically explained in terms of the actual work situation for most cases (with the exception of an ambiguity in the meaning of *calculating*, which was seen to include both numbers and social shrewdness). It was hypothesised that the perception of "popular" jobs will show up in the choice of fields, environments and duties.

Also as a test of rationality, a group of 40 adults was asked to assign categories to a list of jobs. Correct allocation were made for 81,9% of fields, 85,1% of environments and 78,9% of duties. This high inter-rater reliability tends to prove that the system is rational.

The system's usefulness was discussed. Extensive use is made of it in South Africa for career guidance purposes. Possible applications in other areas were identified.

Having validated the system as a dynamic occupational classification system, and identified areas where further research is needed, the empirical use of the measuring instrument as an interest test will be examined in the next chapter.

## CHAPTER 7 - EVALUATION OF THE FED AS AN

### INTEREST TEST

#### *SCOPE OF THE CHAPTER*

*Evaluation of the FED as a psychometric interest test. Test rationale, construct validity, predictive validity, concurrent validity, reliability, standardisation and objectivity..*

#### INTRODUCTION

Having established in the previous chapter that the FED is a satisfactory occupational classification system, it remains to prove that the measuring instrument meets the criteria for a psychometric test as set out by Smit (1981, pp 20-23). In particular the test must be shown to have a rationale, construct validity, factorial validity, predictive validity, concurrent validity and reliability. Research was performed during 1995 according to the research design presented in chapter five. The results will be presented and discussed in this chapter. Aspects that were not researched will also be discussed.

#### TEST RATIONALE

Vocational interest is defined as a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and situations already experienced or expected to produce pleasurable feelings.

The aim of the FED test is to measure vocational interest within the framework of the perceived occupational structure. This structure consists of three levels, namely fields of work, environments in which work takes place, and duties that make up work. An individual will have certain preferences in each of these levels. It is assumed that the job or occupation followed will be made up of a combination of a preferred field, environment and duty.

### **CONSTRUCT VALIDITY**

The measuring instrument has certain categories with similar names to fields measured by other interest tests. There should be significant correlations between the relevant scores on the tests.

### **Research conducted**

The measuring instrument was administered simultaneously with the VIQ and SDS to a sample of 134 school-leavers and with the 19FII to 1280 school leavers. Pearson correlation coefficients were computed between the categories and fields. Dichotomous nominal values of the FED had to be transformed into categorical variables for correlation with VIQ and 19FII stanine scores. To achieve this, a selected FED was considered as a high interest and represented by a 9, and an unselected, low interest by a score of 1. These scores were also correlated to raw scores of the SDS. The loss of scores 2-8 in the FED results in low correlations and a value of 0,3 can be considered to be a high correlation.

## Results and discussion

The correlations obtained are given in table 7.1.

FED category	Equivalent field	Interest test	Correlation
Legal	Law	19FII	0,383 <sup>°°</sup>
Business	Business	19FII	0,377 <sup>°°</sup>
Language	Language	19FII	0,252 <sup>°°</sup>
Numbers	Numbers	19FII	0,333 <sup>°°</sup>
Performing	Performing arts	19FII	0,201 <sup>°</sup>
Service	Service	19FII	-0,010
Travel	Travel	19FII	0,395 <sup>°°</sup>
Nature	Nature	19FII	0,328 <sup>°°</sup>
Outdoors	Outdoors	VIQ	0,250 <sup>°</sup>
Service	Social service	VIQ	0,340 <sup>°</sup>
Book keeping	Office work - numerical	VIQ	0,310 <sup>°</sup>
Clerical	Office work - non numerical	VIQ	0,030
Business	Commerce	VIQ	0,580 <sup>°°</sup>
Investigating	Investigative	SDS	0,160

<sup>°°</sup> significant at the 0,001 level  
<sup>°</sup> significant at the 0,01 level

**Table 7.1: Correlations between FED categories and interest test fields.**

Significant correlations were found between nearly all the categories and fields of the 19FII. The one exception was for the Service category, where there was a negative correlation. In the FED, Service is defined as "doing things for others". The 19FII field is described as "the rendering of service to persons in society who are not needy, such as, for example by waiters, shop assistants and hairdressers". Items include the occupations of waiter, hairdresser, traffic officer, air and train hostess or steward, various shop assistants, bus conductor and hotel receptionist. Many of these jobs could be considered below the status level of a matriculant, whereas "doing things for others" in the FED could apply to many status levels (as was intended in the situs approach to categories).

Correlations with fields of the VIQ are less significant, but of the same order as those for the 19FII. There is a low, non significant correlation between the VIQ office non-numerical, and the FED Clerical duty. This was the field included in the VIQ by government pressure over researchers' protests. Possibly items were added in the VIQ to "stretch" the field, and this has diluted the construct.

The Investigation duty of the FED has a low, non-significant correlation with the SDS investigative type. This may be a problem of purity with the SDS. SDS types theoretically include one sixth of all occupations, whereas the FED duties are more specific.

**The research conducted tends to prove the proposition that FED categories are measuring essentially the same constructs as various interest test fields.**

This study raises the possibility that it may not be necessary to measure interests with inventories of items. Interest tests may be so transparent that the same results could be obtained by asking for a ranking or choice of defined fields.

### **PREDICTIVE VALIDITY**

There are two aspects involved:

1. Do school-leavers follow their interests as indicated when they choose FED?
2. What job outcomes result when FED choices are followed? In other words, are job satisfaction and job performance higher for people who work in occupations that match their FED choices?

## Study 1 - Future work and study directions

### Research conducted

To determine whether school leavers when leaving school follow their interests as indicated by choices of FED, a telephone survey was conducted among 650 students tested in 1989 and 1990. Responses were obtained from 201 students (31%). More than half the testees had emigrated, possibly in the political uncertainty of the early 1990's.

The percentage of school leavers who study after matriculating and follow a course in line with their choice of field on the FED was determined. The exercise was also done for school leavers who are now working, in respect of chosen fields, environments and duties. Actual percentages were compared with expected percentages using the  $\chi^2$  goodness of fit test and results are

given in table 7.2. Using probability theory, it is expected that if choice and future

WORKING N=49	N	% following	$\chi$	Signif
Following field	29	59	86941	0,0001
environment	22	44	48331	0,0001
duty	20	41	55968	0,0001
STUDYING N=152				
Following field	121	80	159904	0,0001

direction were random, only 0,04% of school leavers would follow a chosen category.

° significant at the 0,0001 level  
Table 7.2: FED predictive validity of choices

The 80% of students following a chosen field of the FED compares favourably with the 60% for the 19FII established by Nicol (1978). Of the school-leavers who are working, 59% are in a chosen field and 86% are in jobs involving at least one of the fields, environments or duties they originally selected.

## Study 2 - work outcomes

This part of the study analysed reported job performance and satisfaction with occupations related to choice of fields, environments and duties. The current occupation or study direction was assigned to the categories according to the inventory of occupations (Holman, 1992) and compared with choices originally made on leaving school. A score of 3 was given for every matching choice. Thus if all three FED followed were originally chosen, a score of 9 was given, if only two of the three a score of 6, if only one a score of 3, and if none a score of 0. The same procedure was followed for forty working adults whose choice of three preferred fields, environments and duties were compared with current occupations.

Responses for all three groups to the questions about occupational satisfaction, tenure and job performance were coded as 0, 3, 6 or 9. The  $\chi^2$  goodness of fit test was used to determine the significance of the results.

### Results and discussion

The intention was to perform 3 x 3 cross break analyses with four degrees of freedom. However, empty cells had to be combined with cells containing numbers, so in most cases 2 x 3 (2 degrees of freedom) and for the adult sample 2 x 2 (1 degree of freedom) cross break analyses were performed. The results are given in table 7.3.

	N	Satisfaction chi <sup>2</sup>	Performance chi <sup>2</sup>	Afterwards/ tenure chi <sup>2</sup>
Students	125	14,84 <sup>oo</sup> (2 df)	1,56 (2 df)	9,47 <sup>oo</sup> (2 df)
Workers	86	16,88 <sup>oo</sup> (2 df)	0,78 (2 df)	26,57 <sup>oo</sup> (4df)
Adults	40	27,58 <sup>oo</sup> (1 df)	27,10 <sup>oo</sup> (1 df)	14,61 <sup>oo</sup> (1 df)

**Table 7.3: Predictive validity of FED for outcomes**

The FED appears to predict satisfaction with future studies. To a lesser extent it predicts what students will do immediately after finishing their studies. It also predicts future and current job satisfaction with work as well as future and concurrent job tenure. The FED does not predict future work or study performance for school-leavers. However, it does predict (self assessed) work performance. The more a person's job reflects their current choices of FED categories, the more likely they are to rate their performance as high. This is in contrast with Hughes' (1972) finding that only 1% of employed men belong to the Holland group appropriate to their jobs, and that job satisfaction and job stability are not increased.

### **CONCURRENT VALIDITY**

In order to determine the concurrent validity of the FED, the test was administered simultaneously with the 19FII and 16PF to 1280 school leavers, and with the VIQ and SDS to 134 school leavers.

### **THE NINETEEN FIELD INTEREST INVENTORY (19FII)** **(Manual: Fouché and Alberts, 1971)**

The 19FII was compiled to measure the vocational interests of high school pupils (standards 8 to 10) and students and adults in nineteen broad fields of interest. These are: Fine arts, Performing arts, Language, History, Service, Social work, Sociability, Public speaking, Law, Creative thought (a combination of creativity and thinking), Science, Practical- male, Practical - female, Numerical, Business, Clerical, Travel, Nature, and Sport. The inventory also measures the extent to which a person is actively or passively interested in these fields, as well as the extent to which interest is work or hobby oriented.

The rationale of the test is that interests can be measured by asking testees to declare likes and dislikes for various activities included in the interest fields. Extensive item analysis and selection ensured that the fields, as constructs, are well defined. Logical and factorial validity have been well addressed. Face validity is high according to Nicol (1978). Logical and factorial validity appear to have been well addressed. Occupational profiles are provided in the manual based on the average scores of 5500 adults in 35 different occupations. Norms are given separately for males and females, for standards 8, 9 and 10. Split-half test reliability is high.

### **Research conducted**

The 19FII was administered simultaneously with the FED to 1280 school leavers in the Gauteng province of South Africa. Scores for the 19FII are reduced to stanines according to norm tables provided in the manual. Nominal scores of 9 and 1 were allocated respectively to FED categories chosen and not chosen.

### **Results and discussion**

The correlations of each FED to the fields of the 19FII are given in appendix 2. Summaries of high and low correlations are given as tables 7.4 to 7.6. Table 7.7 gives 19FII fields with highly correlated FED categories.

The associated categories are as could be expected, with a few exceptions. Adventure, Trading, Factory and Nature showed unexpectedly high relationships with the Practical Female field of the 19FII. The original norm tables in the manual were compared with stanines for this sample of 1280 school-leavers.

It was found that, since 1972, males appear to have higher interest scores on Practical-Female and lower interest levels on Practical-Male. Females have a lower interest scores on Practical-Female and a higher interest level on Business.

This may be attributable to the women's movement of the 1970's. School leavers in this study would be the offspring of parents subjected to women's liberation philosophies, who may have reared their children away from previously traditional gender-stereotyping values.

The high association of Academic to Sociability may reflect that school leavers expect student life to be a round of sociability. The high relationships between Weapons, Language and Public speaking, and Nature and Corporate may be spurious.

FIELD	HIGH CORRELATIONS TO 19FII	LOW CORRELATIONS TO 19FII
Adventure	Practical female, Travel, Sport	Public speaking, Numbers, Clerical
Animals	Science, Nature	Sociability, Public speaking, Creative thought, Business
Beauty		History
Business	Public speaking, Law, Numbers, Business Clerical work	Fine arts, Performing arts, Science, Nature, Social work
Chemistry	Science	Law
Children	Social work	Practical female, Numbers, Travel
Creative	Fine arts, Performing arts, Language	Numbers, Business, Clerical work
Electronics	Creative thought, Practical male, Practical female, Numbers, Law	Public speaking
Food	Service, Practical female	Imaginative
Imaginative	Fine arts, Language, Practical female	-
Language	Language, History, Public speaking, Work	Numbers, Nature, Sport
Legal	Language, Public speaking, Law	Service, Practical female
Marketing	Public speaking, Business, Clerical	Performing arts, Social work, Science, Practical male, Nature
Medical	Social work, Science, Active	Clerical, Travel
Movement	Fine arts, Sport	-
Natural forces	History, Science, Nature, Sport	Public speaking, Law, Business
Numbers	Creative thought, Numbers, Clerical	Fine arts, Language, Law
People	Social work, Sociability, Public speaking, Hobby	Fine arts, Science, Numbers, Clerical, Practical female, Nature
Physics	Creative thought, Science	Travel
Plants	Science, Nature	Sociability, Creative thought, Business
Politics	History, Public speaking, Law	Service, Sociability, Science, Practical male, Nature, Practical female, Travel
Property	Fine arts, Practical female, Numbers	-
Service	Social work, Hobby	Fine arts, Business, Travel
Systems	Creative thought, Numbers	-
Trading	Service, Practical female, Numbers, Business, Travel	Language, Social work, Science
Travel	Service, Travel	Creative thought
Work with hands	Practical male, Practical female	Language, Public speaking, Law

**Table 7.4: High and low relationships between FED fields and 19FII fields.**

ENVIRONMENT	HIGH CORRELATIONS TO 19FII	LOW CORRELATIONS TO 19FII
Academic	History, Sociability, Numbers	Social work
Behind counter	Service, Business, Clerical	Science
Client premises	Business	Science
Consultancy	Sociability, Public speaking	Performing arts, Practical female, Practical male, Nature
Corporate	Numbers, Business, Clerical, Nature	-
Craft workshop	Fine arts, Performing arts, Practical male	Law, Numbers
Data processing	Practical female, Numbers, Clerical	Social work, Public speaking
Dynamic	Fine arts, Performing arts, Language, Public speaking	-
Factory	Practical male, Practical female, Work	-
Government	Public speaking, Law	Service, Practical male, Practical female, Nature, Sport, Public speaking
Home	-	-
Indoors	-	-
Isolation	Nature	Sociability, Public speaking
Kitchen	Practical female	Practical male, Language, Public speaking, Creative thought, Numbers, Business
Laboratory	Science, Nature	Sociability, Public speaking, Business
Mining	-	Business
Nature	Science, Practical female, Nature	Sociability, Public speaking, Creative thought, Numbers, Law, Business
Office	Numbers, Business, Clerical	Fine arts, Performing arts, Science, Nature, Sport
Outdoors	Service, Travel, Nature, Sport, Active	Numbers, Clerical
Professional	Law	-
Regimental	-	Business
Religion	Social work, Hobby	Numbers, Business
Storeroom	-	-

**Table 7.5: High and low relationships between FED environments and 19FII fields**

DUTY	HIGH CORRELATIONS TO 19FII	LOW CORRELATIONS TO 19FII
Advising	Social work, Sociability, Public speaking, Law	Practical male, Nature
Bookkeeping	Numbers, Business, Clerical, Passive	Fine arts, Performing arts, Language, Practical male, Nature
Buying	Sociability, Practical female, Numbers, Business, Clerical	-
Calculating	Creative thought, Numbers, Work	Fine arts, Language, Law, Service
Caring	Social work, Science, Nature	Performing arts, Sociability, Practical female, Numbers, Business, Clerical, Public speaking, Creative thought, Travel
Cash handling	Numbers, Clerical	-
Cleaning	Passive	-
Clerical	Clerical, Passive	Fine arts, Performing arts, Science, Nature, Sport
Composition	Fine arts, Creative thought	-
Counselling	Social work, Law	Fine arts, Practical female, Clerical
Disagreeing	Language, Public speaking, Law, Creative thought	Service
Drawing	Fine arts	Social work, Public speaking, Law, Business, Clerical
Driving	Practical female	Social work, Public speaking, Law
Equipment	Practical male, Practical female	Public speaking
Interpreting	-	Practical female, Nature
Investigation	History, Science	Service, Social work, Sociability, Public speaking, Clerical
Judgment	Service, Law, Creative thought	-
Measurement	Practical male, Numbers	-
Microphone	-	Science, Practical male, Numbers
Motivation	Public speaking, Business	-
Organising	Sociability, Public speaking, Law, Business, Travel	Social work, Science
Performing	Performing arts, Public speaking	Numbers, clerical
Practicing	Business	Science
Prediction	Language, Creative thought, Business	Service
Protection	-	-
Risk taking	Sociability, Practical female, Business, Travel	History, Creative thought, Science
Selling	Sociability, Practical female, Business, Travel	History, Creative thought, Science
Teaching	Language, Social work	Business
Tools	Practical male, Practical female, Travel, Nature	Law, Creative thought
Walking	Nature	Public speaking, Law, Creative thought, Numbers
Weapons	Language, Public speaking, Nature	Law, Numbers, Business
Writing	Language	Numbers

**Table 7.6: High and low relationships between FED duties and 19FII fields**

19FII FIELD	ASSOCIATED FED FIELDS	ASSOCIATED FED ENVIRONMENTS	ASSOCIATED FED DUTIES
Fine arts	Creative, Imaginative, Movement, Property	Craft workshop, Dynamic	Composition, Drawing
Performing arts	Creative	Craft workshop, Dynamic	Performing
Language	Creative, imaginative, Language, Legal	Dynamic	Disagreeing, Prediction, Teaching, Weapons, Writing
History	History, Natural forces, Politics	Academic	Investigation
Service	Food, Trading, Travel	Behind counter, Outdoors	Judgment
Social work	Children, Medical, People, Service	Religion	Advising, Caring, Counselling
Sociability	People	Academic, Consultancy	Advising, Buying, Organising, Risk taking, Selling
Public speaking	Business, Language, Legal, Marketing, People, Politics	Consultancy, Dynamic, Government	Advising, Disagreeing, Motivation, Organising, Performing, Weapons
Law	Business, Electronics, Legal, politics	Government, Professional	Advising, Counselling, Disagreeing, Judgment, Organising
Creative thought	Electronics, Numbers, Physics, Systems	Dynamic	Calculating, Composition, Disagreeing, Judgment, Prediction
Science	Animals, Chemistry, Medical, Natural forces, Physics, Plants	Laboratory, Nature	Caring, Investigation
Practical male	Electronics, Work with hands	Craft workshop, Factory	Equipment, Measurement, Tools
Practical female	Adventure, Electronics, Food, Imaginative, Property, Trading, Work with hands	Data processing, Factory, Kitchen, Nature	Buying, Driving, Equipment, Risk taking, Selling, Tools
Numbers	Business, Electronics, Numbers, Property, Systems, Trading	Academic, Corporate, Data processing, Office	Bookkeeping, Buying, Calculating, Cash handling, Measurement
Business	Business, Marketing, Trading	Behind counter, Client premises, Corporate, Office	Bookkeeping, Buying Motivation, Organising, Practising Prediction, Risk taking, Selling
Clerical	Business, Marketing, Numbers	Behind counter, Corporate, Data processing, Office	Bookkeeping, Buying, Cash handling, Clerical
Travel	Adventure, Travel, Trading	Outdoors	Organising, Risk taking, Selling, Tools
Nature	Animals, Natural forces, Plants	Corporate, Isolation, Laboratory, Nature, Outdoors	Caring, Tools, Walking, Weapons
Sport	Adventure, Movement, Natural forces	Outdoors	-
Work	Business, Language	Factory	Calculating
Hobby	People, Service	-Religion	Active
Active	Medical	Outdoors	-
Passive	-	-	Bookkeeping, Cleaning, Clerical

**Table 7.7: 19FII fields and associated categories of the FED**

## THE VOCATIONAL INTEREST QUESTIONNAIRE (VIQ)

(Manual: Coetzee, 1985)

This test was developed in 1972 to measure interests for previously untested sectors of the South African population, particularly black standards 6 to 10 high school pupils. Interests are measured for the fields of Technical, Outdoor, Social service, Natural science, Office work - non-numerical, Office work - numerical, Music, Art, Commerce and Language. The fields were chosen "after a study of the best known interest questionnaires and with due allowance for the particular requirements and occupational possibilities of Black men in South Africa and at the specific request of the department of Bantu Education" (Coetzee, 1985, p 2). Testees indicate whether they like or dislike each activity in an inventory.

The rationale behind the test is that activities in occupations can be distinguished from one another. An individual's inclination towards a certain group of activities should therefore indicate his interest in the occupational group of which the interests form the basis. Norms (as percentiles) are given separately for standards 6 to 10. Smit (1981, p 316) could find no information about the validity of the VIQ.

### Research conducted

The VIQ was administered simultaneously with the FED to 134 school leavers as discussed in the previous chapter. VIQ score percentiles were converted to stanines. To bring the FED in line with a stanine scoring system, a selected FED category was considered as a high interest and represented by a 9, and an unselected, low interest by a score of 1.

### Results and discussion

The correlation tables of FED to each of the VIQ fields are given in appendix 3. Tables 7.8 to 7.10 summarise significant high and low correlations. Generally the correlations were as anticipated, with the exception of the Outdoors field which reflected the South African way of outdoor life with high significant correlations to Food and Buying. There was a negative significant correlation of Outdoors to Counselling, and it appears that an interest in Outdoors is perceived as the opposite of wanting to work Indoors. High and significant correlations were found between VIQ Service - Cash handling, Commerce - Electronics, all Office work - Isolation, Natural science - Medical. Patterns of correlations for the two VIQ office-work fields were similar, confirming the original research that the two fields should not have been split in the VIQ. A split between Art and Music does not appear to be justified.

The FED and Roe's (1956) categories as measured by the VIQ correspond although VIQ fields are not as comprehensive as the FED. With the exception of Roe's Outdoors category, the VIQ appears to be incorporated within the FED.

FIELD	HIGH CORRELATIONS TO VIQ	LOW CORRELATIONS TO VIQ
Adventure	-	Natural science, Art
Animals	-	Music
Beauty	Music	-
Business	Office numerical, Commerce, Office non-numerical	-
Chemistry	Natural science	Music
Children	Social service, Music	Commerce, Technical
Creative	Art, Music	Office numerical, Commerce
Electronics	Technical, Outdoor, Natural science, Office numerical, Commerce	-
Food	Outdoor, Technical	-
Imaginative	Art, Music, Technical	-
Language	Language	Commerce
Legal	-	Commerce
Marketing	-	Technical
Medical	Natural	Office numerical, Commerce, Office non-numerical
Movement	-	-
Natural forces	-	Technical
Numbers	Office numerical	-
People	Social service	Technical, Office non numerical, Office numerical, Commerce, Outdoors
Physics	Natural science	Art, Language
Plants	Office numerical, Commerce	Office numerical, Commerce
Politics	-	-
Property	Outdoor, Technical	-
Service	Social service, Service	-
Systems	-	-
Trading	Office numerical	Technical
Travel	Office non numerical	Technical
Work with hands	Technical	-

**Table 7.8: Relationships between FED fields and VIQ fields**

ENVIRONMENT	HIGH CORRELATIONS TO VIQ	LOW CORRELATIONS TO VIQ
Academic	Office non numerical, Language	-
Behind counter	-	-
Client premises	-	-
Consultancy	-	Technical, Outdoors
Corporate	Commerce	-
Craft workshop	Art, Music	Office numerical
Data processing	Natural science, Commerce	Music
Dynamic	Music, Art	-
Factory	Technical	-
Government	-	-
Home	Language	-
Indoors	-	-
Isolation	Office non-numerical, Office, numerical, Technical, Factory	-
Kitchen	Factory	Music
Laboratory	Natural science, Technical	-
Mining	-	-
Nature	Outdoor	Office non numerical
Office	Office numerical	-
Outdoors	Outdoor	-
Professional	-	-
Regimental	-	-
Religion	-	Art
Storeroom	-	-

**Table 7.9: Relationship between FED environments and VIQ fields**

DUTY	HIGH CORRELATIONS TO VIQ	LOW CORRELATIONS TO VIQ
Advising	-	-
Bookkeeping	Office numerical	-
Buying	Technical, Outdoor, Office non numerical, Office numerical, Commerce	-
Calculating	Technical, Office numerical	Music
Caring	Social service, Natural science	Office numerical, Commerce
Cash handling	Social service, Office non numerical, Office numerical	Art
Cleaning	-	-
Clerical	Natural science, Language	-
Composition	-	-
Counselling	Social service	Technical, Outdoor, Art, Commerce
Disagreeing	-	-
Drawing	Art, Technical	-
Driving	-	-
Equipment	-	-
Interpreting	-	-
Investigation	-	Social service
Judgment	-	-
Measurement	-	-
Microphone	-	-
Motivation	Social service, Music, Art, Language	-
Organising	Art	Natural science
Performing	Natural science	Office numerical, Commerce
Practicing	Technical, Natural science	-
Prediction	Commerce	Social service
Protection	-	-
Risk taking	-	Language
Selling	-	Technical, Social service, Art
Teaching	Social service	-
Tools	Technical	-
Walking	-	Technical
Weapons	-	-
Writing	-	Outdoor, Natural science

**Table 7.10: Relationship between FED duties and VIQ fields**

## THE SELF DIRECTED SEARCH (SDS)

(Manual: Gevers, du Toit and Harilall, 1992)

The SDS questionnaire was originally developed in 1970 in the USA by Holland (1985) to provide a self-assessment questionnaire for his theory of careers. The rationale of the test is to measure occupational interest within a broad framework of career planning, to facilitate the establishment of a correlation between personal and career information. The SDS is a self-assessment of activities a person likes to do, what the person considers he or she can do well (competencies), feelings and attitudes towards different occupations, and abilities or skills. It is intended for use by high school pupils and adults. Scores are obtained for each of the six Holland types, which are:

**REALISTIC:** This type of person works with objects, tools and machinery involving manual skills. Code **R**.

**INVESTIGATIVE:** The investigative type is characterised by a preference for systematic investigation of physical, biological and cultural phenomena, which leads to mastering scientific and mathematical skills. Code **I**.

**ARTISTIC:** This type wants to achieve creativity in a free environment and develops skills in language, art, music or drama. Code **A**.

**SOCIAL:** The social person shows a preference towards developing, training or caring for people using interpersonal or educational skills. Code **S**.

**ENTERPRISING:** This type of person takes the lead, most probably in the business world or in public life, developing leadership and persuasive abilities. Code **E**.

**CONVENTIONAL:** The conventional type prefers ordered activity including the manipulation of data, in clerical, computational and routine tasks. Code **C**.

The six types are represented in this order a hexagon and it is hypothesised that adjacent types have the highest correlations and opposite types the lowest. The SDS does not use norms. Instead, the three highest scores make up a three-letter code. Studies cited in the manual found that around 70% of Holland type scores correspond with envisaged (not actual) occupation. This may be a function of the test itself; having, through self-assessment, explored the implications of a chosen career, it is possible that an individual rejects unsuitable careers at the end of the questionnaire.

Reliability of the SDS was calculated according to the test-retest method in 1985 (retesting after 8 weeks), and the Sichel formula in 1987. Reliability indices of between 0,75 and 0,85 were found for all except the social category.

Generally, the SDS has face validity among the panel who evaluated it, reliability is high and predictive validity of envisaged occupation is high. Lowman (1991, p 16) considers Holland's integration of theory and empirical measure to be the best current interest model. He is of the opinion that it accounts for the factor structure of occupational preferences but that work is needed to refine the theory beyond the six factors by describing subtypes and the interaction between primary, secondary and tertiary interests.

### **Research conducted**

In the interpretation of the SDS, raw scores are not translated into standardised nor any other kind of categorical system. Raw scores were therefore correlated to the nominal scores of 1 and 9 used for the FED.

## Results and discussion

The correlation of FED categories to each Holland category is given in appendix 4.

Figure 7.1 shows the Holland Hexagon with high and low significant correlations of FED to the Holland types. FED within the hexagon have positive correlations to codes. FED outside the hexagon have negative correlations to opposite codes.

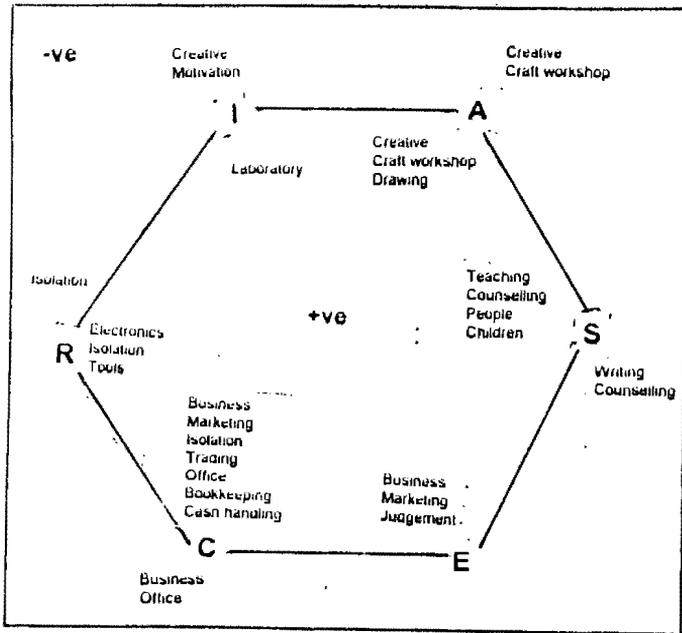


Figure 7.1: Correspondence between FED categories and Holland codes

This figure shows that the FED categories and Holland systems correspond in broad outline and in most cases the hypothesis of adjacent and opposite relationships is confirmed. Unexpected exceptions are that Writing is negatively correlated with Realistic and thus positively associated with Social (This implies that the Social type could be a "communicative" type) and that Creative and Motivation have negative correlations to Enterprising and are therefore positively associated with the Investigative type (implying that Enterprising types work alone and Investigative types are innovators who work through other people - a possible return to the original type name of Intellectual (Holland, 1959)). The positive correlation of Trading to the Conventional type implies that the type is involved in making money as well as administrative work.

Apart from a superficial resemblance, the FED system does not appear to relate well to Holland's types. There are many fields, environments and duties which do not have significant correlations with any Holland types. This may be a function of the two different scales used in the correlation analysis (which is causing very low but significant correlations) or the comprehensiveness of the FED compared with the six Holland types. It may also be because the two systems come from opposing viewpoints: Holland's system describes differences between the people who are doing work, whereas the FED system describes differences in work itself.

THE 16 PERSONALITY FACTOR TEST (16PF)  
(Reference: Cattell, Eber and Tatsuoka, 1970)

Krug (1981) summarises the history of the 16PF since it was published in 1949. Essentially a statistically based classification system of personality, the development of the test was guided by careful theoretical planning, backed up by thorough consolidation and maintenance. Factor analysis of questionnaire items and behaviour ratings revealed fifteen factors, to which an *intelligence* factor was added. During the 1950's and 1960's it was largely a research instrument. In 1970 the *Handbook for the sixteen personality factor questionnaire* (Cattell, Eber and Tatsuoka, 1970) was published which made the test easily available and usable for clinical practice. Research on the test is ongoing, and reliabilities and validities have steadily advanced. By 1981 more than 2000 research publications had been published on the 16PF (Krug, 1981, p 1). The basic instrument has been extended down the age range as far as early childhood, across cultures and outward to include more dimensions. The test is used extensively by clinical and industrial psychologists and is one of the top sellers of the HSRC.

A description of the factors, and their implications for work placement, derived from the handbook, are given in table 7.11 overleaf.

LOW SCORES (-)		FAC TOR	(+) HIGH SCORES	
Description	Indications		Indications	Description
Cold, aloof, critical, stubborn, detached. Sizothymia.	Working alone. Avoid situations requiring compromise	A	Working with people, jobs enjoying social esteem. Avoid working with data	Warm, easy-going, cooperative, outgoing. Affectothymia
Slow, unambitious, dull. Low chrystallised intelligence	Requiring supervision and motivation	B	Skilled jobs	Resolute, quick witted, smart. High chrystallised intelligence
Argumentative, defensive, low ego strength	Working at own pace, avoid accountability and group work	C	Professions, jobs requiring rapid decisions	Can handle frustration, self-esteem, high ego strength
Submissive, humble, mild, easily led	Working within parameters, where assertiveness is not needed	E	Controlling jobs, with challenges. Avoid critical bosses	Assertive, headstrong, competitive. Dominance, Ascendance
Serious, introspective, sober, taciturn, desurgency.	Academic jobs. Avoid conflict situations	F	Selling, performing	Impulsive, effusive, enthusiastic, surgency.
Self centred, multi-nous, expedient. Low superego strength	Environment of disorder, settling disputes	G	Working with moral and societal laws	Adherence to group standards, conscientious. High superego strength
Timid, restrained, threat sensitive. Threctia.	Devotion to duty, fear of authority	H	Risks, challenges, handling emotional situations and human problems	Bold, self-confident, venturesome. Parmia.
Down to earth, tough, cynical, realistic, self reliant. Harria.	Sociometric popularity, committee work, armed forces	I	White collar work	Idealistic, sensitive, intuitive, over protected, clinging. Premsia.
Gullible, Forgiving. Alaxia.	Clerical work, high application	L	Analysis, unpopularity	Suspicious, wary, emphatic, dogmatic. Protension.
Objective, practical. Praxernia	Detail and precision	M	Concept development	Day dreaming, creative. Autia
Gullible, socially clumsy, sincere. Naivete.	Teaching. Avoid manipulative people	N	Controlling clever people, problem solving, research	Manipulative, charming, polished, worldly wise. Shrewdness.
Resilient, insensitive, self assured. Calm adequacy,	Person to person leadership	O	Job with rules, calm environment, avoid group participation	Guilt proneness, dutiful, apprehensive, insecure.
Conservatism of temperament, law abiding	Conservative job	Q1	Making critical contributions, avoid authority figures	Radicalism, rebellious, experimenting, free thinking.
Dependent on group support. Group adherence.	Team work	Q2	Making own decisions, finding solutions, working alone	Independent, self sufficient
Lack of self discipline and will power. Lax. Low self sentiment integration	Work with variety, avoid responsibility and procedures	Q3	Job needing objectivity and balance. Need for structure. Avoid disorder	Self disciplined, compulsive. High strength of self sentiment.
Laid back, calm. Low ergic tension	Stressful job	Q4	Too stressed to evaluate career direction	Free floating anxiety, stressed. High ergic tension

Table 7.11: Factors of the 16PF

Krug (1981) developed a taxonomy of 16PF profiles based on the first four second order factors. These are:

**EXTRAVERSION:** made up of A+ (warmth), F+ (impulsivity), H+ (social boldness) and Q2- (group dependence)

**ANXIETY:** made up of C- (emotional instability), H- (threat sensitivity), L+ (suspiciousness), O+ (guilt), Q3- (low integration) and Q4+ (tension)

**TOUGH POISE:** made up of A- (detachment), I- (tough mindedness) and M- (practicality)

**INDEPENDENCE:** made up of E+ (dominance), Q1+ (rebelliousness) and Q2+ (self sufficiency).

The profile classification considers the 81 patterns generated by combinations of high (>7), average and low (<4) scores on each of the four second order factors. A typical pattern could be 3213, indicating that extraversion and independence are above average, tough poise below average, and anxiety average. Data for 27 114 questionnaires (17 381 testees) was analysed to find the incidence of each score pattern in clinical and normal populations. Specification equations for Holland categories, various occupations, clinical and other scales were applied for each pattern. A narrative interpretation accompanies each pattern.

## Research and discussion

The 16PF was administered simultaneously with the FED to 1280 school-leavers. Norms for first year university students were used to obtain sten scores. First order and second order factor scores were correlated (Pearson product moment correlation) with the nominal scores of 9 and 1 allocated for chosen and not chosen categories of the FED.

Krug patterns were obtained for each field, environment and duty by allocating 3 to significant positive correlations and 1 to significant negative correlations for the second order factors of extraversion, anxiety, tough poise and independence. This simplistic methodology is adequate to show concurrent validity of the FED and Krug patterns, but would have to be improved to match the actuarial exactness of Krug's analysis.

The correlations between FED categories and the 16 factors, as well as to each of the second order factors are given in appendix 5. Summaries of high and low significant correlations are given in tables 7.12 to 7.14.

Correlations in the tables match school-leavers' perceptions of jobs to their personalities and do not reflect actual personalities of people in jobs. The correlations must be interpreted as "School leavers who choose \_\_\_\_\_ tend to have personality traits of \_\_\_\_\_".

FIELD	HIGH CORRELATIONS TO 16PF	LOW CORRELATIONS TO 16PF
Adventure	L (suspicious), Q1 (radical), Independence	A (detached), G (expedient)
Animals	C (emotional stability), Q4 (tension)	A (detached), H (threat sensitive), Extraversion -
Beauty	-	-
Business	N (manipulative, polished)	I (realistic, self sufficient)
Chemistry	B (smart), Q2 (independent)	A (detached), C (defensive), E (submissive), F (intro- spective), Extraversion -, Independence -, Tough poise -
Children	A (warmth), Q3 (self-discipline), I (idealism)	B (slow learner), E (submissive), I (idealistic), Tough poise -
Creative	M (creative), Independence	G (expedient), N (naive)
Electronics	Q1 (rebellious)	a (detached), F (introspective), H (threat sensitive), I(realistic)
Food	-	-
Imaginative	B (smart), Q1 (radical)	-
Language	I (idealistic), M (creative)	Tough poise -
Legal	E (assertive), I (idealistic), N (manipulative, polished)	-
Marketing	A (warmth), G (conscientious), H (socially bold), Extraversion	-
Medical	N (manipulative, polished)	-
Movement	--	-
Nat forces	Q2 (independent)	A (detached)
Numbers	B (smart), G (conscientious), Q3 (self disciplined)	F (serious), I (realistic), Extraversion -
People	A (warmth), F (impulsive), H (socially bold), I(idealistic), Extraversion	Q4 (Laid back), Anxiety -
Physics	-	Extraversion -, Independence -
Plants	Q2(independent)	A (detached), F (introspective), Extraversion -
Politics	E (Assertiveness), Independence	-
Property	-	I (realistic)
Service	A (warmth), G (conscientious), I (idealistic), Q3 (self disciplined)	-
Systems	-	-
Trading	-	I (idealistic)
Travel	F (impulsive)	Q3 (self disciplined)
Work with hands	Tough poise	A (detached), I (realistic), N (naive)

**Table 7.12: Significant relationships between FED fields and  
16PF first and second order factors**

ENVIRONMENT	HIGH CORRELATIONS TO 16PF	LOW CORRELATIONS TO 16PF
Academic	Q2 (independent), Anxiety	C (defensive), F (introspective), H (timid), Extraversion -
Behind counter	-	-
Client premises	A (warmth), N (manipulative, polished)	Q2 (group dependent)
Consultancy	A (warmth), F (impulsive), H (socially bold), Extraversion	Q2 (group dependent)
Corporate	-	I (realistic)
Craft workshop	M (creative)	G (expedient), N (naive)
Data processing	Q2 (independent), Anxiety	A (detached), F (introspective), H (timid)
Dynamic	E (assertive), F (impulsive), H (socially bold), M (creative), Independent	A (detached), G (expedient), N (naive), Q3 (lax)
Factory	Tough poise	A (detached), I (realistic), M (precise)
Government	E (assertive), N (manipulative, polished)	-
Home	I (idealistic)	H (timid), Tough poise -
Indoors	I (idealistic)	Tough poise -
Isolation	L (suspicious), Q2 (independent), Q4 (tension), Anxiety	A (detached), F (introspective), G (expedient), H (timid)
Kitchen	-	B (slow learner)
Laboratory	Q2 (independent)	A (detached), H (timid), Extraversion -
Mining	-	A (detached), F (introspective), H (timid), Extraversion -
Nature	C (emotional maturity), Q2 (independent)	A (detached), F (introspective), H (timid), Extraversion -
Office	G (conscientious), N (manipulative, polished)	-
Outdoors	C (emotional maturity), F (impulsive), H (socially bold), Extraversion, Independence	Q2 (group dependent)
Professional	-	-
Regimental	-	M (precise)
Religion	A (warmth), I (idealism)	E (submissive), Tough poise -
Storeroom	-	-

**Table 7.13: Significant relationships between FED environments and 16PF first and second order factors**

DUTY	HIGH CORRELATIONS TO 16PF	LOW CORRELATIONS TO 19 PF
Advising	A (warmth), Extraversion	-
Bookkeeping	G (conscientious)	C (defensive), E (submissive), Independence -
Buying	-	-
Calculating	B (smart), Q1 (rebellious)	I (realistic)
Caring	C (emotionally mature), I (idealistic)	E (submissive), F (introspective), H (timid), Tough poise, Independence -
Cash handling	-	-
Cleaning	-	F (introspective), Independence -
Clerical	-	E (submissive), Independence -
Composition	-	I (realistic), L (accepting conditions)
Counselling	A (warmth), F (impulsive), H (socially bold), I (idealistic), Extraversion	B (slow learner), Q1 (conservative), Q2 (group dependent), Tough poise -
Disagreeing	E (assertive), L (suspicious), Q1 (rebellious)	-
Drawing	-	A (detached), I (realistic), N (gullible)
Driving	Q4 (tension)	H (timid)
Equipment	Q2 (independent), Anxiety	-
Interpreting	O (guilt prone)	C (defensive), G (expedient)
Investigation	B (smart), Q2 (independent)	A (detached), F (introspective), H (timid), Extraversion -
Judgment	E (assertive), M (creative), Independence	-
Measurement	Tough poise	I (realistic)
Microphone	A (warmth), H (social boldness)	-
Motivation	A (warmth)	Q2 (group dependence)
Organising	A (warmth), B (Smart), E (assertive), F (impulsive), H (social boldness), Extraversion	I (realistic), Q2 (group dependence)
Performing	C (emotionally mature), F (impulsive), H (social boldness), I (idealism), Independence	G (expedient), N (naive)
Practicing	G (conscientious), Q3 (self disciplined)	-
Prediction	-	-
Protection	-	-
Risk taking	E (assertive), F (impulsive), Q4 (tension), Extraversion, Independence	A (detached), G (expedient), Q3 (lax)
Selling	A (warmth), Extraversion	-
Teaching	A (warmth), I (idealistic), Q3 self disciplined	Tough poise -
Tools	Tough poise	I (realistic), N (naive)
Walking	C (emotional maturity), Q2 (independence)	Extraversion -
Weapons	L (suspicion), Q2 (independent), Independence	A (detached), F (introspective), G (expedient)
Writing	I (idealistic)	-

**Table 7.14: Significant relationships between FED duties and 16PF factors**

Table 7.15 summarises the corollary: "School leavers with a personality trait of \_\_\_\_\_ tend to choose \_\_\_\_\_ or avoid choosing \_\_\_\_\_"

FAC TOR	HIGH SCORES			LOW SCORES		
	FIELDS	ENVIRONMENTS	DUTIES	FIELDS	ENVIRONMENTS	DUTIES
A	Children, Marketing, People, Service	Client premises, Consultancy, Religion	Advising, Counselling, Microphone, Motivation, Organising, Selling, Teaching	Adventure, Animals, Chemistry, Electronics, Natural forces, Plants, Work with hands	Data processing, Dynamic, Factory, Isolation, Laboratory, Mining, Nature	Drawing, Investigation, Risk taking, Walking, Weapons
B	Chemistry, Imaginative, Numbers	-	Calculating, investigation	Children	Kitchen	Counselling
C	Animals	Nature, Outdoors	Caring, Performing, Walking	Chemistry	Academic	Bookkeeping, Interpretation
E	Legal, Politics	Dynamic, Government	Disagreeing, Judgement, Organising, Risk taking	Chemistry, Children	-	Bookkeeping, Caring, Clerical
F	People, Travel	Consultancy, Dynamic, Outdoors	Counselling, Organising, Performing, Risk taking	Chemistry, Electronics, Numbers, Plants	Academic, Data processing, Isolation, Mining, Nature, Religion	Caring, Cleaning, Investigation, Walking, Weapons
G	Marketing, Numbers, Service	Office	Organising, Practising, Bookkeeping	Adventure, Creative	Craft workshop, Dynamic, Isolation	Interpretation, Performing, Risk taking, Weapons
H	Marketing, People	Consultancy, Dynamic, Outdoor	Counselling, Microphone, Organising, Performing	Animals, Electronics	Academic, Data processing, Home, Isolation, Laboratory, Mining, Nature	Caring, Driving, Investigation, Walking
I	Children, Language, Legal, People, Service	Home, Indoors, Religion	Caring, Counselling, Performing, Teaching, Weapons	Business, Children, Electronics, Numbers, Property, Trading, Work with hands	Corporate, Factory	Calculating, Composition, Drawing, Measurement, Organising, Tools
L	Adventure, Legal	Isolation	Disagreeing, Weapons	-	-	Composition
M	Creative, Language	Craft workshop, Dynamic	Judgement	-	Factory, Regimental	-
N	Children, Language, Legal, People	Client premises, Government, Office	-	Creative, Work with hands	Craft workshop, Dynamic	Drawing, Performing, Tools
O	-	-	Interpreting	-	-	-
Q1	Adventure, Electronics, Imaginative	-	Calculating, disagreeing	-	-	Counselling
Q2	Natural forces, Plants	Academic, Data processing, Isolation, Laboratory, Nature	Equipment, Investigation, Walking, Weapons	-	Client premises, Consultancy, Outdoors,	Counselling, Motivation, Organising
Q3	Children, Numbers, Service	-	Practising, Teaching	Trading	Dynamic	Risk taking
Q4	Animals	Isolation	Driving, Risk taking	People	-	-

Table 7.15: Relationship between 16PF factors and FED categories

The relationship between FED categories and Krug's patterns are given in table 7.16.

KRUG PATTERN	SHORT INTERPRETATION	RELATED FIELDS, ENVIRONMENTS AND DUTIES
1211	Dependent, predictable, controlled personality. Needs well-defined jobs with externally defined, realistic, specified performance goals.	Chemistry
1221	Submissive, reserved, suppresses anger. Not a leader. Needs well defined jobs not requiring sudden adjustments or interpersonal relationships. Prefers to be left to do work in an orderly, prescribed manner.	Physics
1222	Not sociable. Schizoid features present. Reliable, requires little supervision.	Animals, Numbers, Plants, Laboratory, Mining, Nature, Investigating, Walking
1322	Does not need interaction with others. Neuroticism and psychotocism sometimes present.	Academic, Data processing, Isolation
2211	Submissive, subordinate and accommodating. Conventional, reliable but needs supervision. Not creative.	Caring
2212	Emotionally vulnerable, subjective. Needs person contact.	Children, Language, Home, Indoors, Religion, Teaching
2221	Deferential, submissive. Does not need self expression.	Bookkeeping, Cleaning, Clerical
2223	Self sufficient, creative. Needs some involvement with people.	Adventure, Creative, Politics, Dynamic, Judgment, Performing, Weapons
2232	Insensitive. Not sociable.	Work with hands, Factory, Measurement, Tools
2322	Unreliable.	Equipment
3212	Outgoing, sociable, altruistic, reflective. Needs to nurture others.	Counselling
3222	Flamboyant, action oriented, impulsive. fits into a variety of settings.	Marketing, People, Consultancy, Advising, Selling
3223	Good social presence, exhibitionistic. Folds under opposition. Needs flexibility and to avoid mechanical work.	Outdoors, Risk taking
3232	Adventurous and attention seeking. Not analytical. Entrepreneur.	Organising

**Table 7.16 Relationship between FED categories and Krug (1981) patterns**

Correlations summarised in tables 7.12 to 7.16 are as expected and shed further light on school leavers' perceptions of what kind of people intend to go into each field, environment and duty.

A comparison between the personality characteristics for current workers in particular fields, environments and duties and school leavers choosing matching categories, could add input to the debate on whether people adapt their personalities to conform with existing circumstances of a job, or whether they initially choose occupations to match their personalities (Previn, 1987). The comparison of school leavers' stereotypes of occupations and the more realistic views of employed adults would indicate areas for career guidance education .

## RELIABILITY

### Research and discussion

The FED was administered to 134 school leavers and re-administered after 3 months to establish reliability as an interest test. The probability of a testee choosing one, two or three of the same fields that had been previously chosen was calculated as follows:

Probability of choosing 1 of 27 fields the same =  $(3 \div 27) \times (3 \div 26) \times (3 \div 25) = 0,15\%$

Probability of choosing 2 of 27 fields the same =  $(3 \div 27) \times (3 \div 26) \times (2 \div 25) = 0,11\%$

Probability of choosing 3 of 27 fields the same =  $(3 \div 27) \times (2 \div 26) \times (1 \div 25) = 0,03\%$

Table 7.17 shows the expected to actual choices which were the same on the retest.

NO OF CHOICES THE SAME	FIELDS		ENVIRO NMENTS		DUTIES	
	Expect	Actual	Expect	Actual	Expect	Actual
0	99,71%	5,00%	99,51%	19,90%	99,84%	30,2%
1	0,15%	39,7%	0,25%	38,0%	0,09%	33,3%
2	0,11%	41,0%	0,18%	25,0%	0,05%	27,0%
3	0,03%	14,3%	0,06%	17,1%	0,02%	9,5%

**Table 7.17: Expect-ed to actual per-centages of FED choices for test-retest reliability**

These contingency tables were used in  $\chi^2$  goodness of fit analyses (3 degrees of freedom) to determine whether the reliabilities are significant.  $\chi^2$  values for fields, environments and duties were 32505,67, 14025,70 and 18787,08 respectively. Test-retest reliabilities are significant at the 0,0001 level.

## STANDARDISATION

The result sought from the test is a forced choice of three fields, three environments and three duties. The test can be administered in many ways to achieve this. Some methods used are:

- Explain the test verbally, ask for three choices to be made and read through the lists. This is the method used in this study and is suitable for group tests.
- Explain the test, ask for three choices to be made and leave the testee to read through the list and definitions. This method is used in individual testing.
- Let the testee read the instructions and make the choices. This method is used in distance testing, where tests are completed without a tester being present.

All three methods produce the desired result. The only way a tester can influence results is by stating a personal opinion or reading a definition of a category in a particular tone of voice. For this reason the definitions are not read aloud.

There is no scoring to be done as results are obtained in one step. No scores have to be added, normalised or manipulated to identify high, relevant vocational interests. Standardisation under these circumstances is not as important as in other tests.

**OBJECTIVITY**

The FED interest test is totally transparent. Words are chosen in response to the question, "Would you like this as a job?" Testees who have decided to be psychologists at home will choose "People", "Home" and "Counselling". However, they will find it difficult to choose another two each of fields, environments and duties, and will have to seriously consider other options. The combinations of these options can be used by the tester to describe alternative career paths or devise a career strategy for the person to reach the desired vocation. Alternatively, a testee could have a stereotype of a job in mind but not know where the job is done or what duties are involved. For example, someone could choose the Medical field because they want to please their parents by becoming a doctor, and be unable to select another two fields, nor any environments or duties. In this case the test becomes objective because actual present interests have to be related to perceived job characteristics rather than a job title. A similar situation applies if the testee has no idea at all of what career to follow. High test transparency is thus not a downfall of the FED, but rather forces consideration of the testee's personal perceived occupational structure and related interests.

## **EVALUATION OF RESEARCH**

According to the research conducted, the FED appears to meet the requirements of a psychometric test. However, the adequacy of the research must be considered in the following areas:

- measurement instrument, rating method and interpretation
- statistical methods
- sample group and limitations on external validity
- controls.

### **Measurement instrument, rating and interpretation**

The FED is a combination of three inventories. It is easy to administer, taking at most ten minutes. Asking for a choice of the three most liked categories gives a direct and immediate measure of the testee's highest interests. However, it does not provide a comparison of levels of interest nor normative scores. It is also totally transparent. No attempt is made to control faking.

The advantage of the rating method is that highest interests are identified whether all interests are high, low or indifferent. One instrument with unrestricted choice is used for all testees. It is based on occupational structure and not individual differences. The test meets the modern essential requirement of being politically correct as regards gender and race group.

The combination of choices gives counsellors a good idea of the testee's preferred vocational direction and the processes involved in making a career choice. However, the test should be interpreted together with other information. Ideally it should be complemented by another test measuring actual, rather than expressed, interests.

A personality test should provide input on which environment best suits the testee, and abilities should be assessed to determine whether the duties chosen can be successfully performed. These related characteristics have to be explained for each field, environment and duty when the test is used as a self-assessment tool, as in Holman (1992).

Overall, the measuring instrument fulfils its purposes of forcing a choice of three fields, environments and duties and thus indicating the highest vocational interests of testees. An improvement could possibly be made by asking for a rank order of the top three choices once they are made.

### **Statistical methods**

Nominal measurement limits the type and power of analysis that is possible. Strict significance levels were set to make up for extensive use of  $\chi^2$  and  $\theta^2$  statistics for establishing size and significance of relationships. Arbitrary cut-off values had to be used in evaluating results. A standard error of estimate for reliability could not be derived. The use of  $\theta^2$  precluded an investigation of negative correlations.

Pearson product moment correlations with sten and stanine scores from other tests were performed using values of 9 to indicate that a FED category had been chosen, and 1 to indicate that it had not been chosen. This meant that intervening values of 2 to 8 were lost and correlations appeared low, with coefficients of around 0,3 significant.

Given the restrictions of the measurement instrument, the statistical techniques used were satisfactory. Although the methods are not as powerful as those for interval measurement, there was enough differentiation to draw meaningful conclusions.

**Sample group and limitations on external validity**

Four different samples were used. None were randomly selected.

Construct and concurrent validity with the 19FII and 16PF were examined with a sample of N=1280 school leavers (692 females and 588 males) with a mean age of 16 years and 8 to 9 months, attending English speaking schools in an urban area of South Africa. No other demographic data was obtained. The sample size was large enough to give a satisfactory number of people choosing each category except for the Mining and Storeroom environments. The sample compares favourably with those of N=1648 and 1377 used to develop the 19FII.

Test-retest reliability was evaluated on a sample of 134 school leavers at an English private church school. The group was of mixed race but drawn from privileged (wealthy) homes. The average total GSAT IQ score for the group was 106,3. The sample size is in the order of those used for test-retest reliability of the 16PF where N = 146, N = 95 and N = 150 for various studies (Cattell, Eber and Tatsuoka, 1970, p 30), and for the SDS where N = 117 boys and 128 girls (Gevers, du Toit and Harilall, 1992, p 35).

The same sample was used to examine construct and concurrent validity with the VIQ and SDS, and for this purpose the sample was inadequate. A few of the field, environment duty categories were not chosen by any testees, and some by only one or two, as shown in table 7.18 overleaf.

	Not chosen	Chosen by 1	Chosen by 2
Fields	-	Movement	Language, Nat forces, Plants, Service
Environments	Mining, Regimental, Storeroom	Isolation	Kitchen
Duties	Cleaning, Weapons	Clerical, Equipment, Measurement, Microphone, Protection, Walking	Composition, Driving, Tools

**Table 7.18: Categories insufficiently chosen for concurrent validity studies of the FED with the VIQ and SDS (N=134)**

The effect is that some VIQ and SDS scores are correlated to FED scores which are all or mainly equal to 1. This tends to reduce correlation coefficients as more testees have high interests on the VIQ and SDS. As a result, the magnitude of the coefficients is not a true reflection of the relative relationships between FED categories and interest test fields. Significance levels are questionable for small samples.

Predictive validity for working adults was based on a sample size of 40. This sample size cannot be considered large enough.

A four to five year predictive validity study was done for previously tested school leavers. Of 650 people, only 31% (N=201) could be contacted telephonically. More than half of the group had emigrated. Within the group 86 were working and 125 studying. The samples are relatively small, but significances of statistical results are impressive.

## Controls

The basic principle of research is to "maximise experimental variance, minimise error variance and control extraneous variance" (Kerlinger, 1973, p 308).

Experimental variance is the variation in measures due to a known influence that "causes" scores to lean more in one direction than in another. It is identified by comparing two or more groups, one of which has had a specific treatment applied.

Error variance is a fluctuation of measures due to chance, random factors.

Extraneous variance is the variation in measures due to the influence of variables that have nothing to do with the study.

In this study experimental variance was maximised by using a nominal rating scale to determine only high interests. This was, however, counteracted by loss of statistical power, especially in correlational analysis. The small sample used for comparison of the FED with the VIQ and SDS worsened the problem. Whereas the sample of 1280 school leavers was large enough to make up for not randomising selection of subjects, the smaller school leaver and adult samples enabled extraneous variables to operate. Insufficient details of the demographic composition of all the samples were obtained, with the result that possible extraneous variables were not identified. Error variance was minimised in the use of nominal measures and the simplicity of applying the instrument.

The major control problems arose from using nominal measurement and small samples. Further research is needed to confirm whether results were significantly affected.

## SUMMARY

Research was carried out to determine whether the measurement instrument derived from the FED occupational classification system is psychometrically valid and reliable. The test rationale was based on the definition of vocational interest as a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and situations already experienced or expected to produce pleasurable feelings. The aim of the FED test is to measure vocational interest within the framework of the perceived occupational structure. This structure consists of three levels, namely fields of work, environments in which work takes place, and duties that make up work. An individual will have certain preferences on each of these levels. It is assumed that the job or occupation followed will be made up of a combination of a field, an environment and a duty chosen.

Construct validity was established by obtaining correlations between FED categories and similarly named fields from the 19FII, VIQ and SDS. Significant correlations were found for all except the Clerical and Investigating duties. There was a negative correlation between the FED field of Service and that of the 19FII. It appears that FED categories are measuring essentially the same constructs as various interest test fields. This study raises the possibility that it may not be necessary to measure interests with inventories of items. Interest tests may be so transparent that the same results could be obtained by asking for a ranking or choice of defined fields.

Two aspects of the predictive validity of the FED were examined. It was found that 80% of school leavers follow studies based on a field chosen for a future job. Four to five years after doing the test 59 % of working people are in a field they had chosen, 44% in an environment and 41% in a duty. These percentages are all significant.

The accuracy of the test for predicting work outcomes of satisfaction, performance and tenure/intended occupation was investigated. It was shown that the FED predicts future and current satisfaction with work as well as future and concurrent job tenure. It also predicts satisfaction with future studies. To a lesser extent it predicts what students will do immediately after finishing their studies. The FED does not predict future work or study performance for school leavers. However, it does predict self assessed work performance. The more a person's job reflects their current choice of FED categories, the more likely they are to rate their performance high.

Concurrent validity of the FED categories with the 19FII, VIQ and SDS was determined. The results were largely as expected. The 19FII field of Practical - female was unexpectedly significantly correlated to FED categories of Adventure, Trading, Factory and Nature. A comparison of scores with the original 1972 norms indicated that this could have been due to an increase in male interest in traditionally female activities brought about by the women's liberation movement of the 1970's.

Roe's (1956) categories, as measured by the VIQ, appear to be incorporated in the FED. FED categories and Holland types correspond in broad outline. However, there are many fields, environments and duties which have no significant correlation with any of the Holland types.

This may be due to nominal measurement and the small sample used for comparing the FED with the SDS, but it may also be a function of the different bases of the tests. Holland's system describes differences between the people are are doing work, whereas the FED system describes differences in work itself.

Concurrent validity was also researched between the FED and 16PF first and second order factors. These should be interpreted as personality traits shown by school leavers who choose specific fields, environments and duties, and not as a reflection of the personalities of people in jobs. Relationships were as expected and shed further light on school-leavers' perceptions of what kind of people go into each field, environment and duty.

Test-retest reliability was established as significant at the 0,0001 level using the  $\chi^2$  goodness of fit test. Objectivity was discussed as regards the transparency of the test and the positive effects of forcing testees to choose categories. It was suggested that standardisation of the test is not a major issue and it can be used in different ways for group, individual and distance testing.

The major problems in the research arose from using nominal measurement and small samples for some of the studies. The underlying model and the test have been validated using a sample of multi-racial English speaking urban South African school leavers and the test should be restricted to similar groups until further research has been completed. Despite these shortcomings the FED test has been shown as psychometrically sound. It should, however, be applied in conjunction with other tests for a composite picture of a person seeking career guidance.

## CHAPTER 8 - DISCUSSION AND SUMMARY

### SCOPE OF THE CHAPTER

*Summary of the study. The impact of the network classification model, the FED occupational classification system and the FED interest test. Areas for further research.*

### SUMMARY OF THIS STUDY

#### Introduction

The basis for career guidance was set out by Parsons (1909) as:

- obtaining information about an individual
- obtaining information about jobs, and
- matching the individual to the job.

In their extensive use of interest tests for career guidance, psychologists assume that interest fields are related to jobs or occupations. Patterns of scores on interest test fields are presumed to reflect the relationship between jobs. However, interest test fields have not been researched as occupational classification systems. They are derived from descriptions of groups of people rather than from jobs. They are inflexible and insensitive to changes in technology and perceptions of the job structure. On the other hand, occupational classification research and systems, which have never entirely met the needs of career counsellors, are becoming more mathematical and theoretical, with reducing practical application to career guidance. Career counsellors need a psychology of work to overcome the impossible task of keeping up to date with the detail of tens of thousands of occupations. This study develops and validates an interest test based on the perceived occupational classification system.

### **Interest tests**

Vocational interest is a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and related situations already experienced or expected to produce pleasurable feelings.

The best selling interest tests in South Africa are the 19 Field Interest Inventory (19FII), the High School Interest Questionnaire (HSIQ), Vocational Interest Questionnaire (VIQ), the South African Vocational Interest Inventory (SAVII) and the Self Directed Search (SDS). Both the SDS and SAVII are based on Holland' (1959) theory of careers.

A serious problem with South African interest tests is the lack of follow up research. Since 1970 there have been at least six instruments with totally different formats. Together with extensive use of outdated tests for unauthorised norm groups, this may indicate that none of the available tests meets the needs of the South African market and conditions.

### **Occupational classification systems**

A classification system results whenever units, items, ideas, things or people are put into categories, which derive from the similarity of units with each other and, if the system is dynamic, change with circumstances.

Formal classification systems prevent duplication of information and permit easier communication, recording, retrieval and comparison of data over geographical distances and time. Scientific classification systems must include all previous knowledge about the units being classified. Gaps in knowledge, existing and possible relationships among units must be predicted by the system.

It must have cohesion and be logical, comprehensive and exhaustive so that every unit can be allocated somewhere. Different people should be able to rationally classify units into the same categories.

The following models are used:

Teleological models are used by social scientists to classify units in terms of their "essence" or intrinsic nature.

Linnaean models are hierarchical and are used in the biological sciences.

Darwinian models are continuous and dynamic. The theory of evolution is described in a Darwinian system.

Matrix models show related characteristics of units both horizontally and vertically. The periodic table of the elements is an example.

Numbered category models arrange lists of units so that they are related by number, for example Roget's thesaurus.

Co-sociative models are based on related, rather than inherent characteristics of units. McCormick's Positional Analysis Questionnaire (1979) classifies tasks by behaviours required.

Statistically derived models are artificially built from careful analysis and reduction of items, using techniques such as multiple regression, factor and cluster analysis. Trait personality theories are examples.

Network access models are based on many-to-many correspondence in set theory. They have not yet been scientifically applied although they are used in computer systems. Categories are arranged in levels. Choice of a category on one level precludes access of another category on the same level, but does not restrict access to categories on other levels.

Occupational classifications are used by commerce, governments, sociologists and career psychologists.

- a) In commercial applications, personnel and work study practitioners develop company-specific systems. The *Minnesota theory of work adjustment* and the *Position analysis questionnaire* are used for placing individuals in jobs.
- b) Variations of the *International Standard Classification of Occupations* are used by governments for census purposes. The USA government funded the complex, comprehensive and often revised *Dictionary of Occupational Titles*.
- c) Sociologists use status and situs classifications to study how work affects groups of people. Status categories place individuals and occupations above or below each other in a hierarchical classification. Situs categories divide occupations into categories, each of which includes status from the highest to the lowest levels. Roe (1956) combined the two systems in her matrix classification. Table 3.4 lists sociological situs fields.
- d) Career psychologists use statistically derived interest tests. Fields for various interest tests are listed in table 3.5. The fields are based on individual characteristics rather than occupational attributes and have not changed much since 1935. Holland (1959) identified six basic interest types. Since his theory was operationalised in 1970, there has been very little other research into the structure of occupations. The American College Testing Programme (adapted for South African use in the Easy Steps Guide and SAVII) is an instinctive compromise between thousands of occupations listed numerically in the DOT, and the six Holland types.

There is presently no adequate method for career counsellors to understand and explain relationships between occupations. Holland's (1959) theory is the best available, but like other interest measurements it is static and assumes that structures of interests and of occupations are the same.

Gati (1979) criticised Roe's (1956) circular model and Holland's (1966) hexagonal model, on the grounds that they are not exhaustive, are not always supported by research and that their two dimensionality does not reflect the multi-dimensionality of job characteristics. He proposed a structural hierarchical structure of occupations. Work on his theory has been slow with only 24 jobs classified.

### **The FED classification system**

People see jobs as being related to one another on three levels:

- Field of work determined by specialised training needed
- Work environment associated with various restrictions and social opportunities
- Duties involved in a job.

These three levels are used for the occupational classification system. A job classified by the system is assigned to three categories: one field, one environment and one duty. The network access model describes inter-relationships between the three levels. Access to a category on one level precludes access to other categories on the same level, but does not affect access to any categories on another level

The FED occupational classification system has been developed according to the stages set out by Fleishman and Quaintance (1984). Care was taken to build into the system a scientific basis, cohesion, comprehensiveness and rationality.

Altogether 27 fields were selected according to common language usage. The fields are similar to interest test fields and situs system categories. 23 Environments were identified according to the contact workers have with other people. A list of 32 duties was drawn up in a breakdown of relation to mainly paper-work, talking, thinking, action or feeling. The complete model is described on page 217.

An examination of the categories shows that with a few exceptions (for example, factories did not exist before the Industrial Revolution) they have always been part of the occupational structure. This suggests that the structure does not alter very often, but changes may occur with technological advances and new lifestyles.

Units for classification are occupations and not job titles. Occupational titles were taken from the *A-Z of Careers in South Africa* (Nelson, 1989), from job advertisements in national, local and classified newspapers, from training course titles, and from interviews with people in jobs. This resulted in an inventory of 1200 jobs classified by fields, environments and duties.

It is dynamic, takes into account public perceptions about work being on at least three levels, identifies where there are gaps in knowledge about occupational structure, and provides a model for a theory of career choice.

### **The measuring instrument**

A forced choice rating using a nominal measurement was chosen to operationalise the system. Testees are instructed to "choose from this list the three that you are most interested in for a job".

This scale has the following advantages:

- It is simple to administer, taking only 10 minutes, and easy for school pupils to understand.
- It highlights high interests.
- It fits in with the network access model. Choices from any of the three levels of the model without must not restrict choices on the other levels.
- It throws into relief the relationships between fields, environments and duties, in other words it identifies overlaps, synonyms and lack of relationships.

### Statistical methods

Nominal measurement restricts the range and power of statistical techniques which can be used in the analysis of results. Extensive use was made of  $\chi^2$  and  $\theta^2$  tests. A value of 9 was allocated to each category chosen and a value of 1 to each not chosen for Pearson correlational analyses with other interest and personality tests.

### Research design

The following aspects were researched to validate the FED as an occupational classification system:

- The scientific basis of the model, in particular whether it reflects a difference between occupations perceived as "male" and those perceived as "female", and whether fields represent different educational directions.
- Cohesion, namely the structure and logic of the system.
- Rationality, as shown in the ability of different people to assign occupations to the correct categories.

The following aspects were researched to validate the FED as an interest test:

- Construct validity - the relationship between FED categories and similarly named fields in the 19FII, VIQ and SDS.
- Factorial validity - identifying overlapping and synonymous categories.
- Predictive validity - the ability of FED to predict study and career choices, job satisfaction and performance.
- Concurrent validity - The relationship between the FED and the 19FII, VIQ, SDS and 16PF.
- Test-retest reliability.

Data from four sources was analysed.

- The FED was simultaneously administered with the 19FII and 16PF to 1280 school leavers to test the scientific basis and cohesion of the classification system, and the factorial and concurrent validity of the interest test.
- The FED was simultaneously applied with the SDS and VIQ to 134 school leavers. This tested the construct and concurrent validity of the interest test. The FED test was reapplied to the same sample 3 months later to test the reliability of the instrument.
- A telephone survey of 201 school leavers tested on the FED in 1989 and 1990 was carried out to find out what work and study career choices were made, to determine the predictive validity of the interest test.
- Interviews were conducted with 40 employed adults to determine the rationality of the occupational classification system and the predictive validity of the FED.

### The scientific basis of the FED occupational classification system.

The FED was administered to 1280 school leavers in the Gauteng province of South Africa. Means of categories chosen by males and females were compared using the t-test. Owen and Taljaard (1988) had suggested that male interests favour physical activities, equipment, and problem solving. Gati's (1991) structure of occupations identified a first level of "hard" occupations not related to people.

In this study it was found that males tend to choose fields, environments and duties related to adventurous, rough activities, long term strategic problem solving and active business. They do not avoid "dirty" equipment. Females tend to choose aesthetic and humanitarian categories, and those involving direct contact with people. Some fields, environments and duties were chosen equally by males and females. This raises the possibility that occupations should be represented in three main categories, namely "hard", "neutral" and "soft".

In terms of the network access model it is hypothesised that "hard" occupations are not perceived as being linked with "soft" environments or duties, but may combine with a "soft" duty by access through a "neutral" environment.

It was hypothesised that fields do not exist if training is not available at university, diploma and informal levels. A qualitative examination of education and training opportunities in South Africa was carried out to determine whether the fields of the FED correspond with areas of knowledge required.

Lists of university, technikon and informal training in *A guide to further education in South Africa* (Holman, 1996) were consulted. It was found that, with a few exceptions, all the fields are differentiated by education and training available, although some do not have specific degree courses.

The system is shown to have a sound scientific basis. It depicts the inter-relationship of occupations, is supported by research, is based on previously identified characteristics of occupations and is capable of generating hypotheses about the relationship between categories and units. The use of the three dimensions (*field, environment and duty*) is in line with past suggestions made by other researchers. The use of the network access model appears to be justified, particularly as it supports previous thinking that occupations are divided into "hard" and "soft" categories, together with a third category of "neutral" occupations.

**The cohesion of the FED occupational classification system.**

With a few exceptions, the structure of the system was proved to be

- mutual exclusivity of fields from one another, of environments from one another and of duties from one another
- High relationships of each field to many environments and duties, and of each environment to many duties.

**The comprehensiveness of the FED occupational classification system.**

With the exception of the lists of job titles available for census purposes and Holland's types, the classification of 1200 occupations is more comprehensive than previous occupational classification systems.

**The rationality of the FED occupational classification system.**

Studies were conducted into the rationality of the system. Ambiguity of category names was tested by examining high relationships among fields, environments and duties. Unexpected relationships were logically explained in terms of the actual work situation for most cases.

Also as a test of rationality, a group of 40 adults was asked to assign categories to a list of jobs. Correct allocation, based on a predetermined inventory of jobs, were made for 81,9% of fields, 85,1% of environments and 78,9% duties. This high inter-rater reliability tends to prove that the system is rational.

### **The usefulness of the FED occupational classification system.**

Practical use is being made of the system in South Africa for career guidance. Possible applications in other areas were identified.

### **Construct validity of the FED interest test**

Construct validity was established by obtaining correlations between FED categories and similarly named fields from the 19FII, VIQ and SDS. It appears that FED categories are measuring essentially the same constructs as various interest test fields. This study raises the possibility that it may not be necessary to measure interests with inventories of items. Interest tests may be so transparent that the same results could be obtained by asking for a ranking or choice of defined interest test fields.

### **Predictive validity of the FED interest test**

Two aspects of the predictive validity of the FED were examined. It was found that 80% of school leavers follow studies based on a field chosen for a future job. Four to five years after doing the test 59 % of working people are in a field they chose, 44% in an environment and 41% in a duty. The percentages are all statistically significant.

The FED predicts future and concurrent job satisfaction and job tenure. It also predicts satisfaction with future studies. To a lesser extent it predicts what students will do immediately after finishing their studies The FED does not predict future work or study performance for school leavers. People in a job matching their current choices of FED rate their performance as high.

### **Concurrent validity of the FED interest test**

Concurrent validity of the FED categories with the 19FII, VIQ and SDS was determined. The results were largely as expected. The 19FII field of Practical - female was unexpectedly significantly correlated to FED categories of Adventure, Trading, Factory and Nature, and it was hypothesised that this could have come about by an increase in male interest in traditionally female activities brought about by the women's liberation movement of the 1970's.

Roe's (1956) categories, as measured by the VIQ, appear to be incorporated in the FED. FED categories and Holland types correspond in broad outline. However, there are many fields, environments and duties which have no significant correlation with any of the Holland types. This may be due to nominal measurement and the small sample used for the study, but it may also be a function of the different bases of the tests. Holland's system describes differences between the people who are doing work, whereas the FED system describes differences in work itself.

Concurrent validity was also researched between the FED and 16PF first and second order factors. These should be interpreted as personality traits shown by school leavers who choose specific fields, environments and duties, and not as a reflection of the personalities of people in jobs.

Relationships were mainly as expected and shed further light on school-leavers' perceptions of what kind of people go into each field, environment and duty.

### **Reliability of the FED interest test**

Test-retest reliability was established as significant at the 0,001 level using the  $\chi^2$  goodness of fit test. Objectivity was discussed as regards the transparency of the test and the positive effects of forcing testees to choose categories.

It was concluded that standardisation of the test is not a major issue and it can be used in different ways for group, individual and distance testing.

### **Evaluation of the research**

Only two minor research weaknesses were identified. The first resulted from the use of nominal measurement. This restricted statistical methods available and reduced the power of relationships. However, extremely high significance levels outweighed the disadvantages in most cases. The second problem was that the sample used in construct and concurrent validity studies of the FED with the SDS and VIQ was too small. The small sample may have obscured some additional relationships in a small part of the study, but does not cancel the findings that were made.

Despite these shortcomings the FED test has been shown as psychometrically sound. Applied in conjunction with other psychometric tests, a composite picture is obtained of a person seeking career guidance. The underlying model and the test have been validated using a sample of multi-racial English speaking urban South African school leavers and the test should be restricted to similar groups until further research has been completed.

### **THE IMPACT OF THE STUDY**

The study has introduced three new concepts:

- the network access model
- the FED occupational classification system
- the FED interest test

The impact of each concept will now be examined.

## The network access model

The network access model is illustrated in figure 8.1 below.

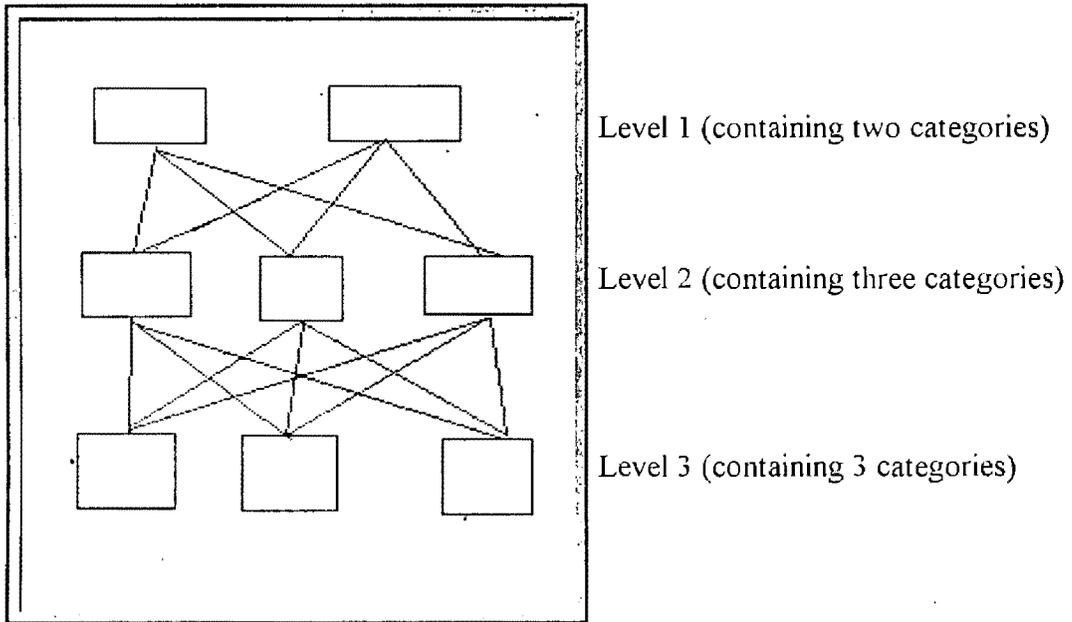


Figure 8.1: Example of a network access model

The model has the following characteristics:

- a model is built on a number of logical levels
- relationships between levels can be stated in both directions
- categories are logically placed on levels according to stated rules
- known characteristics of units are built into the categories
- units are classified into one category on each level
- choice of a category on one level precludes access to other categories on the same level, but does not affect access to any categories on any other level
- a unit is described by its allocation to categories and levels
- gaps are identified where no units fit into a combination of categories
- entry to the model can be at any level.

Based on many-to-many correspondence in set theory mathematics, commercial applications of the model include automatic bank tellers. Informal examples occur in modern-day decisions like purchase of a house (some levels being area, size and important amenity) or the choice of tertiary education (some levels being type of institution, city and specialisation). The network access model is one of decision making or choice. As such, it models thought (logical) processes and subsequent action. Choices are made within a perceived structure which determines the levels and categories of the model. It is relevant for disciplines involving and studying logic, development and freedom of choice. These include psychology, sociology, philosophy, economics and computer science. It may not be suited to natural sciences, where fixed physical laws dictate consequences, nor to the arts where logic is subordinate to creativity.

In particular the model, with its underlying basis in set theory, may provide new perspectives in the mathematics of psychology. Extensive use presently made of inferential statistics, correlations and factor/cluster analysis is criticised by "pure" scientists, who consider mathematical series (where events logically follow one another) as the basis of science. They feel that psychology is instinctive, based in estimation with predictions expressed as "if this, then maybe .... that", and that psychologists ground their diagnoses and decisions on "what feels right". The introduction of the network access system suggests that psychology could in some respects be the "study of logical decision making from facts grounded in experience".

The model has implications for theoretical psychology. It hypothesises about cognitive process. It explains behaviour and provides a personality developmental theory based on personal choices or adjustments, made on levels including interpersonal relationships, behaviour styles and emotional responses. From a counselling point of view, dysfunctional adjustments or choices at one level could be identified and corrected, leaving an individual free to make other choices at other levels.

Sciences all develop through the stages of observation, organisation of data into propositions, bringing together propositions into hypotheses, developing explanatory models, forming a unifying classification system, and recognising an underlying mathematical structure. Psychology, with less than a century behind it, is a relatively new science. It has achieved an unprecedented rate of progress in a short time. Criticisms from other sciences arise from their lack of appreciation of the fact that statistical methods currently used could be a stepping stone in the development of psychology as a full science. Only a short step is needed to identify the classification model and mathematical basis that will place psychology on the same advanced basis as other pure sciences. The network access model, together with explanatory set theory mathematics, may be a further stepping stone in this direction.

In terms of the network access model, occupations are classified on three levels, namely fields, environments and duties. Jobs or occupations are made up of a combination of a field, an environment and a duty. There is evidence that these are the only three dimensions. A new dimension will emerge only if many categories have high relationships with all three dimensions. Fields are mutually exclusive from each other and similarly for environments and duties. There are high relationships between each field and many environments and duties, each environment and many fields and duties, and each duty and many fields and environments.

A distinction is made between categories that are perceived to be "hard" (preferred by males and involving work without people), "soft" (preferred by females and involving work with people), and "neutral". Males tend to choose adventurous, rough activities, long term strategic problem solving, active business and do not avoid "dirty" equipment. Females tend to choose activities involving contact with people and occupations related to aesthetic and humanitarian activities. (This does not preclude either gender from choosing any categories.) It is hypothesised that choices made by the two genders reflects an aspect of the perceived occupational structure, in other words that more males tend to choose categories perceived as male/hard. It is also hypothesised that access between hard fields and soft environments and duties is restricted, but hard fields may combine with soft duties through a neutral environment. Using computer science concepts, permission for access to a category must be given by the existing authorised user or system manager (job incumbents). This may explain why some jobs are considered as male preserves, despite the best efforts of the women's movement.

Some categories, indicated by dashed lines, appear to be synonymous except that labels names are preferred by either males, females, or are neutral. They may indicate occupations in transformation, or that describe currently "popular" jobs. This shows that the system is dynamic. Categories can move between levels, be combined as subsets or change nature with technology as the real structure of work changes. An examination of the categories, however, suggests that occupational structure is mainly constant. There may, however, be different classifications of the categories into fields, environments and duties in countries and communities with different socio-economic priorities. It is hypothesised that changed perceptions precede actual changes. It is also hypothesised that new occupational directions arise first in environments, then develop matching fields when dedicated education is available at degree, diploma and informal training course levels. This reflects the situs nature of the system by representing all educational levels in each field.

The system has a strong scientific basis. It fits the description of a network access model and is an example of many-to-many correspondence in set theory mathematics. It was conceptualised and developed according to scientific criteria. It succeeds in depicting the inter-relationships of occupations, was based on existing knowledge about occupations, and generates hypotheses about the relationships between categories and units. Compared with other occupational classification models (including interest tests), its main advantage is that it is dynamic. It is also flexible with easy classification of occupations which does not involve extensive ongoing research as for the DOT. This results in rationality and comprehensiveness.

More than 1200 jobs are classified within the system, which is a larger number than for any other system except Holland's types (which have been researched for 30 years) and the DOT and ISCO catalogues of job titles. Unlike commerce related systems, it is global and not dependent on one individual nor a particular job. It is closest in nature to sociological situs systems and Gati's structure, but has more practical applications than either.

A major implication of the FED model is the explanation of different processes that can be followed in making a career choice. These are that an individual may:

- decide on an educational specialisation (a degree course), then choose where to work, and according to ability, eventually specialising in a particular duty (field - environment - duty process),
- learn about a field, specialise in a duty (such as organising) and then choose an environment for practising the duty (field - duty - environment process),
- choose to work in a particular environment (say, a laboratory), qualify as required and then do the work involved (environment - field - duty process),
- choose an environment (like working from home), find a duty that can be done in the environment (for example clerical work) and accept any field that offers suitable work (environment - duty - field process),
- identify a skill and the best suited duty (for example book keeping), find a work environment to apply the skill and, through work experience within an industry, be tied to particular field (duty - environment - field process),
- choose a field because a particular skill (working with people) combines with an interest of the individual (medicine), and find the most suitable environment by trial and error (duty - field - environment).

Work is needed to popularise the FED system so that it becomes a standard classification for jobs with the categories included (together with Holland's six types) in career related reference books.

### The FED interest test

The interest test has been designed to measure vocational interest in terms of the following definition:

*VOCATIONAL INTEREST is a dynamic, subjective, positive attraction towards a job, occupation or occupational field, based on the individual's perception of the structure of occupations and situations already experienced or expected to produce pleasurable feelings.*

The main difference between previous and the new tests is that the FED measures interests in categories related to occupations rather than assuming that individual interests define the occupational structure. The starting point for developing the test was the description of occupational structure.

Testees are presented with categories instead of an inventory of items. People understand the constructs without items and they may not be needed. However, the test is totally transparent and no attempt is made to control faking. Testers will obviously feel more comfortable and confident if the test is used with a measuring instrument which examine hidden psychological characteristics. There is no test with similar dimensions and a new battery will have to be developed.

It is suggested that it will be equally effective to ask testees to indicate their three choices of fields, environments and duties directly onto the model (with the headings "soft", "hard" and "neutral" excluded), the only restriction being that they cannot choose two categories joined by a dashed line. (In this application testers can read the definitions.)

Research has shown the adequacy of the measurement instrument. It takes less than ten minutes to administer and is easy to use. Interpretation is immediate, particularly as no standardisation procedures are involved. This will simplify interpretation even further, giving career counsellors immediate information on envisaged career directions. Discussion about anomalies and suggestions of jobs from an inventory of occupations will be facilitated. The model should be particularly relevant for disadvantaged sections of the South African population who have not had access to career guidance or have have been restricted by biased or inappropriate interest test measurements.

Changes to the FED categories and definitions are given as appendix 6.

### **FUTURE RESEARCH**

Taking into account synonymous categories, fields have reduced from 27 to 19, environments from 23 to 13, and duties from 32 to 17. This is 49 as against the original 81 categories. The number of possible cell permutations has dropped from  $27 \times 23 \times 32 = 19\ 872$  to  $19 \times 13 \times 17 = 4199$ .

The existing inventory of 1200 occupations has been reclassified in terms of the revised model. New jobs will have to be added as they are identified.

Confirmation is needed that the research findings of this study apply to the revised model. With the reduced number of categories and resultant strengthening of inter-relationships, smaller samples can be used. With the co-operation of guidance teachers in Gauteng,  $\pm 600$  test results can be obtained annually to monitor changes in perception of the occupational structure. Better demographic data is needed to draw conclusions about occupational perceptions of students at different ages, educational standards, in different language groups and on different socio-economic levels.

If concurrent validity studies with other interest tests are to be repeated, they must be based on larger samples than were used in this study for the VIQ and SDS. It is vital that the fields, environments and duties be linked to the popular Holland types, perhaps providing subtypes and clarifying anomalies within the Holland hexagon, without entering into debate about the respective merits of the two systems.

Research should also spread beyond Gauteng into other urban and rural areas in South Africa.

The system should also be researched with a stratified sample of working adults drawn from all categories to identify their perception of the occupational structure. This may reveal the actual structure of occupations, because their perceptions will reflect their experience with work.

A battery of tests to complement the FED should be developed, to consist of:

- an interest test for the fields, based on educational/training content. Items can be drawn from syllabi for relevant degrees, diplomas and training courses, and presented with the question, "would you like to know more about....?". An educational level scale can be built in to identify whether theoretical or practical training would be of more interest to a testee.
- a personality test to identify factors which affect adaptation to various environments. Orientations towards work with people, decision making, need for freedom or rules, and work with ideas or things/data have been identified as being important (Holman, 1992).
- a test of abilities related to the duties could initially be presented as a self assessment of work related activities, with the question, "how well would you be able to ....."

This battery, based around the FED system, will achieve Parson's (1909) conceptualisation of an ideal career guidance system which provides:

- information about jobs
- information about the individual, and
- a matching of the two.

An ongoing plan is in hand to continue research and provide career guidance which meets the unique requirements of the South African situation, with the FED occupational classification system and interest test.

### **CONCLUDING REMARK**

This study set out to devise, operationalise and validate an occupational classification system as an interest test for career guidance. It has succeeded in achieving this with the introduction of the network access classification model, the FED occupational classification system and the FED interest test.

θ<sup>2</sup> relationships between FED fields

FIELD	Adven	An.m	Beaut	Busin	Chem	Child	Great	Elect	Food	Imag	Lang	Legal	Mark	Medic	Movem	NatF	Numb	Peop	Phys	Plant	Polit	Prop	Serv	Syst	Trad	Trav	WHand
Adventure	-	392	027	218	141	137	244	285	065	367	111	238	085	163	229	295	067	225	223	147*	142	122	156	166	127	404	369
Animals	392	-	123	224	196	315	141	068	131	186	221	151	107	308	115	426	068	228	105	703	042	100	160	085	050	371	218
Beauty	027	123	-	293	043	372	142	0	303	125	153	096	205	227	138	0	081	262	049	099	120	085	106	099	079	434	083
Business	218	224	293	-	137	242	144	389	226	252	251	489	765	262	227	167	632	323	286	161	400	469	252	445	770	466	241
Chemistry	141	196	043	137	-	101	130	245	0	110	053	062	071	508	073	243	169	098	529	219	0	0	077	198	0	079	105
Children	137	315	372	242	101	-	207	073	243	075	273	201	166	441	279	090	125	566	093	143	193	071	465	080	075	393	036
Creative	244	141	142	144	130	207	-	139	134	549	298	132	163	180	216	073	105	332	150	181	169	102	056	044	051	310	183
Electronics	295	068	0	389	245	073	139	-	050	200	0	095	152	101	098	107	195	035	441	065	072	244	042	521	135	164	368
Food	065	131	333	225	0	243	134	050	-	045	030	073	128	188	084	071	085	311	0	163	0	144	088	0	056	378	170
Imaginative	367	175	125	252	110	075	549	200	045	-	223	104	231	136	212	072	069	242	148	090	126	292	144	252	100	193	317
Language	111	221	153	251	053	273	298	0	030	223	-	207	110	144	099	065	101	217	089	0	173	0	105	089	099	274	044
Legal	238	151	096	489	062	201	132	095	073	104	207	-	213	242	057	130	096	270	071	0	445	109	160	071	075	213	053
Marketing	065	107	205	765	071	166	163	152	128	231	110	213	-	177	127	093	161	227	041	088	256	284	070	124	550	256	083
Medical	163	308	227	262	508	441	180	101	188	136	144	242	177	-	259	069	128	387	200	145	217	121	251	123	124	204	124
Movement	220	115	138	227	073	279	216	098	084	212	099	057	127	259	-	060	046	269*	108	072	0	062	048	055	045	314	153
Natural Forces	295	426	0	167	243	090	073	107	071	072	065	130	093	069	060	-	090	088*	136	400	0	076	063	069	030	295	158
Numbers	067	066	081	632	159	125	105	195	085	069	101	096	161	128	046	090	-	119	189	073	055	094	097	191	179	215	156
People	225	228	262	323	098	556	332	035	311	242	217	270	227	387	269	088*	119	-	038	056	041	046	397	097	101	467	167
Physics	223	105	049	286	529	099	150	441	0	148	089	171	041	200	108	136	189	038	-	120	063	071	066	158	054	038	142
Plants	147*	703	099	161	219	143	181	065	163	090	0	0	188	145	172	400	073	056	120	-	080	088	0	081	036	165	558
Politics	142	042	120	400	0	193	169	072	0	126	173	445	256	217	0	0	055	132	063	080	-	071	028	0	081	254	071
Property	122	100	085	469	0	071	102	244	144	292	0	109	284	121	062	076	094	046	071	088	071	-	0	176	123	202	191
Service	156	160	106	252	077	455	056	042	088	144	105	160	070	251	048	063	097	397	086	0	028	0	-	058	096	171	124
Systems	166	085	099	445	198	080	044	521	052	252	089	071	124	123	055	069	191	097	158	081	076	176	058	-	187	095	144
Trading	127	050	073	770	0	076	051	135	056	100	099	075	550	124	045	030	179	101	054	036	081	123	096	187	-	167	115
Travel	404	371	434	466	079	393	310	164	378	193	274	213	256	204	314	295	215	467	039	165	254	202	171	095	167	-	182
Work w hands	369	219	083	241	105	036	189	388	170	317	044	063	089	124	153	158	156	167	147	095	071	131	124	144	115	182	-

0 indicates that a value could not be calculated.  
 Decimal points omitted.

02 relationships between FED fields and environments

FIELD/ ENV	Acad	ECoun	CPrem	Cons	Corp	Craft	DataP	Dynam	Fact	Gover	Home	Indor	Isol	Knsh	Labor	Mim	Natur	Offic	Outd	Prof	Regim	Relg	Stor
Adventure	154	176	246	331	190	267	216	286	367	189	232	090	386	153	304	721	603	194	658	320	411	122	0
Animals	127	138	054	343	093	285	086	146	086	040	333	122	352	219	324	426	877	143	615	323	237	148	0
Beauty	039	178	225	417*	197	461	105	230	0	092	374	287	025	293	128	0	247	367	357*	270	067	065	0
Business	351	532	589	599	718	213	621	351	235	479	414	300	168	137	196	0	300	614	449	591	235	132	503
Chemistry	249	061	042	283*	184	105	213*	223	0	0	138	021	030	050	724*	0	295*	233*	209*	471*	106	0	0
Children	257	060	212	509	273	274	117	276	056	198	483	544	143	346	234	146	410	262	500	464	272	529	0
Creative	164	024	125	418	193	666	133	570	030	179	246	320	260	137	081	0	255	251	406	290	097	175	0
Electronics	150	103	130	275	336	258	640	236	364	046	210	132	217	051	312	298	231	269	310	341	151	111	250
Food	055	198	217	387*	145*	189*	052	148*	071	032	344*	218	066	733	073	0	252*	194*	296*	154*	031	073	263
Imaginative	191	092	173	443	177	583	238	495	256	138	332	201	276	046	202	0	275	217	466	319	132	075	254
Language	278	063	087	414*	175	248*	069	282*	038	138	196	152	091	0	106	0	323*	305*	368*	332*	108	162	0
Legal	197	075	184	480*	368	120	083	235	063	538	210	060	049	025	106	0	217	433	359	564*	185	109	0
Marketing	167	268	441	568	563	213	300	240	196	151	235	227	146	109	062	0	158	641	358	374	073	024	254
Medical	223	067	185	500	159	193	135	244	029	168	376	293	167	129	555	147	323	259	409	736	222	326	0
Movement	045	058	059	265*	225	372	021	304	139	026	259	136	056	085	131	0	265*	222*	621*	360*	123	152	259
Natural Forces	030	0	027	308*	091*	047*	083	116*	043	0	326*	054	235	140	276*	461	751*	213*	594*	127*	096	039	0
Numbers	442	115	060	389*	400*	049	329	114	174	053	190	081	192	029	152	0	118	526*	232*	383*	051	094	259
People	195	265	316*	634	384	283	013	430	055	292	332	422	100	319	151	0	324	410	601	506	295	440	252
Physics	182	033	072	233*	197*	182*	054	221*	060	131	142*	049	189	033	588*	0	206*	293*	266*	290*	144	0	0
Plants	140*	042	0	188*	029	258*	034*	030*	049	0	285*	034*	082	239	309*	164	750*	083*	571*	110*	039	130	0
Politics	226	033	095	448*	322*	121	050	237*	040	690	101	049	127	033	047	0	131*	375*	263*	371*	087	138	0
Property	062	146	242*	509*	189*	305*	142	261*	242	034	144*	084	142	037	028	0	290*	267*	217*	307*	099	0	0
Service	162	176	124	418*	199	104	0	105	037	134	282*	262	030	118	041	0	321*	318*	388*	328*	297	411	0
Systems	159	0	190	307*	312*	184*	492*	243*	119	051	123*	122	097	033	229	0	115*	315*	270*	347*	146	036	0
Trading	192	438	373	367*	347*	079	251	110	138	126	229	154	083	085	0	0	100	576*	286*	256*	099	062	511
Travel	279	394	384	489	431	400	267	452	108	347	270	302	249	389	224	290	523	473	664	345	289	289	252
Work w hands	076	222	113	251	190	474	231	186	734	023	286	177	307	149	166	443	403	077	482*	248	268	083	0

0 indicates that a value could not be calculated.  
 Decimal points omitted.

FIELD/ ENV	Judge	Meas	Micr	Motiv	Organ	Perf	Prac	Pred	Prot	RiskT	Sell	Teach	Tools	Walk	Weap	Write
Adventure	224	212	286	148	277	277	270	113	341	666	144	152	285	340	712	176
Animals	171	087	060	077	193	154	289	023	363	336	075	289	136	607	281	199
Beauty	114	047	195	204	283	235	220	027	191	086	144	266	0	109	0	071
Business	456	241	162	471	579	254	388	718	259	456	730	271	197	085	194	173
Chemistry	071	245	0	062	134	130	268	121	078	112	068	080	149	126	148	029
Children	226	084	143	235	237	250	266	087	344	134	122	686	0	159	085	206
Creative	098	216	267	209	373	418	243	118	095	170	078	223	139	123	115	459
Electronics	166	270	193	080	155	137	241	129	168	266	209	046	465	082	290	023
Food	771	055	122	097	279°	152°	218	035	060	155	156	141	134	173	068	032
Imaginative	188	215	120	179	411	288	265	205	075	206	076	206	245	025	242	384
Language	097	0	114	167	239°	198	134	032	106	039	0	276	031	033	092	500
Legal	521	0	065	206	292	162	131	174	221	277	087	073	051	053	123	240
Marketing	304	086	202	364	477	174	181	324	089	284	566	116	067	071	044	212
Medical	206	169	088	340	245	185	390	089	305	170	072	264	088	185	108	155
Movement	087	049	175	319	150	452	291	059	159	190	125	262	114	030	113	130
Natural Forces	087	112	043	079	156°	110	259°	073	095	097°	057	152°	142	617	071	034
Numbers	111	099	037	115	169	0	220	379	050	087	022	165	115	0	0	027
People	178	042	302	415	501	402	274	168	227	267	241	443	125	155	163	286
Physics	105	257	0	048	118°	025	231°	226	087	191	0	023	143	0	222	0
Plants	105°	123	0	065°	114°	0	180°	043	149°	180°	0	159°	0	462°	124	040
Politics	384	0	231	225	301°	098	086	224	114	229°	051	068	0	035	033	179
Property	149°	323	0	109	320°	029	151°	075	098	200°	227°	067	214	039	110	0
Service	093	051	038	235	196	022	128	091	128	181	068	347	061	094	118	028
Systems	106	107	232	095	410	026	044	101	198	213°	152	093	100	0	131	031
Trading	044	0	106	166	315°	021	166	143	025	259	539	055	086	030	028	0
Travel	262	204	504	347	467	402	416	185	327	404	360	329	182	319	257	380
Work w hands	056	311	097	110	219	183	322	128	043	251	157	091	779	184	288	092

0 indicates that a value could not be calculated.  
 Decimal points omitted.  
 ° significance below 0,001

ENVIRONMENT	Acad	BCoun	CPrem	Cons	Corp	Craft	DataP	Dynat	Fact	Govet	Home	Indor	Isol	Kitch	Labor	Mini	Natur	Offic	Outd	Prof	Regim	Relig	Store
Academic	-	057	057	196	235	063	304	184	139	150	108	116	163	0	199	135	180	345	169	328	169	122	0
Behind counter	057	-	250	178	255	111	080	067	278	064	217	104	069	204	076	0	144	434	367	102	031	036	0
Client premise	057	250	-	334	251	165	070	053	064	157	151	100	075	051	156	0	124	426	339	343	088	064	0
Consultancy	196	178	334	-	451	331	288	400	313	312	361	321	152	271	297	0	329	532	426	539	252	253	0
Corporate	235	255	251	451	-	096	305	262	223	184	120	138	104	086	106	0	115	595	346	335	107	367	694
Craft workshop	053	111	165	331	096	-	124	422	308	0	309	264	189	173	134	274	285	218	492	231	126	262	0
Data Process	304	080	070	268	305	124	-	124	132	095	226	035	178	053	273	281	122	346	190	286	114	115	0
Dynamic	184	067	053	400	262	422	124	-	0	243	180	168	170	110	158	0	288	172	493	280	128	122	0
Factory	139	278	064	313	223	308	132	0	-	0	0	065	041	080	126	306	268	135	412	134	149	130	0
Government	150	054	157	312	184	0	095	243	0	-	057	069	093	063	067	0	174	337	294	285	244	102	0
Home	108	217	151	361	120	309	226	180	028	057	-	273	226	316	133	273	347	229	426	417	018	145	0
Indoors	116	104	100	321	138	264	035	168	065	069	273	-	125	177	081	0	171	326	278	349	089	167	450
Isolation	163	069	075	152	104	189	178	170	253	097	228	125	-	058	121	294	382	079	315	303	120	072	0
Kitchen	0	204	051	271	086	173	053	110	080	063	316	177	068	-	099	0	375	141	362	159	123	074	463
Laboratory	199	076	156	297	106	134	273	158	126	067	133	081	121	099	-	0	336	197	312	370	064	055	449
Mining	135	0	0	0	0	274	281	0	306	0	273	0	294	0	0	-	933	0	410	0	0	299	0
Nature	180	144	124	329	115	285	122	288	268	174	347	171	382	375	336	933	-	164	661	301	385	460	442
Office	345	434	426	532	595	218	346	172	135	337	229	326	079	141	197	0	164	-	267	440	181	045	442
Outdoors	169	367	339	426	346	492	190	493	412	294	426	278	315	362	312	410	661	267	-	331	427	406	441
Professional	328	102	343	539	335	231	286	280	134	285	417	349	303	159	370	0	301	440	331	-	194	176	0
Regimental	169	031	088	252	107	128	114	128	149	244	018	089	120	123	064	0	385	181	427	194	-	133	211
Religion	122	036	064	273	367	262	115	122	130	102	145	167	072	074	055	299	460	045	406	178	133	-	0
Storeroom	0	0	0	0	694	0	0	0	0	0	0	450	0	463	449	0	442	442	441	0	211	0	-

0 indicates that a value could not be calculated.  
 Decimal points omitted.  
 ° significance below 0,001

ENV /DUTY	Advis	BKeep	Buy	Calc	Carin	CashH	Clean	Cler	Comp	Couns	Disag	Draw	Drive	Equip	Intrp	Invst
Academic	201	326	147	387	204	158	045	078	246	236	245	196	055	084	230	308
Behind counter	190°	195	431°	054	203°	307	102	260	053	146°	051	088°	165	103	031	088°
Client premise	318	268	362	105	228	179	043	346	119	182°	267	198	169	076	127	187
Consultancy	664	395	335	346	460	339	360	534	396	622	442	354	204	118	510	437
Corporate	401	404	480	400	205	467	264	435	216	314	354	161	182	230	153	232
Craft workshop	292	049	076	097	362	101	116	033	400	272	212°	735	064	235	191	260
Data Process	238	339	227	416	156	373	129	075	210	088	131	274	198	344	174	212
Dynamic	324	037	035	192	262	135	0	066	380	337	400	472	146	236	258	279
Factory	056°	0	069	100°	054°	143°	0	0	131°	083°	155°	252°	158	410°	075	252°
Government	299°	172	099	095	156°	106	0	126	116	310°	212	095	224	032	136	222°
Home	424	220	233	176	486	068	266	163	185	484	219	327	283	130	223	249
Indoors	323	156	095	157	404	083	208	109	170	434	200	225	146	223	086	190
Isolation	182°	048	185	128	251°	114	0	0	175	120°	143	287°	130	034	118	208°
Kitchen	167°	098	056	054	516°	117	245	046	053	376°	122	193°	100	035	061	193°
Laboratory	179	061	019	317	456	040	205	0	193	224	134	201	254	284	294	566
Mining	146°	0	0	0	145°	0	0	0	0	0	0	147°	0	459°	0	0
Nature	254	216	136	136	677	211°	366	194	190	371	205	389	375	240	222	449
Office	456	660	553	515	320	559	112	681	340	351	377	261	154	258	281	363
Outdoors	409	296	297	247	616	255	429	122	332	551	430	478	599	324	298	524
Professional	504	414	342	354	510	276	220	124	344	551	325	358	189	236	406	433
Regimental	122	185	024	069°	440°	052	273	042	112	296°	084	209	230	122	054	230°
Religion	340°	055	0	029	557°	064	0	0	142	582°	054	049°	072	110	033	097°
Storeroom	0	256°	258°	257°	0	0	276°	0	0	0	0	0	0	263°	0	0

0 indicates that a value could not be calculated.

° Decimal points omitted.

° significance below 0.001

DUTY	Advis	BKeep	Buy	Calc	Carin	CashH	Clean	Cler	Comp	Couns	Disag	Draw	Drive	Equip	Intrp	Invst
Advising	-	112	237	218	291	097	113	0	188	488	337	186	121	084	216	216
Bookkeeping	112	-	194	427	214	523	244	407	131	181	119	131	072	074	083	165
Buying	237	194	-	138	081	242	089	153	098	070	193	120	054	083	071	091
Calculating	218	427	138	-	086	190	086	185	230	077	165	203	052	208	134	254
Caring	291	214	081	086	-	225	505	186	084	631	154	294	229	161	160	327
Cash handling	097	523	242	190	225	-	0	236	043	064	099	058	0	118	150	166
Cleaning	113	244	089	086	505	0	-	182	086	149	0	153	100	101	0	191
Clerical	0	407	153	185	186	236	182	-	074	188	071	065	088	090	123	098
Composition	188	131	098	230	084	043	086	074	-	111	177	444	076	131	235	260
Counselling	488	181	070	077	631	063	149	188	111	-	129	191	138	041	226	262
Disagreeing	337	119	193	165	154	099	0	071	177	129	-	176	0	074	143	165
Drawing	186	131	120	203	394	068	153	065	444	191	176	-	186	193	123	259
Driving	121	072	054	052	229	0	100	088	076	138	0	186	-	228	059	206
Equipment	084	074	083	208	161	118	101	090	131	041	074	193	228	-	0	109°
Interpreting	216	083	071	134	160	150	0	123	235	226	143	123	059	0	-	303°
Investigation	216	165	091	254	327	166	191	698	260	262	165	259	206	109°	303°	-
Judgement	305	073	064	100	149	092	088	077	136	194	244	136	160	084	140	135
Measurement	125	044	0	276	081	0	0	0	140	082	090	452	0	216	051	252
Microphone	225	128	173	068	110	073	0	104	101	222	220	174	121	0	0	088
Motivation	336	031	213	069	209	040	0	177	051	345	192	098	072	025	063	085
Organising	390	189	212	195	247	281	189	315	225	323	281	285	141°	127°	135	218
Performing	249	067	060	037	178	065	043°	074	227	310	208	310	150	027	131	095
Practicing	132	181	145	206	313	126	274	068	201	237	093	344	110	202°	113	208
Prediction	276	126	168	287	042	090	0	0	134	085	222	112	0	0	181	241
Protection	202	083	095	068	503	102	048°	123	067	149	143	107	089	091	053	225
Risk taking	187	132	296	121	212	212	040°	068	160	127	169	181	237°	137°	149	273
Selling	174	295	615	151	102	255	044°	150	057	105	186	100	154	134	023	075
Teaching	232	172	035	083	530	059	203	140	065	473	130	182	094	049	081	137
Tools	149	0	056	081	243	090	152	0	106	084	072	320	101	434	090	088
Walking	136	080	029	028	617	062	105	0	056	134	0	208	171	107	033	229
Weapons	042	074	056	080	239	118	0	0	079	124	074	194	225	103	031	233
Writing	205	091	0	0	316	055	0	086	066	289	099	267	063	033	139	193

0 indicates that a value could not be calculated.  
 Decimal points omitted.

DUTY	Judge	Meas	Micr	Motiv	Organ	Perf	Prac	Pred	Prot	RiskT	Sell	Teach	Tools	Walk	Weap	Write
Advising	305	125	225	336	390	249	132	276	202	187	174	232	149	136	042	205
Bookkeeping	073	0	128	031	189	067	181	126	083	132	295	172	0	080	074	091
Buying	064	0	173	213	212	060	145	168	095	296	615	035	056	0	056	0
Calculating	100	276	068	069	195	037	206	287	068	121	151	083	081	028	080	0
Caring	149	081	110	209	247	178	313	042	503	212	102	530	243	596	239	316
Cash handling	092	0	073	040	281	065	126	090	102	212	255	059	090	062	118	055
Cleaning	088	0	0	0	189	043°	274	0	048°	040°	044°	203	152	105	0	0
Clerical	077	0	104	177	315	074	068	0	123	068	150	140	0	0	0	086
Composition	136	140	101	051	225	227	201	134	067	160	057	065	106	056	079	166
Counselling	194	082	222	345	323	310	237	085	149	127	105	473	084	134	124	289
Disagreeing	244	090	220	192	281	208	093	222	164	169	186	130	075	0	074	199
Drawing	136	452	174	098	285	310	344	112	107	181	100	182	320	208	194	267
Driving	160	0	121	072	141°	150	110	0	089	237°	154	094	101	171	225	063
Equipment	084	213	0	025	127°	027	202°	0	091	137°	134	049	434	107	103	033
Interpreting	140	051	0	063	135	131	113	181	053	149	023	081	090	033	031	139
Investigation	135	252	088	085	218	095	208	241	225	273	086	137	088	229	233	193
Judgement	-	049	036	127	279	020	145	140	024	338	041	054	0	030	084	052
Measurement	049	-	0	046°	042°	047°	174°	111°	0	044°	048°	0	214°	057°	0	0
Microphone	036	0	-	033°	114°	197°	061°	0	113	267°	069°	095	095°	0	124	040
Motivation	127	046°	033°	-	394	100	183	269	022	171	203	145	076	027	075	023
Organising	279	042°	114°	394	-	190	214	172	069	161	213	130	128	114	085	169
Performing	020	047°	197°	100	190	-	215	0	153	160	057	174	054	056	079	166
Practicing	145	174°	061°	183	214	215	-	071	113	191	078	115	139	123	092	063
Prediction	140	111°	0	269	172	0	071	-	0	186°	083	0	0	0	035	034
Protection	024	0	113	022	069	153	113	0	-	186	047	081	031	157	260	029
Risk taking	238	044°	267°	171	161	160	191	186°	186	-	168	052	139	171	369	063
Selling	041	048°	069°	203	213	057	078	083	047	168	-	101	082	029	0	025
Teaching	054	0	095°	156	130	174	115	0	081	052	101	-	049	104	0	153
Tools	0	214°	0	076	128	054	139	0	031	139	082	049	-	143	137	033
Walking	030	057°	0	027	114	056	123	0	157	171	029	104	143	-	072	0
Weapons	084	0	124	075	085	079	092	035	260	369	0	0	137	072	-	065
Writing	052	0	040	023	169	166	063	034	029	063	025	153	033	0	065	-

0 indicates that a value could not be calculated.  
 Decimal points omitted.  
 ° significance below 0,001

Correlations between FED fields and 19FII fields

APPENDIX 2.1

fed	FineArts	PerfArts	Language	History	Service	SocWo	Sociabl	PubSpeak	Law	CThought	Science	PracMate	PracFem	Numbers	Business	Clerical	Travel	Nature	Sport	Work	Active
Adventure	021	011	-040	037	-020	-048	-001	-136**	-069	-040	-006	057	106**	-149**	-083	-163**	133**	165	146**	056	-012
Animals	-018	-030	-051	-037	-038	-004	-123**	-139**	-039	-111*	115**	037	-002	-077	-127**	-067	-015	317**	070	015	-004
Beauty	-014	-057	004	-091*	085	-035	-021	009	010	-039	-019	-029	0609	-037	-023	027	-014	-069	-037	-049	053
Business	-102*	-198**	-039	-069	-009	-102*	077	110*	128**	071	-166**	-085	062	286**	377**	252**	016	-122**	-036	-117**	016
Chemistry	-049	029	008	028	-057	-065	-057	-060	-090*	060	274**	015	-007	078	-084	-009	-093	064	-026	060	005
Children	-069	-030	025	-018	066	281**	-038	009	062	-073	-033	-0052	-156**	-093*	-099	-049	-098*	-004	016	044	-036
Creative	283**	093*	146**	012	-067	-050	008	-000	-080	-035	-019	002	-044	-157**	-111*	-135**	-030	-014	-017	-024	020
Electronics	042	066	003	054	013	-034	-008	-120**	106*	092*	082	142**	201**	098*	-040	063	-022	005	-055	-003	-010
Food	009	012	-059	-037	133**	008	052	-079	-071	-111*	-078	-052	163**	-090*	-069	-036	084	036	-045	-062	039
Imaginative	231**	076	092*	040	-041	-017	021	005	-029	065	019	044	088*	-051	-003	-037	084	036	-022	035	-022
Language	017	028	252**	086*	-017	-022	-062	133**	050	-010	-056	-084	-077	-106*	-069	003	-041	-105*	-116**	-019*	030
Legal	-038	031	100*	051	-108*	039	-016	194**	383**	071	-071	-042	-107*	022	072	037	-068	075	-034	-074	-069
Marketing	-051	-096*	-038	-055	-028	-086**	081	149*	-58	063	-145**	-114**	-005	025	225**	120**	015	-133**	-031	-055	037
Medical	-026	036	043	039	-014	170**	031	044	059	066	222**	-001	-088*	038	-061	-091*	-100*	014	062	069	-112*
Movement	092*	078	031	-043	011	029	002	-048	-034	-053	041	024	-030	-078	-048	-023	-022	-001	105*	-023	-078
Natural Forces	042	014	-019	114**	051	-108*	-085	-127**	-105*	-037	139**	015	058	-027	-133**	-078	-001	180**	093*	052	-033
Numbers	-120**	-032	-111*	-010	-032	-052	-053	-067	-116**	140**	051	018	-020	333**	060	140**	-085	-068	-047	-030	084
People	-192**	-079	-059	-066	054	160**	182**	156**	096*	-004	-099*	-082	-221**	-142**	-068	-118**	002	-124**	-079	117**	-002
Physics	-036	053	-014	058	-070	-039	010	-064	-082	092*	158**	056	015	076	-063	-005	-090*	007	-056	-021	025
Plants	066	028	-022	024	019	-060	-135**	-048	-080	-101*	145**	007	021	-024	-123**	-025	-044	283**	033	060	-010
Politics	-028	-027	050	092*	-098*	-034	-089*	198**	124**	019	-090*	-107*	-118**	-016	040	-063	-089*	-088*	-067	-001	004
Property	134**	011	-071	-046	021	-007	022	-080	-043	033	-027	070	163**	119**	080	033	-001	033	058	-032	-021
Service	-107*	-068	-035	-039	-010	156**	-047	-033	-013	-069	-044	-035	-046	-047	-090*	-023	-090*	-052	-043	090*	001
Systems	025	048	-037	041	-054	-048	-001	003	-027	099*	045	-020	053	124**	004	071	045	-028	-022	-029	-042
Trading	008	-024	-099*	-064	086*	-099*	108*	011	-014	065	-128*	010	091*	154*	232**	185**	031	025	-015	-071	037
Travel	012	-037	025	022	156*	-058	101*	001	-025	-093*	-033	-003	-008	-063	004	-006	395**	000	079	-035	021
Work w hands	051	011	-113*	-033	-016	-047	-029	-187**	-147**	-039	-042	230**	134**	-061	-047	016	-020	060	029	-023	032

Decimal points omitted.

\*\* significance level 0,0001

\* significance level 0,001

## Correlations between FEED environments and 19FII fields

	FineArts	PerfArts	Language	History	Service	SocWk	Social	PubSpeak	Lea	CThought	Science	PracMare	PracFem	Numbers	Business	Clerical	Travel	Nature	Sport	Work	Activ
Academic	-0.26	-0.05	0.41	0.95*	-0.29	-0.54*	1.79**	0.49	-0.21	0.56	0.19	-0.53	-0.56	1.14**	-0.02	0.77	-0.69	-0.19	-0.85	-0.32	0.51
Behind counter	-0.33	0.18	-0.50	-0.50	1.24**	0.15	0.42	0.09	-0.32	-0.44	-1.06*	0.05	0.61	0.92	1.15**	1.20**	0.51	-0.28	-0.24	-0.53	-0.20
Client premise	-0.31	-0.63	-0.16	-0.36	0.65	-0.65	0.49	0.34	-0.16	0.16	-0.88*	-0.06	-0.04	0.27	1.28**	0.61	0.80	-0.78	-0.60	-0.35	0.36
Consultancy	-0.59	-0.95*	0.14	-0.69	-0.63	0.37	1.10*	1.27**	0.62	0.81	-0.62	-0.85*	-1.10*	0.55	0.64	0.01	-0.48	-1.37**	-0.68	-0.46	-0.44
Corporate	-1.57**	-0.59	-0.22	-0.14	-0.01	-0.72	0.66	1.08*	-8.3	0.74	-0.33	0.43	-0.59	1.25**	1.60**	0.90*	0.06	1.03*	-0.35	-0.39	0.52
Craft workshop	3.55**	0.92*	0.53	-0.48	0.13	0.43	-0.41	-0.80	-1.04*	-0.20	3.65	-1.40**	0.66	-1.38**	-0.44	-0.51	0.38	-0.27	0.09	-0.25	-0.11
Data Process	-0.13	0.00	-0.61	-0.21	-0.57	-0.95*	-0.76	-0.91*	-0.69	0.54	0.46	-0.10	0.88*	1.48**	-0.04	1.07*	-0.43	-0.35	-0.70	-0.57	0.47
Dynamic	2.32*	1.63**	1.77**	0.17	0.13	0.21	0.54	1.47**	0.65	0.93*	0.52	-0.12	0.05	-0.71	0.39	-0.78	0.36	0.01	0.56	-0.72	-0.52
Factory	0.18	0.17	-0.51	1.46	5.58	1.63	0.52	-0.66	-0.66	0.28	0.15	1.65**	1.37**	0.55	0.06	0.54	0.27	0.12	0.57	-0.67*	-0.30
Government	-0.76	-0.67	0.01	0.70	-1.16**	-0.12	-0.13	1.77**	1.87**	-0.27	-1.13	-1.14**	-1.12*	0.24	0.81	0.16	-0.37	-1.17**	-0.94*	-0.75	0.15
Home	-0.24	-0.32	0.09	-0.47	0.47	0.40	0.05	-0.90*	-0.10	-0.45	-0.36	-0.51	0.43	-0.40	0.18	-0.54	-0.45	0.63	0.40	-0.00	0.04
Indoors	-0.03	0.17	0.51	-0.12	0.27	0.83	-0.15	0.28	-0.00	-0.15	-0.35	-0.29	-0.63	-0.46	-0.32	0.12	-0.47	-0.56	-0.55	0.06	0.17
Isolation	0.16	0.24	-0.27	0.57	-0.69	-0.81	-1.26**	-0.99*	-0.77	-0.61	0.61	0.50	0.52	-0.04	-0.55	-0.53	-0.12	1.40**	0.25	0.11	-0.05
Kitchen	-0.19	-0.32	-0.93*	-0.65	0.71	0.23	6.54	-1.14**	-0.90	-1.35**	-0.73	-0.79	1.35**	-1.17**	-1.20**	-0.84	0.56	0.19	-0.63	0.36	0.89*
Laboratory	-0.23	0.19	-0.07	0.44	-0.59	-0.77	-0.95*	-0.89*	-0.52	0.72	3.26**	0.54	-0.27	0.66	-1.13*	-0.57	-0.71	0.52*	-0.16	0.26	-0.22
Mining	0.21	0.12	-0.38	0.06	-0.22	-0.16	0.22	-0.62	-0.70	-0.58	-0.27	0.44	0.50	-0.71	-1.10*	-0.36	-0.12	0.65	0.24	0.80	0.37
Nature	0.35	-0.11	-0.35	0.85	-0.43	-0.25	-1.35**	-2.05**	-1.41**	-1.31**	0.86*	0.62	0.85*	-1.67**	-2.09**	-1.30**	0.20	3.28**	0.84	0.82	0.12
Office	-1.30**	-1.02**	-0.72	-0.35	-0.65	-0.68	0.24	0.17	-1.8	0.56	-0.87*	-0.81	-8.21	2.20**	1.64**	1.93**	-0.47	-1.66**	-0.87*	-0.03	0.75
Outdoors	-0.17	0.54	0.16	0.29	1.33**	0.52	0.7	0.32	0.22	-0.64	0.23	0.64	0.26	-1.31**	-0.63	-1.05*	1.52*	1.28**	1.98**	0.55	-1.12*
Professional	0.32	0.21	0.33	0.06	-0.03	0.74	0.56	0.68	1.53**	0.41	0.55	-0.61	-0.62	0.42	0.79	0.31	-0.56	-0.58	0.13	0.46	-0.23
Regimental	-0.55	-0.14	-0.56	0.54	0.04	0.45	-0.47	-0.29	0.03	-0.71	-0.18	0.25	0.11	-0.24	-1.01*	-0.14	0.22	-0.52	0.63	0.33	0.21
Religion	0.25	0.63	0.31	0.20	0.05	1.99**	-0.53	0.20	-0.25	-0.66	-0.26	-0.35	0.05	-0.96*	-1.71**	-0.03	-0.46	0.26	0.60	1.25**	-0.37
Storeroom	0.03	-0.07	-0.40	0.12	0.11	-0.41	0.60	0.11	-0.10	0.02	0.21	0.12	0.38	-0.06	0.09	0.11	0.55	0.27	-0.19	0.28	-0.06

Decimal points omitted.

\*\* significance level 0.0001

\* significance level 0.001

## Correlations between FED duties and 19FII fields

	FineArts	PerfArts	Language	History	Service	SocWoc	Sociabil	PubSpeak	Law	C.Through	Science	Pract/Maie	Pract/Fem	Numbers	Business	Clerical	Travel	Nature	Sport	Work	Active
Advising	-.007	.042	.072	.034	.003	.103*	.105*	.110*	.090*	.069	.106	-.068*	-.024	-.045	.070	.003	-.058	-.107*	-.075	.044	-.019
Bookkeeping	-.172**	-.152**	-.163**	-.070	-.007	-.064	-.070	-.063	-.046	-.037	-.073	-.093*	-.064	.309**	.102**	.268**	-.018	-.098*	-.070	-.004	.122**
Buying	.042	.044	-.006	.009	.056	-.015	.122**	.069	.003	.031	-.063	-.030	.147**	.088*	.197**	.122**	.079	.021	.030	-.050	-.013
Calculating	-.095*	-.042	-.136**	-.061	-.092*	-.029	.029	-.045	-.057**	.175**	.079	.054	.000	.299**	.034	.074	-.024	-.073	-.043	-.068*	.028
Caring	-.075	-.082*	-.036	-.045	-.007	.196**	-.131**	-.152**	-.076	-.133**	.068*	.060	-.109*	-.109*	-.210*	-.097*	-.101*	.217**	.047	.081	-.012
Cash handling	-.089	-.063	-.062	.005	.070	.020	-.028	-.056	.009	-.023	-.002	.025**	-.002	.191**	.082	.205**	.028	.011	-.036	-.054	.077
Cleaning	-.010	.006	-.056	-.039	.076	-.033	-.032	-.042	-.047	-.067	-.006	.011	.038	-.015	-.040	.071	-.000	.020	.010	.075	.099*
Clerical	-.135**	-.089*	-.51	-.063	-.015	-.056	-.038	.016	.031	-.040	-.139**	-.076	-.049	.071	.067	.200**	-.035	-.093*	-.115**	.044	.089*
Composition	.139**	.016	.017	.043	.079	-.061	.015	-.034	-.050	.141**	.028	.026	.082	.102*	.010	-.026	.044	-.035	.010	-.046	-.058
Counseling	-.150**	-.063	.032	-.030	.065	.300**	.021	.085	.110*	-.030	.021	-.056	-.211**	-.056	-.077	-.066*	-.044	-.046	-.011	.052	-.036
Disagreeing	.005	.005	.101*	.055	-.102*	-.015	.014	.164**	.171**	.137**	.009	.014	-.059	-.033	.067	-.068	-.047	.073	-.031	-.064	-.035
Drawing	.414**	.078	.004	-.049	.007	-.156*	-.054	-.151**	-.099*	-.055	.009	.040	.041	-.073	-.106*	-.098*	-.063	.046	.077	-.056	.019
Driving	-.016	.019	-.062	-.019	.042	-.089*	-.014	-.110*	-.090*	-.060	-.032	.061	.118**	-.062	-.019	-.037	.053	.065	.029	-.011	.023
Equipment	.030	.036	-.039	-.014	.032	-.015	.068	-.100*	-.054	.070	.030	.147**	.163**	-.016	-.002	.062	.080	.016	.029	-.010	-.036
Interpreting	-.034	.001	.063	.044	-.048	-.039	-.054	.021	.062	0	-.046	-.055	-.097*	.007	.018	-.030	-.004	-.109*	-.017	-.007	.031
Investigation	-.005	.004	-.002	.133**	-.116**	-.114*	-.170**	-.090*	.050	.030	.190**	.003	-.367	.018	-.093*	-.114**	.057	.045	-.058	.047	-.026
Judgement	-.024	.023	.019	.013	.085*	-.011	-.008	.055	.088*	.109*	-.012	-.061	-.054	-.010	.049	-.021	-.030	-.016	.015	.040	-.010
Measurement	.033	-.046	-.063	-.035	-.012	-.063	.064	-.044	-.061	.038	.075	.090*	.063	.089*	-.028	.013	.017	-.014	.069	-.063	.002
Microphone	-.025	.031	.035	-.027	.073	-.008	.090	.049	-.061	-.060	-.113*	-.094*	.002	-.094*	.033	-.009	.051	-.056	.004	.015	.034
Motivation	-.047	-.004	.023	-.027	.035	.018	.072	.157**	.064	.080	-.032	.015	-.018	.003	.107**	-.013	-.006	-.018	.015	-.002	-.057
Organising	.011	.010	.019	-.076	.054	-.086*	.089*	.189**	.097*	.037	-.168**	.038	-.029	.040	.193**	.0660	.102*	-.077	-.017	-.033	-.064
Performing	.047	.201*	.075	.022	.018	-.080	.044	.133**	.048	-.073	-.029	-.031	-.034	-.136**	-.078	-.110*	.006	-.057	-.039	.027	-.009
Practicing	.039	.048	-.028	-.009	-.002	.002	-.122	-.020	-.004	-.012	-.108*	.026	.056	.057	-.056	.034	-.011	.082	.111*	-.007	-.061
Prediction	-.115**	.010	.089*	.070	-.111*	-.035	.033	.059	-.000	.110*	-.013	-.076	.045	.076	.103*	.001	.024	-.080	-.059	-.040	.024
Protection	.005	-.038	-.001	.013	.004	.042	-.055	-.061	-.045	-.069	-.002	-.024	.042	-.041	-.058	.021	-.054	.072	.019	.081	.040
Risk taking	-.005	.026	-.044	-.000	-.020	-.057	.084	-.022	.037	-.008	-.007	-.014	.092*	-.103*	.096*	-.100*	.150**	-.006	.094*	-.038	.004
Selling	-.037	-.034	-.079	-.088*	.084	-.041	.095*	-.007	-.060	-.097*	-.124**	-.033	.107*	.020	.108*	.068	.102*	-.023	.015	-.060	.019
Teaching	.037	.027	.101*	.025	.071	.161**	-.019	.046	.031	-.045	-.013	-.029	-.045	-.051	-.108*	.054	.023	.012	.036	-.008	-.027
Tools	.050	.026	-.048	-.004	.042	-.018	.076	-.114**	-.097**	-.023	-.036	.168**	.159**	-.029	.022	.026	.024*	.096*	.053	-.066	.012
Walking	.047	-.014	-.056	.043	-.035	-.048	-.082	-.163**	-.191**	-.129**	.061	.060	.043	-.111*	-.178**	-.102*	.013	.210**	.031	.068	.018
Weapons	-.034	-.029	-.037	.094*	.008	-.031	-.028	.116**	-.094*	-.041	-.005	.028	.077	-.108*	-.113*	-.063	.026	.100*	-.004	.060	.068
Writing	.039	.010	.168**	.028	.007	-.040	-.097	.035	.037	-.081	-.028	.001	-.059	-.117**	-.063	-.061	-.011	-.067	-.042	.042	-.002

Decimal points omitted.

\*\* significance level 0,0001

\* significance level 0,001

	Technical	Outdoors	Soc Serv	NatScience	OfficeN-n	OfficeNum	Music	Art	Commerc	Lang(VIO)
Adventure	00	-02	-16	-22	-13	-05	-05	-21	-01	-18
Animals	-01	15	-16	05	-07	-06	-28	-14	-14	-15
Beauty	-01	15	15	05	17	-06	23	13	10	11
Business	08	09	-12	-13	25	51**	-14	-03	58**	-03
Chemistry	14	-14	-14	42*	-10	-20	-25#	-01	-17	-13
Children	-20	-09	47**	02	-08	-24	25	-11	-27	04
Creative	00	01	01	-04	-13	-29	26	34#	-26	03
Electronics	50**	26	-05	25	17	43**	-09	08	36#	15
Food	21	31@	-03	-07	-07	-13	01	06	18	14
Imaginative	18	05	01	-02	-07	-09	20	30	-04	09
Language	-08	-07	-14	-10	12	-08	01	08	-23	35#
Legal	-17	-10	-10	-19	-13	-11	05	-02	-26	03
Marketing	-20	-04	-07	-16	47**	-19	11	01	34#	-03
Medical	08	-05	11	48**	-22	-24	-12	-02	-21	-17
Movement	14	-10	10	17	-07	-06	10	12	-16	02
Natural Forces	-31	01	-18	01	-10	-08	-19	-15	-11	-13
Numbers	09	-06	06	-04	-13	27	-12	00	06	-10
People	-29	-21	30	01	-26	-20	03	-12	-25	-02
Physics	-03	-06	-07	28	-11	-17	-19	-25	-17	-20
Plants	-14	-01	-14	-05	-10	-20	-18	04	-23	-13
Politics	-08	-08	-07	-25	-03	-02	02	-02	-17	21
Property	16	22	-06	10	-04	17	-03	09	23	05
Service	-08	-07	34@	13	-10	-14	14	-01	-17	27
Systems	04	-10	-10	-07	01	-08	01	-05	06	-07
Trading	05	-03	12	-06	13	22	-06	-10	20	06
Travel	-20	-05	-15	-17	22	05	-01	-02	06	-07
Work w hands	28	06	-10	-06	-02	01	06	10	06	11

Decimal points omitted.

\*\* significance level 0,0001

# significance level 0,005

\* significance level 0,001

@ significance level 0,05

## Correlations between FED categories and SDS types

	R	I	A	S	E	C		R	I	A	S	E	C
Adventure	03	-16	-21	-12	-03	-16	Advancing	02	-02	12	20	16	-02
Animals	10	10	-06	-12	-05	01	Bookkeeping	-11	-05	-22	-20	09	38*
Beauty	-11	-02	30@	24	05	-02	Buying	26	13	06	07	26	25
Business	09	-07	-39**	-27	35#	45**	Calculating	15	12	-22	-24	-11	06
Chemistry	02	12	-07	-15	-29	-22	Caring	-01	20	15	18	-29	-21
Children	-15	-04	26	47**	-01	01	Cash handling	-07	06	-02	05	12	32#
Creative	-13	-21	31@	-01	-36*	-45**	Cleaning	.	.	.	.	.	.
Electronics	45**	27	02	-07	11	22	Clerical	02	-01	-01	-07	04	12
Food	28	-14	05	-08	17	-02	Composition	-01	10	-20	-13	-14	-08
Imaginative	15	17	19	10	-08	-16	Counselling	-29@	-12	13	45**	-01	01
Language	-21	-10	08	-05	00	-08	Disagreeing	02	06	-05	-09	06	-08
Legal	-12	-17	-00	08	13	-09	Driving	21	-01	33#	10	-17	-19
Marketing	-14	-06	-20	03	33#	29@	Driving	12	-20	21	-05	10	-08
Medical	02	26	05	02	-24	-21	Equipment	21	-01	-01	-07	-03	05
Movement	-05	25	12	17	-17	-16	Interpreting	-23	-05	00	08	06	01
Natural Forces	-07	04	-20	-16	-14	-03	Investigation	-11	16	06	-02	00	-02
Numbers	-02	08	-20	-24	-18	03	Judgement	-01	11	-07	-01	30@	18-
People	-26	-07	08	31@	-00	-10	Measurement	21	06	05	17	10	05
Physics	23	-22	-02	-15	-17	02	Microphone	02	-07	18	-07	-10	-16
Plants	-02	04	08	-05	-19	-22	Motivation	-06	06	07	11	-30@	-22
Politics	-13	02	27	09	14	-01	Organising	-06	-31@	-02	-11	10	02
Property	13	02	01	05	24	13	Performing	-08	-26	18	05	-07	-24
Service	05	-13	06	15	-13	-20	Practicing	15	19	-05	02	-25	-12
Systems	10	06	-05	-05	-11	-02	Prediction	01	06	-07	-25	03	-00
Trading	08	-02	-05	-09	09	32#	Protection	02	-06	-06	07	05	-08
Travel	-16	-21	-01	02	03	07	Risk taking	-01	02	-20	-15	14	00
Work w hands	18	-10	02	-14	-06	-17	Selling	-05	-04	-25	-21	-01	08
Academic	-23	-07	-08	-15	-05	15	Teaching	-08	-02	15	31@	-10	-08
Behind counter	02	12	24	17	17	18	Tools	30@	-02	-05	-15	-03	03
Client promise	17	-06	-01	-13	09	18	Walking	07	-10	-19	-11	-14	-18
Consultancy	-14	07	04	14	27	03	Weapons	.	.	.	.	.	.
Corporate	10	15	-05	-09	-04	-03	Writing	-35#	-29	07	-02	-10	-11
Craft workshop	-19	-24	30@	10	-12	-32#							
Data Process	24	18	-12	02	-03	15							
Dynamic	08	-10	15	-15	-09	-25							
Factory	20	08	-12	-03	07	06							
Government	-01	-05	-02	02	03	12							
Home	-10	-11	08	-06	-02	-12							
Indoors	-26	-05	-02	15	-14	-05							
Isolation	34#	25	18	33#	17	32#							
Kitchen	-21	-20	17	01	-14	-27							
Laboratory	12	35**	-02	-05	-22	-20							
Mining	.	.	.	.	.	.							
Nature	18	-03	-03	-09	-06	-06							
Office	-20	-19	-31@	-14	26	34#							
Outdoors	13	-06	-05	-02	-16	-17							
Professional	06	17	-02	12	02	10							
Regimental	17	-01	-06	-05	-09	-08							
Religion	-13	-02	21	22	-06	-01							
Storeroom	.	.	.	.	.	.							

Decimal points omitted.

\*\* significance level 0,0001

\* significance level 0,001

## Correlations between FFD fields and 16PF 1st and 2nd order factors

	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4	Ext	Anx	TPs	Ind
Adventure	-.142**	-.005	012	078	065	-.118*	004	-.017	067*	-.060	-.082	-.01	120**	002	-.064	034	-.022	-.004	036	126**
Animals	-.169**	-.039	123**	-.032	-.071	-.043	-.110*	-.003	040	053	-.081	032	-.020	062	042	094*	-.105*	024	-.022	-.016
Beauty	040	-.038	018	-.025	058	-.024	050	-.009	-.064	-.010	-.040	025	-.045	-.067	010	-.047	058	032	013	-.043
Business	042	-.033	-.035	016	-.041	032	005	-.110*	-.014	-.058	112**	-.019	-.055	-.032	005	-.011	037	006	065	-.003
Chemistry	-.099*	097*	-.095*	-.089*	-.102*	-.005	-.082	023	030	064	021	-.003	051	092*	-.022	007	-.110**	016	-.101*	-.097*
Children	183**	-.094*	027	-.120**	-.016	033	031	181**	-.046	033	-.001	068	-.068	-.068	108*	-.020	068	-.002	-.136**	-.048
Creative	-.040	040	-.055	079	083	-.114**	077	079	039	157**	-.090*	025	062	-.007	-.022	-.006	047	025	-.067	089*
Electronics	-.148**	009	-.040	-.017	-.099*	001	-.100*	-.107*	013	014	-.001	002	116**	074	039	010	-.070	021	019	021
Food	026	019	-.032	-.015	027	-.058	-.028	-.007	-.045	-.027	-.019	039	-.042	-.009	-.035	049	012	074	028	-.021
Imaginative	-.064	084*	018	060	048	-.052	001	025	-.002	059	-.031	-.044	086*	044	-.043	-.025	-.048	-.012	-.019	025
Language	055	054	-.078	001	014	-.019	-.012	130**	027	98*	-.029	-.014	-.016	053	-.058	052	-.025	028	-.100*	003
Legal	054	-.017	-.045	113*	-.026	-.006	044	092*	093*	043	084*	-.055	017	010	004	-.032	-.012	-.036	018	079
Marketing	143**	-.021	-.026	041	039	095*	097*	-.038	-.050	-.063	073	014	-.048	-.059	-.032	-.015	094*	015	032	046
Medical	040	005	067	-.064	-.056	057	-.040	022	-.022	004	085*	033	-.049	-.005	-.011	-.001	-.008	-.020	-.052	-.047
Movement	-.007	030	-.013	031	047	-.065	030	043	-.026	010	-.045	-.040	-.036	-.036	029	-.022	024	-.020	038	-.009
Natural Forces	-.136**	-.006	051	-.017	-.027	035	-.067	-.032	017	-.051	055	-.062	-.002	083*	027	012	-.075	-.016	032	-.030
Numbers	-.062	131**	-.045	-.051	-.099**	090*	-.081	-.100*	-.031	-.074	-.001	-.023	032	070	084*	-.042	-.107*	011	005	-.062
People	315**	-.005	056	058	197**	065	239**	102**	-.061	-.012	013	-.006	-.067	-.202	-.030	-.092*	260**	-.093*	-.006	053
Physics	126	065	-.051	-.084	-.086	029	-.062	-.009	-.007	070	016	-.037	074	078	008	-.001	-.123**	-.032	-.043	-.099*
Plants	-.178**	-.025	038	-.021	-.089*	-.013	-.076	-.004	-.005	036	-.063	001	-.025	138**	007	055	-.136**	-.023	025	-.048
Politics	-.009	010	002	147**	-.025	010	063	024	006	-.008	081	-.082	045	029	-.014	-.042	-.003	-.057	055	110**
Property	069	009	-.019	-.048	-.008	-.067	-.059	-.167**	056	-.016	-.019	063	005	016	-.071	064	-.060	073	070	-.066
Service	112**	-.046	050	-.077	-.051	119**	-.027	131**	000	-.059	031	-.020	-.034	-.033	122**	012	004	-.039	-.073	-.074
Systems	-.069	051	-.002	-.024	-.065	005	-.054	-.053	-.065	-.037	060	043	028	045	032	-.002	-.060	027	-.001	-.057
Trading	016	-.010	-.017	043	-.006	-.038	015	-.116*	-.051	-.074	029	015	019	-.022	-.006	019	012	030	066	040
Travel	073	-.058	006	-.014	097*	-.032	030	-.001	008	-.018	-.042	014	-.054	-.059	-.091*	-.025	057	022	029	-.012
Work w. hands	-.144**	-.038	-.029	010	-.047	-.020	-.043	-.164**	029	-.065	-.120**	001	076	076	031	059	-.070	024	094*	052

Decimal points omitted.

\*\* significance level 0,0001

# significance level 0,005

\* significance level 0,001

@ significance level 0,05

Correlations between FFD environments and 16PF 1st and 2nd order factors

	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4	Ext	Ans	TPs	Ind
Academic	-075	035	-127**	-048	-195**	-014	-195**	062	061	055	023	-038	033	175**	-027	076	-196**	137**	091	-041
Behind counter	059	027	-016	008	061	074	046	-063	-046	-072	-001	-038	-046	-014	062	-028	057	-058	042	-010
Client premise	114**	030	018	006	011	-042	038	-039	042	-027	124**	032	-029	-088*	045	-017	079	019	045	023
Consultancy	196**	017	019	042	155**	030	141**	-008	-050	035	-036	019	-009	-156**	-035	-024	172**	-012	-000	065
Corporate	052	051	-067	043	042	058	025	-091*	-052	-055	053	-063	015	-070	-030	-041	067	-057	060	-003
Craft workshop	-010	-016	-063	005	026	-125**	050	-020	-018	106*	-113**	042	066	-003	014	012	010	011	001	025
Data Process	-112*	005	-056	-043	-172**	011	-137**	-058	-024	029	-008	059	057	137**	-012	042	-130*	083*	-019	-040
Dynamic	-105*	071	040	147**	091*	-103*	108*	082	056	097*	-067*	-004	023	-015	-093*	-032	062	028	007	111**
Factory	-118**	-028	010	017	047	-013	-013	-167**	032	-107*	060	-033	038	043	050	010	-044	040	164**	054
Government	039	-059	018	109*	-035	090	053	003	030	-004	125**	-035	-008	-012	028	-057	037	-018	-006	070
Home	008	-016	-014	-049	-034	-056	-083*	121*	-025	069	011	025	-074	050	-054	018	-057	041	-118**	-026
Indoors	078	-074	-012	-054	019	026	015	112**	-030	005	-071	-014	052	-079	-039	011	036	011	-082*	-053
Isolation	-178**	043	-033	034	-108*	-131**	-124**	-062	107*	021	-014	057	077	093*	-036	095*	-124**	093*	017	028
Kitchen	-039	-109*	026	011	015	-012	020	014	027	-037	-048	069	-067	-009	-007	016	002	016	018	-009
Laboratory	-159**	052	048	-047	-080	049	-114**	-045	-018	023	058	-038	043	139**	012	-024	-134**	-042	-016	-060
Mining	-114**	-042	011	-041	-092*	-015	-100*	-007	-044	-003	-016	-025	-033	062	008	012	-105*	006	-014	-026
Nature	-204**	-016	084*	-081	-114**	001	-138**	024	040	018	-046	-022	021	144**	050	071	-151**	-017	-047	-038
Office	0652	031	-045	049	-022	090*	003	-069	-033	-033	096*	-020	-040	-028	065	-056	033	-009	043	-065
Outdoors	053	-020	098*	093	214**	-048	180**	025	015	-072	-080	-058	030	-117**	-046	000	143**	-071	077	106*
Professional	073	029	030	-023	-011	043	-000	013	-003	-013	076	020	-055	-038	023	003	004	-026	031	-027
Regimental	-036	-059	020	-018	-035	-011	-041	-028	059	-101*	047	012	-023	002	039	037	-036	-016	033	-041
Religion	101*	-018	012	-079	-108*	022	-003	136**	-048	-013	018	012	-072	-021	044	-020	-020	016	-113**	-077
Storeroom	020	-033	-017	000	-007	040	020	-004	016	-028	014	016	026	004	014	-023	026	003	-008	001

Decimal points omitted.

\*\* significance level 0,0001

# significance level 0,005

\* significance level 0,001

@ significance level 0,05

## Correlations between FFD duties and 16PF 1st and 2nd order factors

## APPENDIX 5.3

	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4	Ext	Anx	TPs	Ind
Advising	110**	023	-013	025	059	030	-069	032	-009	-007	052	-035	-038	-076	-052	-011	067*	-041	010	005
Bookkeeping	-022	-026	-091*	-091*	-076	086*	-063	-063	-033	-121	053	030	-070	012	025	-003	-047	040	018	-100*
Buying	020	034	-038	035	016	-078	042	-060	-001	-028	024	042	-002	-029	-029	030	014	059	024	013
Calculating	-064	099*	-010	-054	-071	064	-051	-109*	-057	-015	031	-009	099*	047	045	-055	-076	-021	-003	-036
Caring	-031	-040	137**	-177**	-099*	057	-115**	116**	-047	044	-012	052	-044	048	054	-035	-042	-014	-122**	-111**
Cash handling	-022	006	-042	014	-029	019	003	-021	030	-049	024	003	-056	-015	-000	-017	-010	004	045	-009
Cleaning	044	033	009	-071	-096*	008	-057	-001	016	-047	057	035	-027	048	027	004	-026	013	-043	-097*
Clerical	046	-004	-027	-103*	-070	056	-063	-004	-010	-010	052	052	-053	-005	004	-004	-017	012	-056	-121**
Composition	-078	076	-013	-038	-016	028	-069	-089*	-093*	024	-019	-058	060	-069	-011	-040	-048	-022	023	003
Counselling	208**	-093*	018	-034	095*	023	095*	219*	-029	021	-021	024	-096*	-094*	-010	-036	147**	-010	-124**	-017
Disagreeing	020	037	-036	173*	068	-067	070	033	089*	030	057	-033	104*	-030	-073	006	036	-017	036	077
Drawing	-138**	004	040	-002	017	-080	-041	-123**	-022	072	-092*	023	024	050	048	-036	-058	-019	057	-015
Driving	-078	-032	-016	-027	-055	-059	-114**	-042	023	-021	-000	001	009	056	-014	084*	-076	-001	037	-010
Equipment	-071	-058	000	-003	-058	-007	-053	-080	-052	-039	-048	-043	035	096*	-017	032	-034	100*	047	029
Interpreting	004	057	-092*	-009	-042	-085*	-040	066	054	081	-004	091**	027	034	016	-017	032	-034	-081	014
Investigation	-173**	099*	-000	-026	-086*	001	-136**	-034	022	033	033	022	027	106*	023	-003	-103*	025	-017	-056
Judgement	-007	-001	-037	093*	-050	-066	021	022	065	085*	018	-013	081	004	-049	010	014	010	-009	099*
Measurement	-082	016	073	025	041	038	029	-167**	-034	-062	-010	-010	-012	-047	-000	-054	-039	-073	115**	002
Microphone	098*	-028	-018	001	052	021	089*	042	-010	-030	026	007	-003	-080	-016	-038	081	-009	-005	001
Motivation	104*	-014	028	068	068	075	046	-021	-008	-024	-032	-050	009	-131**	-005	-016	052	-034	029	036
Organising	130**	009**	-029	094*	108*	029*	133**	-087**	071	-034	-025	-057	-039	-132**	-067	040	127**	-003	126**	074
Performing	020	-018	-040	098*	125**	-124**	181**	102*	020	063	-099*	020	010	-026	-063	048	070	011	-038	096*
Practicing	-048	-015	019	-047	-037	131**	-034	-078	010	-031	-008	022	020	012	093*	-052	-078	-039	020	-071
Prediction	-037	-005	-067	058	-052	-024	-038	006	012	020	003	012	054	007	044	-013	-070	028	-006	036
Protection	-055	020	-001	-051	-054	017	-015	-045	054	-062	020	017	-003	012	017	073	-004	027	002	002
Risk taking	-083*	-008	-047	122**	105*	-160**	071	-017	067	-021	-019	000	050	-043	-143**	101*	083*	049	059	139**
Selling	110**	009	-006	010	063	-005	080	-089	-067	-107	025	-026	-031	-058	003	027	090*	-026	039	003
Teaching	084*	-026	066	-035	037	046	045	189**	-142	042	001	-021	-009	019	086*	-049	032	-024	-125**	-020
Tools	-079	-037	017	-016	0506	-006	028	-113**	011	-069	-104*	-019	057	-011	053	032	029	-021	120**	036
Walking	-121**	007	090*	-055	-086*	039	-090*	031	-035	-003	056	-067	-043	126**	039	-032	-102*	-060	002	-030
Weapons	-128**	-024	-026	067	-094*	-091*	-063	021	132**	051	-018	-031	071	094*	-015	070	-079	040	-007	121**
Writing	040	-017	-012	-013	-008	-042	005	135**	011	019	-004	005	-024	066	007	028	-042	003	-024	014

Decimal points omitted.

\*\* significance level 0,0001

\* significance level 0,001

# significance level 0,005

@ significance level 0,05

FED fields and definitions

<i>Field of work</i>	<i>Definition- what you have to know about</i>
Adventure	Danger, survival and physical effort
Business	Money, Marketing, Trading
Chemistry	Properties and reactions of substances
Creative	Putting thoughts into practice
*Electronics	Transistors, circuit diagrams and boards
Education	Furthering knowledge and skills of others
Food	Planning and preparing meals
Imaginative	Thinking up and organising new ideas
Language	Communication and storage of information and thoughts
Legal	Interpreting and putting into practice society's rules
*Natural Forces Living things	Climate and use of the Earth's resources Plants, Animals and the environment
Manufacturing	Processing raw materials into finished goods
Medical	Treatment and advice on health matters
Numbers	Applying formulae, manipulating figures
People	Human behaviour and social interaction
Politics	Making and administering decisions that affect society
Property	Buildings, construction works, building materials
Religion	Ministry, spiritual growth and beliefs
*Travel & tourism	Hospitality. Different places and cultures

\* Not supported by all levels of education

FED environments and definitions

<i>Environment</i>	<i>Main people contact</i>	<i>Definition - surrounded by</i>
Isolation	<i>Nil</i>	Seeing no other people
Data processing	<i>Minimum</i>	Computer hardware and VDU screens
Mining		Rock faces, dust
Storeroom		Shelves, boxes, crates
Academic	<i>Work team</i>	Learning, books and papers
Consultancy		Other peoples' employees and staff
Dynamic		Temperamental people, many changes
Factory Craft workshop		Machines, noise, grease Designs, hand held tools
Government		Bureaucracy, rules and regulations
Laboratory		Laboratory equipment
Office		Office equipment, management, procedures
Outdoors		Open space, fresh air
Client sales	<i>Client centred.</i>	Samples, quotes, goods for sale or rent
Home		Your own possessions, family and pets
Professional		Certificates of education, confidentiality, facts to interpret, perfect work

FED duties and definitions

Duty	Related to	Definition
Bookkeeping Calculations Cash handling Clerical	<i>Paper</i>	Adding up figures, balancing totals Doing complicated sums Counting money, giving change Filing, filling in forms, solving queries
Drawing Measurement		Art, design and composition Using rulers and tapes, drawing angles and distances
Advising Counselling Teaching	<i>Talking</i>	Making suggestions and giving instructions Helping people with their personal problems Passing on knowledge
Buying & selling		Negotiating prices, doing deals
Disagreeing		Stating your own opinions
Microphone		Talking to strangers at a distance
Motivation Organising		Delegating, influencing others to work for you Co-ordinating people, resources and activities
Investigating	<i>Thinking</i>	Research, analysing, presenting results
Judgment		Choosing between options. Deciding on a course of action
Prediction		Working out strategies and trends for the future
Driving	<i>Action</i>	Controlling a vehicle
Equipment		Watching gauges, using levers and pressing keys to control a machine
Tools		Using hand-held instruments to change the shape of something
Weapons		Aiming at targets, killing
Looking after	<i>Feeling</i>	Caring, nurturing, cleaning, protecting others and what is important to them
Performing		Showing emotion, physical strength or skill in front of an audience
Taking risks		Playing the odds, "Gut-feel" decisions

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