Thesis title:

The Formulation and Development of Instruments to Measure Field Dependence – Field Independence Using Spatial and Verbal Modalities

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Abstract

The thesis gives a description of the formulation and development of an Embedded Shapes Test which was subsequently used as a method of measuring the construct/cognitive style of field dependence – field independence, using a spatial modality. Two additional methods of measuring field dependence – field independence were also formulated and developed, which used a verbal modality, in the form of a Sense Word Test (SWT) and Non-Sense Word Test (NSWT).

Each of the above field dependence – field independence 'tests' were used in a series of pilot studies and studies, as part of their development and application. With two of the studies, of which there were four, additional 'tests' were used to measure cognitive attributes considered to have some association with those inherent in the measurement of field dependence – field independence. These included the Chronological Order Integration Test (COIT) and the Gestalt Picture Completion Test (GPCT) in Study Three; and the GPCT; British Ability Scales (BASI)/Short Form IQ; and the Cognitive Styles Analysis (CSA) in Study Four.

The COIT in Study Three provided a framework to measure field dependence – field independence using a verbal modality through the medium of text. Therefore, this enabled comparisons to be made within a verbal modality through the medium of words and non-sense words by the SWT and NSWT, as well as a spatial modality by the EST.

The inclusion of the GPCT, in Studies Three and Four enabled the process of measuring field dependence – field independence to be compared with a process that appeared to be opposite to it, i.e. an integration – synthesis process, or putting together pieces of information, instead of a segregated – analytical process, or taking apart a piece of information, respectively. The BASI/Short Form IQ was included in Study Four to provide a measure of cognitive ability. Since an argument directed at the concept and measurement of field dependence – field independence is that it is measuring cognitive ability rather than cognitive style, a comparison was made between field dependence – field independence and cognitive ability/intelligence as measured by the BASI/Short Form IQ. A further comparison with measurements of field dependence – field independence was made possible by the inclusion of the CSA in terms of a

Wholistic or Analytic perception of information, as well as a propensity, on the part of the individual, to think spatially or verbally, i.e. in the Imager or Verbaliser mode of the CSA.

The inclusion of school subject performance/attainment levels, in each of the four studies, was to enable comparisons to be made between the various measurements of field dependence – field independence, i.e. EST, SWT, NSWT and COIT, and GPCT, BASI/Short form IQ, CSA, and the characteristics of the different school subjects themselves. This enabled the exploration as to whether or not the characteristics of particular school subjects have an affinity to field dependence – field independence in terms of cognitive style and/or cognitive ability. This exploration was augmented in Study Three by the inclusion of GCSE subject grades for the sample members.

In Chapter 14 (Comparisons of the Outcomes from the Four Studies), Witkin's Group Embedded Figures Test (GEFT) was introduced to provide a comparison of reliability between the EST3, SWT2 and NSWT1, using the Cronbach Alpha statistic.

The sample used for each of the pilot studies and studies consisted of Year 8, male and female, students of mixed ability, from Comprehensive and Middle Schools. The sample sizes for each of the two pilot studies were thirty, but varied for the four studies from 62 to 224 to increase the statistical validity and to decrease the standard error.

Within each of the four studies, means; standard deviations; Multivariate Analysis of Variance (MANOVA); correlations (Pearson Product Moment) and Cronbach Alpha statistics were used to analyse the data.

The EST3, SWT2 and NSWT1 were used in each of the four studies and produced a high level of construct validity across the four studies. A number of significant F ratios and correlations were obtained between the variables in each of the four studies. In particular, significant F ratios were obtained for EST3; Sex; Test Type (SWT2 and NSWT1), e.g. ($F = 4.00$; df 2, 56; $p = 0.05$ – Study 1); School Subjects and GCSE Subjects; and significant correlations between EST3 and Science (General), e.g. $r = 0.4006$; $p = 0.05$ – Study 1; Modern Language (French); COIT A and S; COIT B and S; and IQ within the corresponding that included these variables.

Correlations (r) between EST3, SWT2 and NSWT1 within each study produced a number of high reliability values (See Chapter 14, Table 14.4 for full details).

In addition, the Cronbach Alpha values for the EST3, SWT2 and NSWT1 gave a high reliability, i.e. 0.84263, 0.92799, 0.91946 for Study One; 0.90281, 0.93720, 0.88725 for Study Two; 0.89441, 0.94493, 0.92713 for Study Three; and 0.84942, 0.93779, 0.91099 for Study Four, respectively. The Cronbach Alpha value for the EST3 was greater than that for the GEFT, i.e. 0.93544 and 0.89234, respectively. Similar values were obtained for the SWT2 and NSWT1 when compared to the GEFT, i.e. 0.97891 and 0.96411, respectively.

Key Words

Cognitive Styles; Field Dependence – Field Independence; Embedded Shapes Test; Sense Word Test; Non-Sense Word Test; Chronological Order Integration Test; Gestalt Picture Completion Test; British Ability Scales (BASI/Short Form IQ); Cognitive Styles Analysis; Spatial Modality and Verbal Modality.

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F.P.

“ … questions one asks, the lines of enquiry [which] are opened up, …the extent to which one has stimulated others to answer questions which raise more questions”

One of H.A. Witkin’s beliefs in relation to the measure of a person’s work.

(Lewis as cited by Wapner in Field Dependence in Psychological Theory, Research, and Application: Two Symposia in Memory of Herman A. Witkin; Edited by Bertini, M., Pizzamiglio, L. and Wapner, S.; 1986, page 4; LEA)

Chapter 1

Overview of the Thesis

1.1 Introduction

The aims of this chapter are to give an indication of where the topic of this research stands within the field of cognitive styles research, to give a context and purpose for the research, as well as possible consequences of the research.

Also, to lay out and describe from the beginning to the end, the sequence of thinking and development that has informed and constituted the research.

1.2 Summary Review of the Literature

(This is developed and extended in various chapters of the thesis).

From studies in perception the Group Embedded Figures Test (GEFT) was developed by Witkin and his co-researchers (1948a, 1962 and 1971), this enabled the measurement of field dependence – field independence to be efficiently measured, using a series of geometrical figures which were themselves developed by Gottschaldt, 1926.

No one cognitive or psychological ability or attribute can be thought of in total isolation from other cognitive abilities or psychological attributes. Therefore, the investigation into field dependence – field independence in terms of What exactly is it? How is it measured? and How does it relate to other measurable cognitive abilities on psychological attributes?, is of importance for a better understanding of it. Also, field dependence – field independence has the additional role of a major cognitive style in cognitive style and learning style research. For both of these two broad characteristics of field dependence – field independence, many cognitive abilities, psychological attributes, cognitive styles and learning styles are discussed and compared in an attempt to answer the above questions with regard to field dependence – field independence.

Perception (Witkin and Asch, 1948b) is a crucial element in the measurement of field dependence – field independence, i.e. Is the simple shape or figure perceived or not perceived in the complex shape or figure? Therefore, it is necessary for perceptual ability and spatial ability to be considered in association with problem solving (Duncker, 1945) and thinking skills (Guilford, 1967), general and specific abilities/intelligence (Spearman, 1971) in trying to ascertain why some individuals are field dependent and some field independent. Also, it is likely that creativity (Hudson, 1966) and memory (Baddeley, 1990), in association with the above, are influential in relation to an individual's position on the field dependent – field independent continuum (Shouksmith, 1970). All of these aspects are of a cognitive nature which are inter-related and between them contribute to the description of the process involved in the successful solution of field dependence – field independence tasks (Witkin [et al], 1962). However, there are a number of other attributes of, arguably, a less cognitive nature that are influential to field dependence – field independence measurement. These include, personality characteristics and traits (Costa and McCrae, 1991), aspects of the self-concept, i.e. the level of self actualisation (Rogers, 1961) or confidence on the part of the individual to attempt tasks such or those contained in measures of field dependence – field independence, and motivation (Morgan, 1993).

Although field dependence – field independence is a cognitive style that can 'stand-alone', it is necessary to consider it in relation to other cognitive styles (Riding and Rayner, 1998) or part of the attempt to gain a more comprehensive understanding of it in terms of cognitive style dimensions (Riding and Cheema, 1991). Also, learning styles (Riding and Rayner, 1997), and what may be best described as, 'additional categorisations' that contribute to the mechanisms of learning (Jonassen and Grabowski, 1993), that may require to be taken into account for either a greater understanding of field dependence – field independence itself or the position it holds in a possible unifying scheme of all cognitive and learning styles, as well as 'additional categorisations'. Many attempts have been made at such a unification (Messick, 1984; Miller, 1987; Schmeck, 1988; Rayner, 2000).

The more prominent of these is the Onion Model (Curry, 1983); Cognitive Style Dimensions (Riding and Cheema, 1991); Cognitive Styles Analysis (CSA) (Riding, 1991 and 2000); and Intellectual Styles (Zhang and Sternberg, 2001 and 2005).

With some models, e.g. Triarchic Theory of Intelligence (Sternberg, 1985) the focus extends beyond that of cognitive and learning styles to include an emphasis on the comprehensive nature of life experiences, all of which contribute either positively or negatively to the development of learning abilities.

Also, the importance of other attributes of a non-cognitive or style classification, such as personality type/trait, self-concept and motivation, that are likely to contribute to any explanation of human learning behaviour, need to be incorporated into any unifying model that extends beyond cognitive/learning styles.

However, cognitive style and learning style research remains in a state of development (Coffield [et al], 2004a and b). In spite of the research attempts to define and unify cognitive and learning styles a new paradigm is required (Rayner, 2011). A unified, robust model of cognitive/learning styles is not only required as part of the explanation of cognitive processes, with cognitive/learning styles being the outward manifestation of brain functioning as explained by studies from neuro-science (Riding [et al], 1997; Kozhevnikov, 2011).

Such a model would enable the application of cognitive/learning style to be made more efficiently in the realms of education, including the understanding of cultural differences in education, and business processes/organisations (Zhang, 2008; Armstrong and Cools, 2009).

Admirable though much research has been over the last forty years, into cognitive/learning styles, much of it has not addressed fundamental issues in relation to the cognitive processes involved in learning in detail. The study of and further development of field dependence - field independence provides an opportunity for the fundamental issues of learning to be addressed, resulting in the possibility of a greater understanding of them.

1.3 The Research Context

The bi-polar construct of field dependence field independence has a long history within psychological and educational research which has established it as a major assessment instrument of individual differences. In spite of this, questions continue to be asked, from the psychological and educational research community, about its original formulation and what it is actually measuring. The team field dependence – field independence was developed by Witkin and his co-researchers in the late nineteen forties from studies of perceptual ability between individuals. Encapsulated in the term of field dependence –field independence is the motion of two different styles of perception which later evolved into two different cognitive styles, or ways of perceiving and engaging with the world, on the part of the individual, whether this involved learning, problem solving or social activities. Witkin and his co-researchers further developed the concept of field dependence-field independence into a theory of human thinking and behaviour which they called Psychological Differentiation (Witkin [et al], 1962).

However, throughout the period of the development of field dependence-field independence, concerns began to be raised as to whether or not the idea of field dependence –field independence could only be considered as a formulation for the measurement of perceptual and spatial ability, on the part of individual, and not generalised into the measurement of a style, cognitive or otherwise which would be beneficial in the learning and teaching process (Witkin, 1971). Also, evidence began to accumulate which showed that measurements of field dependence-field independence corrected significantly with measurement of general and specific ability or intelligence (Goldstein and Blackman, 1978).

Therefore, it appears that the robustness and identity of the concept of the field dependence – field independence requires further investigation to explore the accuracy with which field dependence – field independence has been traditionally measured; Can it only be measured via a non-verbal modality?, What is the relationship between field dependence – field independence and measures of ability or intelligence, as well as an individual's performance on subjects within the school curriculum?, and What associations does it have with personality characteristics, and aspects of the concept of the 'self'?

In addition to the above, field dependence – field independence in the role of a cognitive style, has become a major element in the cognitive styles, learning styles and learning strategies research. (McKenna, 1990; Tinajero and Paramo, 1997 and 1998; Richardson and Turner, 2000; Richardson, 2011)
This gives a further reason for the continuation of research into the measurement of field dependence – field independence.

1.4 The Purpose of Undertaking the Research

To address the questions already referred to and the epistemological and the phenomenological issues they raise, it would be necessary to construct a new version of an existing method of measuring field dependence – field independence in terms of a perceptual/spatial modality (Witkin [et al], 1971), as well as the construction of new methods to measure field dependence – field independence in terms of a non-spatial modality.

Also, a number of further measurements of various cognitive attributes and levels of academic performance/attainment would have to be made to enable comparisons to be made with measurements of field dependence – field independence as described above, from the individuals of the sample(s) to be used. These would include a measurement of perception/ability (Gestalt Picture Completion Test, Street, 1935); intelligence quotient comprising four separate measures of verbal reasoning, non-verbal reasoning, auditory memory and speed of information processing (British Ability Scales (BASI, Elliot [et al], 1986); cognitive style dimensions in the form of Wholistic – Analytic and Visualiser - Verbaliser (Riding, 1991, 2000); school examinations performance/attainment and GCSE examinations performance/attainment.

Therefore, the major purpose of the research is the development of new and original instruments to investigate and measure the concept of field dependence – field independence. Associated with this endeavour is the comparisons to be made between the measures of field dependence – field independence produced and those of other cognitive attributes, that may or may not be directly or indirectly related to measures of field dependence – field independence, spatial or non-spatial. In addition to this, will be the comparisons made between all of these measures and school/GCSE subject performance/attainment, and the consequences such compositions might indicate for learning and teaching.

1.5 Framing the Research

The Research Questions
The focus of the research will be associated with the following research questions:-

1. *Is it possible to produce a more sensitive and therefore more accurate measurements of field dependence – field independence using a spatial modality?*
2. *Is it possible to measure field dependence – field independence using a verbal modality?*
3. *Is it possible to show a relationship between the measurements of field dependence – field independence, ability, and attainment in school subjects?*

1.6 Organisation of the Thesis

The thesis is arranged into four parts and within each part there are a varying number of chapters.

The first part 'Background to the Thesis' starts with an overview of the thesis, Chapter One; an account of the history, development, and application of field dependence – field independence, Chapter Two; related psychological attributes to field dependence – field independence, Chapter Three; and the relationship between field dependence – field independence and cognitive styles, learning styles and learning strategies in general, Chapter Four.

The second part ‘Research Methodology and Development’ gives the research approach and paradigm, as well as, ethical considerations of the research, Chapter Five; the developments of the instruments used to measure field dependence – field independence, Chapter Six; and further developments involving an extension and application of the concept of field dependence – field independence, Chapter Seven.

The third part ‘Experimental Studies’ begins with two pilot studies, Chapter Eight; these are followed by four independent studies of increasing complexity, Chapters Nine, Ten, Eleven, and Twelve respectively; and ends with a comparison of outcomes from the four studies, Chapter Thirteen.

The fourth part ‘Further Developments and Conclusions from the Research’ discusses further possible developments of the instruments used in the research, and the conclusions (and implications for further research) from the overall thesis, Chapter Fourteen.

The Appendices include the raw scores from each of the four experimental studies; a copy of the final version of the instruments used; and modified test booklets/answer sheets for some of the ‘tests’ administered.

Presentation of the Chapters

Chapter One	Provides an explanation of the reasons for undertaking the research.
Chapter Two	Gives the story of field dependence – field independence and its origins and developments, as well as its application and credibility in psychological and educational research.
Chapter Three	A discussion of the relationship between a number of cognitive and psychological attributes to field dependence – field independence is undertaken.
Chapter Four	Explanation of the relationship between major cognitive and learning styles, additional models to describe the process of learning, and attempts to produce unifying models, to field dependence – field independence.

Chapter Five	Explanation of the research rational, methodology and design, together with ethical considerations in the execution of the research.
Chapter Six	An account is given of the initial thinking and subsequent Development of the Embedded Shaper Test (EST); Sense Word Test (SWT); and Non-Sense Word Test (NSWT), together with a description of their administration and scoring.
Chapter Seven	This chapter compares the differences between the Embedded Shapes Test (EST); Sense Word Test (SWT); and Non-Sense Word Test (NSWT); in terms of the measurement of field dependence – field independence.
Chapter Eight	Within this chapter further developments are explored in relation to three models. One model explores field dependence – field independence using text, one extends the basic concept of field dependence – field independence, and one places field dependence – field independence as the foundation of a comprehensive model of the learning process.
Chapter Nine	Pilots One & Two The administration and scoring of the Embedded Shapes Test (EST); Sense Word Test (SWT); and Non-Sense Word Test (NSWT), are carried out for the first and second time through Pilot Study One and Two respectively, and the outcomes discussed.
Chapter Ten	Study One From information gained by Pilots One and Two, modifications are described with regards to the Embedded Shapes Test (EST); Sense Word Test (SWT); Non-Sense Word Test (NSWT). Also, the administration scoring and outcomes from these tests are analysed, together with performance/attainment scores from a number of school subjects. The analysis is illustrated by a series of tables and graphs, which are discussed, and conclusions made.
Chapter Eleven	Study Two No modifications were made to the Embedded Shapes Test (EST), Sense Word Test (SWT), and Non-Sense Word Test (NSWT) for their administration in Study Two. However, performance/

attainment scores from different school subjects were used. The analysis between scores obtained from the EST, SWT, NSWT, and school subjects are illustrated by a series of tables and graphs which are discussed and conclusions made.

Chapter Twelve — Study Three

In addition to the use of the Embedded Shapes Test (EST); Sense Word Test (SWT); and Non-Sense Word Test (NSWT), with no Modifications from Study Two, the Gestalt Picture Completion Test (GPCT) (Street 1935), a different type of measurement of perceptual ability, and the Chronological Order Integration Test (COIT) (Riding et al, 1995), an additional measurement of field dependence – field independence using a verbal modality involving a text rather than words, were used. Also, performance/attainment scores from an increased number of school subjects and performance/attainment grades from a number of General Certificate of Secondary Education (GCSE) subjects were used.

Scores from each of the above 'tests', school and GCSE subjects were analysed and illustrated by a series of tables and graphs, which are discussed and conclusions made.

Chapter Thirteen — Study Four

This study like that of Study Three included the Embedded Shapes Test (EST), Sense Word Test (SWT), Non-Sense Word Test (NSWT) and the Gestalt Picture Completion Test (GPCT) (Street 1935). In addition to these 'tests', a measurement of an Intelligence Quotient (IQ) was undertaken using the British Ability Scales (BASI) Short Form Intelligence Quotient and the Cognitive Styles Analysis (CSA) (Riding, 1991 and 2000) were used.

Also, performance/attainment scores from an increased number of school subjects (to that of Study Three) were used.

Scores from each of the above 'tests' and school subjects were analysed, illustrated by a series of tables and graphs, which are discussed and conclusions made.

Chapter Fourteen	In this chapter a comparison is made between the outcomes from the Embedded Shapes Test (EST), Sense Word Test (SWT), Non-Sense Word Test (NSWT) from the four studies; the Gestalt Picture Completion Test (GPCT) from Study Three and Four; and the school subjects, both within and between the four experimental studies. A further comparison is made between the measurement of field dependence – field independence from the use of a spatial modality, i.e. EST, and a verbal modality, i.e. SWT, NSWT and COIT. Also, the validity and reliability of the EST, SWT, NSWT and COIT are discussed.
Chapter Fifteen	Further developments of the EST, SWT, NSWT and COIT are discussed in terms of the establishment of instruments that are potentially able to measure field dependence – field independence with greater precision from both a spatial and verbal perspective.
Chapter Sixteen	This chapter discusses the overall conditions from thesis, the Possible future of field dependence – field independence in psychological and educational research and practice, as well as the field of cognitive and learning styles in general.

1.7 The Significance of the Research

One of my motivations for initiating research into the measurement of field dependence – field independence was concerned with my role as, a one-time High School Teacher, and in my current role as an Educational Psychologist. As a High School Teacher, observing students in the classroom approach learning and problem solving in a variety of ways and asking myself the question, Why does this happen when all of the students have been given the same information in the same way?; and as an Educational Psychologist, in the assessment of students, when asking students to perform cognitive and educational tasks, when the presentation of the task was done in the same way with all students, Why is the learning/problem solving behaviour so varied irrespective of a recognised level of educational ability?

The answer to this question is likely to begin with the perception of the learning task or problem itself. What is first seen by the individual? What is the interpretation? and What is understood by the individual of the given problem? The perception of a given problem is fundamental to the generation of a solution or possible solutions to it. Is the learning task or problem clearly seen or only partially seen?

A measure of individual's level of field dependency – field independency can possibly provide a measure of the ability to be able to fully or partially (or not at all), detach surrounding information from the essential information of a given learning task or problem.

However, field dependency – field independency, as an isolated measure of s specific ability, is likely to be insufficient to fully explain the process that enables a successful solution to any learning task or problem to be produced by any individual. Other cognitive and psychological attributes have to be taken into account in an attempt to achieve this.

Such attributes could include the following elements:-

Perception/spatial ability, problem solving, thinking intelligence/ability, creativity, memory (of a cognitive/practical/academic nature), personality characteristics, self-concept and motivation

But the starting for the successful completion of a learning task or solution to a given problem is the clarity of the perception of the learning task or problem, on the part of the individual. Can the wood be seen in spite of the trees? Is the individual able to go to the heart of the matter?, i.e. the essential components of the learning task or problem.

Therefore, the focus of the thesis will be on the measurement of field dependence (dependency) – field independence (independency) using spatial and verbal modalities, and how it is reflected in thinking behaviour, within the processes of learning and problem solving, which in turn will be compared with a variety of additional cognitive skills measurements and school subjects attainment data. This will provide the opportunity within the overall investigation of the thesis to explore quantitative, and to a certain extent qualitative evidence, of the relationship between measures of field dependence – field independence and educational outcomes of the individual that are members of the samples of students used for the research.

In addition to the above, I feel that my experience of both the role of High School Teacher and Educational Psychologist, gives me a unique perspective on the processes of learning and problem solving, as well as the interaction between learning and teaching. Such experience will enable me to reflect on the learning and teaching process through the research data generated as part of this thesis, not only in cognitive terms but also in human interaction terms between learner and teacher.

A further motivation for my engagement with this thesis is in relation to the potential contribution the research may make to the measurement of field dependence – field independence, and the role of this concept in the understanding of cognitive abilities and the process(es) and interaction of learning and teaching.

Furthermore the research is not only concerned with a possible improvement in the measurement of field dependence - field independence using a spatial (geometrical) modality but also using a verbal modality.

Although field dependence – field independence has traditionally been measured using a spatial (geometrical) modality, it is (logically) very likely that the concept is applicable to a variety of non-spatial learning tasks that involve language and the requirement for answers to be given in a written format. Hence the attempt to measure and investigate field dependence – field independence through a verbal modality or medium, i.e. letters, words and text.

Therefore, this research extends the basic concept of field dependence – field independence and applies it to many aspects of learning and teaching across the high school curriculum, and beyond, but also to the processes of learning in general.

1.8 Conclusion

Through this research the aspiration is not only to provide answers to the research questions posed, but also to gain an additional understanding of the concept of field dependence – field independence and ways in which its application to learning, in particular, and teaching can assist the processes inherent in them.

Chapter 2

The Cognitive Style of Field Dependence – Field Independence

2.1 Introduction

Field dependence – field independence is the name given to a unique cognitive style, whose origins are associated with research into physical visual perception and subsequent developments associated with cognitive ability and personality theory.

The cognitive style of field dependence – field independence is a bi-polar construct with a continuum between the two extremes. Within the middle of the two extremes, there appears to be an overlapping region, where an individual might display field dependent and /or field independent characteristics in relation to a cognitive task or social situation. The mid-point of the continuum could be described as the lowest level of field dependency as well as field independency. However, the mid-point is relative to the maximum number of points possible in any 'test' of field dependency – field independency, i.e. a given score on one 'test' could place an individual in a different position on the continuum in comparison with the same score from a different 'test'.

To take account of the above situation, the raw scores for the field dependent – field independent measures in this Thesis, principally those from the Embedded Shapes Test (EST3), were divided into three or four groups depending on the Study, i.e. low, medium and high for Studies 1, 2 and 4; and low, low-medium, high-medium and high for Study 3.

2.2 Origin and Developments of Field Dependence – Field Independence

H. A. Witkin et al began a series of experiments in the 1940's to assess an individual's ability to determine whether or not the 'up-right', i.e. a vertical line, or their body position, was perpendicular to the horizontal.

The initial experiment consisted of a rod and frame, in which the task of the experimental subject was to align the rod to the vertical position irrespective of its position in relation to the sides of the frame. The experimental environment was a darkened room, the rod and frame were illuminated, each were pivoted independently about a common centre, and the experimenter controlled the tilt of the frame, i.e. positioned it to a number of different angles, right and/or left, so that with each different angle, the experiment subject attempted to align the rod to the vertical position independently of the frame. This experiment became known as the Rod and Frame Test (RFT).

Later the basic experimental arrangement of the RFT was developed and elaborated upon so that the frame became a complete room, capable of being tilted to a variety of angles and the rod was replaced by the body of the experimental subject, seated in a chair within the room, which itself was capable of being tilted to a variety of angles relative to the room, with both chair and room being pivoted, independently about a common centre. The experimenter controlled the tilt of the room, to a variety of angles within the vertical plane, and the task of the experimental subject was to adjust the chair so that it and the experimental subject sitting in it became positioned in an upright position, irrespective of the angle of tilt of the room. This experiment became known as the Body Adjustment Test (BAT).

Both of these experiments are concerned with the ability of the experimental subject to complete the given task, i.e. positioning the rod or their body into the vertical position irrespective of the position of the frame or room, by taking into account any influence the context or surrounding field, i.e. frame or room, might have.

In general the results from these experiments were somewhat surprising in that some experimental subjects produced a discrepancy of up to thirty degrees between their positioning of the rod and/or chair (their body) to the ‘upright’ position. Witkin et al investigated whether the results from these experiments could be explained by a consideration of differential sensitivity due to bodily sensations. If this were so, then the visual context of the two tests, especially the BAT, would have nothing to do with the results obtained. Witkin et al were able to show that bodily sensations, i.e. ‘feelings’ of upright or tiltedness, were not the principal cause of the experimental results.

Witkin et al (1954) suggested that what the two tests have in common is the ability of the experimental subject, to separate a given element from all of the elements that constitute the context. This idea was related in turn to the Gestalt idea of ‘figure and ground’, where a given figure or element to be located, is not always seen because of all the elements that constitute the ground or background or surrounding context, mask or embed the element to be identified.

These results enabled Witkin et al to formulate the idea of a contextual field which was influenced, in varying degrees, to the ability and efficiency of individuals to solve a problem which was located or contained within the elements that constituted the field. This became known as field dependent – field independent, a bipolar construct which reflected or described an individual's particular style, or cognitive style, of solving problems (Witkin et al, 1954; Witkin, Goodenough and Karp, 1967).

From a combination of the above two ideas, Witkin et al developed the Embedded Figures Test (EFT), a paper and pencil test, which used a collection of modified figures selected from Gottschaldt (1926). Each test item in the Embedded Figures Test consists of a simple and complex figure. The simple figure is contained in the complex figure, but is difficult to locate because the complex figure also contains a number of distracting lines, and so the simple figures is lost or embedded within the complex figure. Therefore, the task of the testee is to find or disembed the simple figure within the complex figure by drawing around it.

Witkin et al also found that by using colours for some of the complex figures the level of distraction or degree of embeddedness could be increased.

Although the development of the EFT enabled the assessment of field dependence – field independence to be done using less elaborate means, it remained an individual assessment. As a consequence of this, Witkin et al developed the Group Embedded Figures Test (GEFT), which as the name suggests can be administered on a group basis, thus reducing administration and assessment time.

The GEFT is similar to the EFT in that it uses seventeen of the complex figures taken from the EFT, with the major difference being the use of light shading instead of colours for the same parts of the same complex figures, 'to emphasize large organised gestalten serving to embed the simple forms' (Witkin et al, p26, 1971).

Therefore, in both the EFT, and the GEFT, the individual who is able to successfully complete the most test items, i.e. locate the simple figure within the complex figure, is designated as field-independent, and the individual who is only able to successfully complete a few test items i.e. unable to locate the simple figure within the complex figure, is designated field dependent.

There is a third test named the Children's Embedded Figures Test (CEFT), which uses drawings of common objects, cut out in wood to form a jigsaw for the complex figures, the simple figures consisting of a single jigsaw piece which can be taken from the jigsaw as a whole. Only the designated, correct single piece of jigsaw or simple figure can be taken from the whole jigsaw, forming the complex figure, for each test item to be successfully completed within the overall test. Successful identification, of the designated piece for each test item, would indicate a high level of field independence.

This test was developed so that field dependent – field independent cognitive style could be assessed in children, thus providing field dependent – field independent measurements, and through the later use of the EFT or GEFT, over a long period of time, i.e. childhood to adulthood, the stability or instability of field dependence – field independence could be studied and documented.

2.3 Psychological Differentiation

Up to this stage in the development of the concept of field dependence – field independence, the idea of a continuum between the extremes of the bi-polar construct, i.e. field dependence at one end and field independence at the other emerged. But what are the characteristics of the designated field dependent and field independent person in terms of the way they function in a particular context, whether it be cognitively or socially, and would an individual move from one extreme (field dependent) to the other (field independent), or at least change position along the continuum between the two extremes, depending on the context of the particular problem or situation they were faced with?

In an attempt to answer these questions, Witkin et al (1962) developed the theory of Psychological Differentiation, which in many respects can be considered to incorporate an alternative model of human personality.

Psychological Differentiation attempts to explain human behaviour, individually and collectively by extrapolating from the notion of field dependency – field independency in terms of a physical perception perspective to a social perception perspective. In this way non-cognitive (personality) attributes, traits and characteristics of the individual are taken into account, while simultaneously recognising that all of them originate from a physical perceptual base which is essentially that of field dependency – field independency.

Differentiation in the Witkin et al (1962) model of personality is concerned with the development and variability of cognitive functioning, and how this relates to a range of pathologies, which are different for both the field dependent and field independent individual.

The field dependent individual is considered to exhibit characteristics related to the identification of problems, which in turn can be associated with dependency, passivity and helplessness. At an extreme level of field dependence, such characteristics can manifest themselves with the conditions of alcoholism, asthma, and cardio disorders. In contrast, the field independent individual exhibits characteristics which can relate to delusions, ideas of grandeur, and a continuous concern with identity. At an extreme level of field independence, the characteristics of field independent individuals can relate to paranoid, obsessive-compulsive and neurotic behaviour.

The essence of psychological differentiation according to Witkin et al, consists of the four dimensions of field dependence – field independence; articulation of body concept; sense of identity and defence structures.

An additional way of classifying field dependent – field independent individuals is to use the terms 'global' and 'articulated' respectively.

Characteristics of field dependent individuals include a dependence on external reference to achieve solutions, well developed interpersonal skills, and therefore, they are comfortable interacting with people, particularly in ambiguous situations, where they rely on others to help them to decide on judgements and actions. In contrast, characteristics of field-independent individuals include the utilisation of internal referents, in a wide variety of procedures, they demonstrate more developed skills in cognitive restructuring and in the ability to segregate and manipulate abstract concepts, and they are more autonomous towards others in social situations. It is not surprising then, to learn, that field dependents favour occupations in the humanities, social services, and caring professions, whereas field independents prefer occupations in the mathematics, sciences and technological professions. Also, field dependent and field independent people are distinguished by their performance on perceptual and intellectual tasks.

'Such differences between the field dependent and the field independent reflect the higher-order construct of self-nonself segregation, which in turn is a particular, though centrally important, aspect of the still higher construct of psychological differentiation (Witkin, Goodenough and Oltman, 1979). A more differentiated person shows more self-nonself segregation; there are more definite and firmer boundaries "between an inner core of attitudes, feelings, and needs identified as the self, and the outer world, particularly other people" (p1127). As part of a more segregated self are a more articulated body concept and a greater sense of personal identity. Overall, the more segregated the self, the more likely a person is to be field-dependent, having greater cognitive restructuring skills though fewer interpersonal competencies' (Korchin, p47, as cited by Bertini et al, eds. 1986).

For a more detailed description of Psychological Differentiation see Chapter Three, Section 3.7, Theories of Personality.

2.4 Mobility - Fixity

Not all individuals are at the extremes of the field dependent – field independent continuum. Some individuals are able to move between the two extremes depending on developed differentiation and circumstances and/or inner state. This movement is designated by the idea of 'mobility-fixity' (Werner 1957), and observations suggest that it is applicable to field independence and not field dependence.

'Though both kinds of persons ('mobile' and 'fixed') have achieved the capacity to function in a field dependent fashion, the kind of field dependent person who is 'fixed' always does, whereas the one who is 'mobile' may or may not. Mobility can be characteristic of highly differentiated persons only, i.e. of persons who have available to them both a developmentally advanced mode of functioning (field independence) and a developmentally earlier mode (field dependence). Shifting of levels, implied by mobility, is thus not a possible feature of field dependent persons' (Witkin et al, p11, 1971).

2.5 Related Concepts to Field Dependence – Field Independence

i) Cognitive Control

Cognitive Controls can be considered to be different from cognitive styles depending on the criteria from which they are defined. Santostefano (1978, op.cit. Jonassen and Grabowski, 1993) define cognitive controls to –
'have the status of intervening variables that define principles by which motoric behaviour, perception, memory and other basic quantitative forms of cognitive functioning are organised as an individual coordinates himself(/herself) with his(her) environment.'

However, many of the attributes referred to in the above definition can be applied to a definition of field dependence – field independence.

Perhaps, a more meaningful way of differentiating between a cognitive control and a cognitive style is to consider a cognitive control as uni-polar and a cognitive style to be bi-polar. Since bi-polar implicitly suggests a continuum between two poles (two extremes), there is scope for the individual to display varying degrees of a given skill across it; whereas uni-polar implicitly suggests, a fixed level of a skill, which would be used in a general or specific context and/or situation.

The following diagram (Jonassen and Grabowski, 1993) shows the characteristic differences in field dependence – field independence:-

Characteristic Differences in Field Dependence – Field Independence

Field Dependence	Field Independence
global	analytical
accepts structure	generates structures
externally directed	internally directed
attentive to social information	inattentive to social cues
conflict resolvers	philosophical
sociable and gregarious	individualistic
affiliation oriented	distant in social relations
interpersonal	intrapersonal
needs friendship	reserved, aloof
influenced by the salient features	experimental
actually oriented	generates own hypothesis
acquires unrelated facts	acquires information to fit conceptual scheme
accepts ideas as presented	represents concepts through analysis
influenced by format/structure	less affected by format/structure
gets feelings/decisions from others	impersonal orientation
sensitive to others	insensitive to social undercurrents
affected by stress	ignores external stress

ii) Weak Coherence Theory

The term 'weak central coherence' is a relatively new way to describe tasks that focus local over global processing styles (Firth, 1989). This theoretical approach is used in studies of Autism (Autistic Spectrum Disorders (ASD)) where there is an attempt to differentiate between field dependence – field independence and 'weak coherence theory' (Happé and Firth, 2006). Evidence for or against this concept/theory remains in the process of accumulation.

‘Despite the implicit assumption within the literature that weak central coherence/field-independence is equivalent to a locally biased perceptual style and strong central coherence/field-dependence is equivalent to a globally biased perceptual style, the direct relationship between these constructs has not been examined systematically.’ (Milne and Szczerbinski, 2009).

However, attempts at the identification of the specific skills between field dependence – field independence and other perceptual tests, e.g. Gestalt Picture Completion Test (Street, 1931) are not new.

‘Witkin et al (1962) reviewed a series of existing correlational and factor analytic studies, and concluded that field independence was a narrow constant that refers specifically to the ‘ability to separate an item from its context (p47)’ In other words, an item must be embedded within a structural context rather than merely being surrounded by amorphous material. This early research highlighted that field independence is separate from the ability to identify an incomplete figure as measured by Gestalt Completion Tests (e.g. Street 1931, Mooney 1957). Tasks requiring identification of incomplete figures were only related to those that required dis-embedding, and loaded onto separate factors described as measuring ‘speed of closure’ (Thurstone 1944)’(Milne and Szczerbinski, 2009).

Speed of closure as described above is different from the speed of completing embedded figure/shape tasks. As Carroll (1993) expresses this in terms of a cognitive flexibility factor – ‘Speed of detecting and disembedding a known stimulus array from a more complex array’

In addition, sensitivity to coherent motion and coherent form or significant correlations between performance on the Children’s’ Embedded Figures Test and coherent motion thresholds have been reported in children with autism (Pellicano, Gibson, Mayberry, Durkin and Babcock, 2005), and detection of both coherent motion and coherent form can be seen as measures of low-level perceptual integration, respectively. (Milne and Szczerbinski, 2009).

iii) Cognitive and Non-Cognitive Attributes

The fundamental characteristics of field dependence – field independence can be considered to relate well to the ideas of convergent and divergent thinking and associated occupations (Hudson, 1966), i.e. seeking a number of possible answers to a problem before the selection of one particular answer to solve the problem; adaptive-flexible thinking (Guilford et al 1957), i.e. the need to think creatively in an attempt to derive an acceptable answer to a given problem; and the introversion and extroversion dimensions of Eysenck and Eysenck Personality Theory (1976), in terms of the shared cognitive and the intra and interpersonal/social aspects, i.e. some individuals prefer to problem solve on their own and others prefer a group or team approach to problem solving, particularly in the context of a given occupation; respectively. (See Chapter 3 - The Cognitive Style of Field Dependence – Field Independence and Associated Cognitive and Psychological Attributes, for further details).

2.6 Applications of Field Dependence – Field Independence

i) Education

The cognitive style of field dependence – field independence suggests implications for aspects of education and training. A consideration of field dependence – field independence can provide evidence for how the pupil or student approaches a given cognitive task as well as how they attempt to complete the task. In addition, the cognitive style (field dependence or field independence) of the teacher can be taken into account within the overall educational process to ensure a 'match' and not a 'mis-match' of cognitive style between teacher and pupil/student. Obviously, no one teacher is going to have the same cognitive style as all of the pupils or students in a given class, but if the teacher is aware of their particular style designation, i.e. field dependence or field independence, he or she can vary their approach to the teaching/educational process so as to maximise the requirements of the two cognitive styles of field dependent – field independent within a given class.

One of the difficulties that has arisen with the interpretation of field dependency – field independency test results from the EFT and/or GEFT, is that field dependency and field independency has been treated as a description for the design of a teaching approach and associated teaching materials, i.e. the adoption of a global or analytical methodology instead of a combination of the two, that do not always maximise support for the learner (Tinajero and Paramo, 1998)

A consequence of this approach is that the learner can become labelled as either field dependent or field independent, leading to a possible assumption on the part of the teacher that the learner with one style (field dependent), has limitations, which could become associated with a lack of aspiration for the learner to progress in learning attainment; and with the other style (field independent) to assume that the learner requires little help from the teacher to progress in learning attainment.

The style of field dependency - field independency (as do other styles, cognitive and learning) need to be treated in terms of the learner's propensity to approach learning and the processing of information, of whatever modality, in a particular manner (Price, 2004).

The role of the teacher is to maximise and integrate such a propensity into the teaching approach and the design of teaching and learning materials and programmes. This can be enhanced by the employment, on the part of the teacher, of formative assessments with feedback to the learner, of whatever style, on a regular basis, linked to the style propensity of the learner.

ii) Miscellaneous

Although field dependency – field independency has been predominantly applied to educational research, at all levels, in relation to learning and teaching, it has also been used in a variety of other areas of research to either attempt to clarify and/or substantiate the concept of field dependency – field independency, e.g. a unified definition of style and central coherence theory; or to use it as a technique, sometimes among other techniques to try to explain , and in some cases address particular manifestations of human behaviour in particular contexts or circumstances. Topics include educational achievement; vocational and occupational issues; clinical issues; autism; therapeutic issues (counselling); social psychology; individual differences; personality traits and/or characteristics; and cross-cultural differences (Bertini et al, 1986).

2.7 Sex Differences

A variety of studies have shown sex differences between the two dimensions of field dependence – field independence, boys and men tend to be more field independent than girls and women. Also, an individual's designation as field dependent or field independent has a relative stability in the middle years of life, once a propensity for a field dependent or field independent mode of functioning has been acquired through the developmental years, but all individuals tend to become more field dependent with age (Witkin et al, 1962, 1971, 1981).

2.8 Measurement and Interpretation of Field Dependence – Field Independence

One of the current criticisms of the measurement of field dependence – field independence in the form of the Group Embedded Figures Test, is that it is more a measurement of cognitive ability rather than cognitive style, although the research evidence is not conclusive at the present time.

The concept and measurement of field dependency – field independency is not without a number of different interpretations and concerns have been raised with regard to the applicability of it in educational and psychological contexts.

With regard to the concept of field dependency – field independency, Witkin et al state that it is a cognitive style (1981), irrespective of the origin of it evolving from studies in physical perception of the 'upright' and body orientation relative to the 'upright' (1962).

In addition, field dependency – field independency has a bi-polar formulation which incorporates a continuum from field dependency to field independency, exhibiting at the extremes, a different set of characteristics, each of which, predominantly one or the other, are manifested within the individual. Field dependency characteristics include cognitive rigidity in relation to analytical thinking and academic problem solving, but well developed social awareness and adaptability in terms of reactions to and interactions with others; whereas field independency characteristics include, cognitive flexibility and adaptability in relation to analytical thinking and academic problem solving, but a lack of well-developed social skills in terms of their approach to and interactions with others.

However, the measurement of field dependency – field independency is the focus of concern which relates to the concept, formulation and interpretation of it. This involves a consideration of how field dependency – field independency is measured through the use of the EFT and GEFT (Witkin et al, 1971).

Some researchers argue (Richardson, 2011) that both the EFT and the GEFT take into account, in a direct way, spatial ability, as well as visuospatial processing and executive functioning in working memory. Therefore, the EFT and the GEFT are measures of cognitive ability more than they are of cognitive style. Such a view is supported by the idea of dual coding theory and cognitive load theory (Milne and Szczerbinski, 2009). The assumption here is that there are two distinct but connected systems in memory, one designated for verbal-linguistic information and the other designated for non-verbal or visuospatial information, and the potential relationship between working memory capacity and the processing of visuospatial material, respectively (Rittschof , 2010).

In spite of the above arguments, field dependency - field independency does have a style dimension which is independent of ability (Riding and Pearson, 1994) and there is evidence, in addition to that from Witkin et al (1981), that it does describe an approach to information processing.

The development of the EST is an attempt to address the concerns expressed by some researchers with regard to a visuospatial memory component intact in the assessment of field dependency – field independency, through the use of the EFT and GEFT by placing the sample shape by the side of the complex shape. With each test item/question of the test, unlike that of the EFT and/or the GEFT where the sample figure is placed away from the complex figure (EFT) as on the back page of the test booklet (GEFT).

This major change in the assessment of field dependency – field independency between the EST and the GEFT, in particular, is related to Research Question 1, as follows:-

Is it possible to produce a more sensitive and therefore more accurate measurement of field dependency – field independency using a spatial modality?

Therefore, it is proposed that by eliminating, or at least considerably reducing, a need for the testee to remember the simple shape before trying to disembed it from the complex shape, there will be a greater focus on the measurement of field dependency – field independency, and less, or no, measure of functionality in working memory, which in turn, arguably, will provide less of a measurement of cognitive ability and more of a measurement of field dependency or field independency.

The above approach to the measurement of field dependency – field independency, i.e. the disembedding of a simple element contained within a complex element, with the simple element placed by the side of the complex element, is extended within the Thesis, by the development of the Sense Word Test (SWT) and the Non-Sense Word Test (NSWT) in the context of a verbal modality. This relates to Research Question 2 as follows:-

Is it possible to measure field dependence – field independence using a verbal modality?

If the assumptions of dual coding theory are correct, then both the verbal-linguistic and visuospatial systems of processing information would be engaged in the completion of the test items/questions within the SWT and NSWT, particularly the SWT because it utilises real words for both the simple and complex elements of each test item/question.

2.9 Conclusion

The cognitive style of field dependence - field independence formulated by Witkin et al is more than just a cognitive style in that it only attempts to explain an aspect of intellectual functioning. It has through its development (which continues) provided a link between perception of both a physical and social nature; an insight into the analysis and synthesis that takes place in thinking and creativity, as they relate to problem solving; and personality type factors that are manifest within the individual and between individuals.

Research into the construct of field dependence – field independence has stimulated further research into the whole area of cognitive and learning styles. It could be said that it has provided a demonstration of the inter-relationship between cognitive and personality factors within the human being, in an attempt to explain how the human being responds and functions in a variety of situations and contexts, thus, making a major contribution to the knowledge base and understanding of cognitive styles and personality theory, within individual differences.

Chapter 3

The Cognitive Style of Field Dependence – Field Independence and Associated Cognitive and Psychological Attributes

3.1 Introduction

In this chapter a range of theories and models will be discussed and related to a number of different psychological attributes, in terms of how they relate to, or are associated with field dependence – field independence.

Baddeley (1990) referring to theories and models says,

'Theories and models are like maps, offering a useful way of summarising what is known. In this respect they are similar to laws or principles. In addition to their descriptive function however, theories and models attempt to go beyond what is known, and offer a possible explanation of existing findings and suggest ways in which phenomenon can be further explored. In short, laws and principles describe what we know, whereas models and theories provide tools for learning more.'

Although the theories, models and psychological attributes referred to are different, they are all related in varying degrees because they form part of the human condition in terms of cognitive and, to a certain extent, social processes and interactions. Also, they are considered from the point of view of how they might be associated with the concept and construct of field dependence – field independence, in terms of the possible process(es) that lie behind the field dependent – field independent designation.

Therefore, by considering a range of new and not so new ideas related to physical perception, thinking, intelligence/ability, creativity, memory, personality, the self-concept and motivation, an explanation can begin to be assembled to account for the nature of, and mechanisms that constitute field dependence – field independence.

3.2 Perception and Spatial Ability

i) Perception

Although the concept of field dependence-field independence has its roots in the notion of a perceptual field, in relation to the degree of how such a field masks elements within it and is perceived by the individual, it does not explain, or attempt to explain, the mechanism(s), by which perception of the field and elements within it, are perceived by the individual, whether the outcome is designated field dependent or field independent. While it would be very difficult to separate elements of the field from the overall field because of their influencing associations to the perceived overall outcome, i.e. field dependent or field independent, it is likely that particular elements of the field could influence disproportionately the overall outcome. This may not apply to the Rod and Frame Test, for example, due to the simple or relatively simply shape of the rod, the frame, and the combination of the two shapes together. However, with more complex shapes and 'fields', e.g. Witkin's Group Embedded Figures Test (GEFT) (1971), and Pearson's Embedded Shapes Test (EST) (2008), the simple figure or shape, equivalent to the 'rod' and the complex figure or shapes, equivalent to the 'frame', pose a more difficult perceptual task.

The transference and equivalence that Witkin (1971) advocates between the Rod and Frame Test and Embedded Figures Test(s) is open to question, e.g. Are they measuring the same cognitive attribute or something with only partial similarities?

With both Witkin's Group Embedded Figures Test and Pearson's Embedded Shapes Test, the simple figures or shapes as well as the complex figures or shapes, can be difficult to mentally manipulate in terms of their relationship(s) to each other, not only as an embedded pair of figures or shapes but also from the perception of the figure or shape, simple and complex, as a separate figure or shape. It is as though there are two levels of perception that have to be worked through when the activity of disembedding, embedded figures or shapes, takes place. The first level is the perception of the figure or shape, simple and complex, involved in a given embedded task, i.e. appreciating all of the geometric properties; the second level is the matching or the determination of the relationship / association / location of the simple figure or shape within the complex figure or shape. If the individual's perception of both simple and complex figure or shape has not been achieved correctly, due to a variety of factors, e.g. familiarity with geometrical shapes and patterns, a particular creativity, ability and motivation to succeed, then it is unlikely that the relationship / association / location between the two will be discovered or disembedding successfully achieved. The point at which the simple and complex figure or shape stop to be perceived separately, before beginning to be perceived together, so that the embedded solution can be identified and achieved, is difficult to predict, but as with all cognitive activities, a variety of cognitive and psychological attributes are involved.

In attempting to demonstrate the perceptual mechanism(s) that could explain or possibly explain an individual's designation of field dependent or field independent, aspects of Gestalt Psychology (Wertheimer, 1923; Kohler, 1920; Koffka, 1955) could be used. Gestalt is the

German word for ‘form’, ‘shape’ or ‘whole configuration’. Also, ‘Gestalts’ or ‘Gestalten’ are basic units of perception which form a given perception. The phrase, the whole is different from the sum of its parts, is often used in the above context within Gestalt Psychology.

In addition to the above terminology there are within Gestalt Psychology, several ‘Gestalt Grouping Principals’, namely Proximity (Nearness); Similarity; Good Continuation; Common Fate; Symmetry and Closure (Wertheimer, 1923). Many of these ‘Gestalt Grouping Principles’, together with several corollaries, have been codified under the general label of the ‘Law of Pragnanz’ or the law of the ‘good figure’. This refers to the tendency to perceive a given configuration in its most simple and stable form from all other possible alternatives.

A further way of analysing spatial information within a visual field is through consideration of what came to be known as figure-ground, which forms part of ‘Gestalt Psychology’.

Therefore, particular aspects of ‘Gestalt Psychology’, i.e. figure and ground; closure; and the ‘Law of Pragnanz’ appear to suggest a way to analyse the simple and complex figures of the Group Embedded Figures Test (GEFT) (Witkin, 1971) and the Embedded Shapes Test (EST) (Pearson, 2008) used to determine the level of field dependency and field independency.

Figure and Ground (Rubin, 1915) are related to a picture where the ‘figure’, within a picture, is a person, animal, object or a combination of these things, and the ‘ground’, of the picture, is the background to the picture. This description is simplistic because with some pictures or arrangements of spatial information representing the figure and the ground, figure and ground can be alternated. Does this happen with embedded figures and shapes? If it does, then perhaps the field independent person can see each alternative, i.e. simple figure/shape as figure, and complex figure/shape as ground, or vice versa, enabling them to disembed the simple figure/shape from the complex figure/shape; and with the field dependent person, they are only able to see one alternative, i.e. the complex figure/shape as the ground overwhelming the simple figure/shape as the figure within the ground, and therefore, are unable to disembed the simple figure/shape from the complex figure/shape.

Closure is related to the completion of the depiction of a person, animal, object or combination of these things from only partial pictorial information given, e.g. items contained in the Street Gestalt (Picture) Completion Test (Street, 1935). Therefore, is a similar but reverse process operating with the complex figures or shapes in tests of field dependence – field independence, (Witkin, 1971; Pearson, 2008), in that the number of lines contained in the complex figure or shape close down or mask out the simple figure or shape, thus making it difficult to locate and so, disembed one from the other? In this analogy the simple figure or shape would be represented by pieces or fragments of the person, animal or object to be ‘closed’, but since ‘closure’ in the form of the lines of the complex figure or shape having already taken place, the simple figure or shape would become obscured due to the abstract nature of the resultant complex figure or shape, i.e. the ground of the figure/ground combination.

The Law of Pragnanz or the law of the ‘good figure’ can be applied to the simple figures or shapes of field dependent – field independent tasks because in the majority of, if not all cases, they represent a recognisable geometrical figure or shape comparable to the complex figure or shape. Therefore, the ‘good figure’ model can account for the individual being able to locate a simple figure or shape within a complex figure or shape because the figure or shape the individual is required to recognise is a familiar figure or shape likely to be known to the individual.

The degree of complexity of the complex figures within tests of field dependence – field independence can be increased by the use of ‘shading’; a simple figure or shape of three dimensions to be located in or disembedded from a complex figure or shape of two dimensions; or the use of colour, e.g. Group Embedded Figures Test (GEFT) (Witkin, 1971) and Colour Embedded Figures Test (CEFT) (Witkin, 1971), respectively.

ii) Spatial Ability

A reasonable assumption to make would be that field dependence – field independence would correlate highly with spatial ability because of the spatial, geometrical nature of the Group Embedded Figures Test (GEFT) (Witkin, 1971) or the Embedded Shapes Test (EST) (Pearson, 2008). However, spatial ability is difficult to define due to the association it has with mathematical ability on the one hand and with what could be termed practical ability on the other hand, with the characteristics and measurement of intelligence, perhaps, somewhere between the two. This in turn brings into question the definition of intelligence and how it is measured.

Shape recognition, shape orientation, spatial relationships between figures, shapes or objects, and the recognition and discrimination of patterns, where they exist, are all important aspects of spatial ability. Also, whatever the exact neurological mechanisms that define perception and spatial ability, in association with the physical world, i.e. light, colour and the dimensions of scale of an object, there are going to be common and individual differences between groups of individuals and individuals themselves.

In terms of tasks involving the disembedding of simple figures or shapes from complex figures or shapes, all of the above factors appear to apply.

3.3 Problem Solving and Thinking

i) Problem Solving

Before a solution or solutions to any problem can be found, a problem has first to be recognised or identified. Also, an understanding of the psychological processes involved would give greater clarity to both identification and derived solutions. Guilford (1954) believed that 'problem solving', as a phenomenon, had no stable meaning within psychological literature. By this he meant that 'problem solving' had no simple, clear definition or explanation of the psychological and cognitive process involved. What is sometimes not taken into consideration is the situation or context in which the problem exists. Therefore, a consideration of this situation or context can help to define and evolve solutions to a given problem. Also, the attitude and level of motivation the potential 'problem solver' brings to the problem situation can be influential, either positively or negatively, to the solution of the problem in terms of the number of possible solutions and the quality of the solutions.

Raaheim (1974) states:

"Woodworth and Schlosberg (1955) write that a problem exists when the individual has a goal, but no clear or well learned route to the goal. If we go back to Kohler (1917) we find the notion of 'Uniweg', or detour, which has to be taken by the individual to reach the goal. Vinache (1952) speaks of the 'obstacle', or difficulty that must be overcome, and Johnson (1955) says that in a problem situation the individual's first goal-directed response is unrewarding."

Harlow (1949), from experiments with rhesus monkeys, developed the idea of 'learning sets' or a 'mental set' from a trial and error approach to problem solving and/or learning. The ‘learning set’ is a generalised approach to a class or category of similar problems rather than the development of a specific solution to a specific problem.

The Gestalt Psychologists developed the view that problem solving was a matter of trial and error, they believed that effective problem solving was only possible when the individual had some insight into the nature of the problem and therefore, able to restructure the problem to find a solution. With regards to past experience or memory of similar problems, the Gestalt Psychologists demonstrated that it could be both positive and negative if an inappropriate ‘mental set’ was applied to the problem, which would hinder the generation of a solution.

Luchins (1942) investigated the notion of a ‘mental set’ and demonstrated that in human problem-solving, individuals can become conditioned in thinking in a particular way as a consequence of their experience. The individuals in this investigation were given a number of problems and taught to solve them using a series of three steps. They were then given additional problems which could be solved using either three or two steps, the two step approach enabling the problem to be solved more efficiently. No-one used the two step approach even when the problems were given where only the two step approach was appropriate. The individuals who had not had the experience of solving the problems with the three step approach only, were more flexible in the approach they adopted, generating alternative ways of solving the presented problems.

This investigation demonstrated how previous experience can be over-whelming to an extent that it produces a rigidity of thinking. The subjects of the investigation could readily solve problems that were familiar to them but not problems that were unfamiliar. Luchins referred to this situation as habitual fixation of mind or ‘Einstelling’, which prevents people (it did in the investigation) from gaining any insight into the nature of a given problem and consequently, solving the problem by producing a clear solution.

The idea of ‘functional fixedness’ is similar to ‘Einstelling’ but with a link between the environment in which the problem is located as well as the approach the individual adopts to bring to the problem.

Duncker (1945) (as cited by Witkin et al 1971), conducted experiments in which:
“The subject(s) is given a stick and asked to fit it across the doorway, but the stick is too short. Subjects quickly learn that to solve the problem they must use a wedge to make the stick stay

in place. The experimenter has left a wedge around, but he has deliberately 'embedded' it, i.e. on the table in the experimental room is a bottle with a stopper of just the right size to provide the needed wedge. To use it for this purpose (the problem of spanning the width of the doorway) it must be taken out of the functional context of stopping up the bottle and used in the context of serving as a wedge (thus solving the problem)."

In a similar experimental approach to the investigation of 'functional fixedness', Glucksberg (1962) devised a problem in which everyday items were to be used in unfamiliar ways. The problem for the participants in the experiment was to secure two candles onto a wall using only a box of matches, the two candles and some drawing pins. The outcome of the experiment was that the participant's ability to solve the problem was greatly impaired by their inability to think of the use of the objects in ways that were different from their familiar or usual functions.

With the Duncker experiment the additional factor of 'embeddedness' and therefore, the cognitive style construct of field dependence – field independence needs to be taken into account and the link between perception, problem solving and cognitive style.

ii) Thinking

A further cognitive style, which is directly related to the understanding and explanation of problem solving and thinking, is that of divergent and convergent thinking as investigated and described by Hudson (1966).

Convergent thinkers tend to focus on particular types of problems and to look for solutions to them within well-established frameworks. In contrast, divergent thinkers are able to consider any particular type of problem, and to view a problem outside of its usual or established framework, generating in the process a number of possible solutions, some of which may be unconventional.

For the problem, 'What can a house-brick used for?' or 'How many uses might a house-brick have?', the convergent thinker would have a tendency to give a few conventional solutions or answers, which could be for example, to build a wall or to support something. Whereas, the divergent thinker would have a tendency to give several answers which could include a range of applications, such as for example, a tray for paper clips (because of the dip in the centre of some house-bricks), a door stop or a bookend (because of the size and weight of a house-brick).

Therefore, it can be assumed that convergent thinkers display a high level of ‘functional fixedness’, and divergent thinkers a low or very low level of ‘functional fixedness’, which in the case of extreme divergent thinking, may be non-existent.

A subsequent development of divergent thinking is that of ‘Lateral Thinking’ (de Bono, 1969). This involves an individual’s ability to think beyond or outside of habitual modes and patterns of thought in an attempt to develop original solutions to a variety of problems. Lateral Thinking involves the deliberate attempt to identify the assumed or taken for granted limitations to a given problem and the possible solutions within this limited context, and then viewing the problem in a completely new way, as if nothing like it had been encountered before. This approach also includes the necessity of being aware of any ‘mental set’ or learnt strategies that would inhibit original solutions to a given problem. The difference between a conventional thinking and a lateral thinking approach to a problem can be illustrated by the following example:

“- someone returning to an airport car park at night in mid-winter and finding that their car locks were frozen up would begin to look for ways of unfreezing the locks (conventional thinking) ….
- a Lateral Thinking approach might be to spend the night in the airport hotel instead, and drive the car away in the morning when the locks had unfrozen naturally” (Haynes, 1998).

The degree, to which an individual can display convergent and divergent thinking, and lateral thinking, are influenced by the individual’s level of creative ability and personality characteristics, both of which will be discussed in later sections of this chapter.

iii) The Thinking Process

Thomson (1966) considers that there are general characteristics of problem–solving behaviour, which indicate clearly distinguishable phases in a typical cycle as follows:-
“ 1 The subject must recognise and fixate the problem.
In human problem-solving it is rarely the case that random movements are set off by a blind undirected feeling of frustration. There is a difficulty, obstruction, or frustration which has to be pinned down and made capable of description and analysis. The problem once known for what it is, may be met by activity or avoided by flight or withdrawal – but it is not a problem at all until it is defined.

2. Search or exploration of the field within which the problem exists is the next step after identification.

This stage may be marked by passive observation of the data, careful inspection of the materials involved, or the interrelations which have to be traced and reorganised, or it may involve reflection on possible hypotheses suggested through an examination of perceptual data. Sometimes manipulation of materials, or trial and error moves take place during exploration; sometimes much verbalisation, ‘working it out in one’s head’, characterises this phase.

3. Analysis of the problem follows:

The results of identification and explanation must be sorted out and, if possible, a plan constructed which reorganises the situation so that there is a continuous series of stages between confrontation with the problem and final solution. If this is not possible, or if it doesn’t work out, the problem must be restarted and leads suggested for testing.

4. Finally comes attack, involving the tackling of preliminary parts before the final stages can be accomplished: such partial solution, by getting sub-problems solved, may be necessary at first. Associated with this and earlier phases are emotional reactions – anxiety or tension, disappointment, anger, satisfaction, relief, according to progress or failure. Such emotional factors may have considerable effects on the course of the problem-solving attempt and may influence the final outcome.”

In terms of the four stage model of creativity, i.e. Preparation, Incubation, Illumination and Verification (Patrick, 1930) and the above phases, Thomson’s model of problem-solving, they would correspond as follows:-

1	Recognise and fixate problem	Preparation
2	Exploration of field containing the problem	Incubation
3	Analysis of the problem	Identification
4	Attack the problem (all stages)	Verification

Both of these approaches to thinking (problem-solving and creativity) strongly suggest that the solution to any problem is arrived at through a systematic framework which includes prior knowledge, exploration and hypothesis testing. Even if a ‘eureka moment’ is experienced it is within this systematic framework which includes prior knowledge as its starting point.

The above formulation of the Thomson and Patrick models could be extended further to include additional cognitive/psychological attributes as follows:

1 Recognise and fixate problem	Perception / Memory / Schema	Preparation
2 Exploration of field containing the problem	Creativity	Incubation
3 Analysis of the problem	Ability / Intelligence	Illumination
4 Attack the problem (all stages)	Cognitive Style / Learning Style Personality Self / Motivation	Verification

The stage of 'attacking the problem' could be differentiated in relation to deciding or adopting a method of attack. A particular method of attack is likely to be associated with 'individual differences', which in turn relates to a cognitive and/or learning style.

However, the above formulations are not necessarily linear in the sense that the process of solving a problem is started at recognising and fixating the problem, each stage 'worked through' to attack the problem, until a solution to a given problem has been achieved. The reality of problem-solving is such, that there can be a 'to and fro' movement between the stages (of whatever model) with a disproportionate amount of time spent at each stage, before any solution is achieved overall. Also, arguably, the more complex and perhaps fundamental a problem may be, the more complex and time consuming is the attempt to achieve a solution, e.g. in physics the formulation of a 'unified field theory', or in psychology a unified model of all psychological attributes to explain human behaviour, cognitively and socially.

Duncker (1945) considered problem solving to involve the elements of:-
Mistaken solutions are not inappropriate; Each new proposal is a reformulation of the problem; All hypotheses need to be judged on their functional characteristics; Blind solutions need to be restricted to a specific problem – situation.
Also, that it was necessary to analyse the goal that was being strived for so that the problem solved would have a more informed perspective of what must be done to move from the 'recognition of the problem' state to the 'final solution' state. Duncker used the term 'resonance' by which he inferred that problem solving was not a strictly rational activity for the majority of problems, but included an automatic application of previous experiences brought to the problem through an individual's cognitive and perceptual processes.

Thomson (1966) describes this process in the following way:-

"These cognitive–perceptual responses are set off through reactions to 'signals' from the immediate environment in which the problem is set. Various possibilities are suggested by what the subject (individual) perceives in the present and by his (or her) reactions to present stimuli as determined by past experience. Success comes through, more or less, chance-reformulations and changes in the present data – the solution emerging from a particular reorganisation of the 'psychological field'. Sometimes the solution appears suddenly, (a eureka moment) sometimes there has to be a search for the source of the difficulty and the working out of a practical means – and relationship; problem solving can exhibit either trial and error or a partially analytical approach when 'resonance effects' determine the solution."

Whatever thinking processes or a thinking process might be, or include, the above models are only describing the overt manifestations of the thinking process, as it reaches for a solution of some kind, dependent on the initial problem. The thinking process(es), as described above, can be considered to be the 'tip of the iceberg' in terms of attempts at a full explanation. Therefore, the 'iceberg' can be thought of as containing a collection of psychological (motivational, emotional and social) and cognitive (perception, creativity, ability/intelligence and memory) processes that take place between and within the stages of the above models of thinking. Together with experience, opportunity and personal style of thinking and learning (cognitive and learning styles, learning strategies; including field dependence – field independence, both in its own right and as an integrated component of other psychological attributes, e.g. preferred approach to learning and use of a particular modality i.e. verbal or spatial, as assessed in the Cognitive Styles Analysis (Riding, 1991 and 2000)).

3.4 Theories of Intelligence

Since the early formulation of its concept, development and measurement, research into intelligence, has produced many models in an attempt to define and quantify it. Binet and Simon (1905), the pioneers of the identification and measurement of intelligence, considered intelligence in terms of 'to judge well, to comprehend well, to reason well'; whereas Terman (1916) considered intelligence to be 'the ability to carry on abstract thinking'; and Heim (1920) argued that 'intelligent activity consists in grasping the essentials in a situation and responding appropriately to them.'

More recent models have not attempted to focus on the notion of intelligence directly as a single entity, but to approach it as an entity which is comprised of many different factors e.g. Guilford's Model of the Intellect (1967); and others which take account of a range of additional factors that are non-cognitive or environmental in nature, e.g. Sternberg's Triarchic Theory of Intelligence (1985).

From the application of the statistical technique of 'factor analysis', Spearman (1923) developed a 'two factor theory of intelligence'. This consisted of a factor, 'g', for general intelligence, and a factor 's', for specific intelligence. Burt (1955) and Vernon (1971) identified a number of additional factors which occurred between the factors of 'g' and 's'. They identified two clusters from the additional factors, which they labelled v:ed for verbal skills and educational ability; and k:m for spatial and mechanical abilities. Both Burt and Vernon considered the factor 'g' to be inherited and therefore fixed, but the factor 's' and the group factors within v:ed and k:m as the consequence of education / training.

Cattell (1971) made a further distinction between the major factors of intelligence, resulting from the application of factor analysis, which he described as 'fluid' and 'crystallised intelligence', i.e. aspects of intelligence that are 'fluid' could be influenced and therefore, changed by education / training and aspects of intelligence that would be less influenced or not influenced at all by education / training are 'crystallised'.

Therefore, Spearman's 'g' factor relates to Cattell's crystallised intelligence and Spearman's 's' factor to Cattell's fluid intelligence.

Thurstone (1938) considered intelligence as consisting of a set of 'primary mental abilities', all independent of each other. These consisted of verbal comprehension, verbal fluency, number, spatial visualisation, memory, reasoning, and perceptual speed. By assessing a range of abilities in this way, a profile consisting of several scores is produced, rather than a single score, as is the case with intelligence or Intelligence Quotient (IQ) scores. This enables an individual's strengths and weaknesses, in terms of a range of skills, to be compared simultaneously.

By contrast to Thurstone, Guilford in his Model of the Intellect (1967), which is a multi-factorial theory of intelligence, produced a description of intelligence which consists of three different types of components, each one having several sub-components. The three components are, 'mental operations', which is concerned with how the mind approaches a given task; 'contents', which is concerned with different types of activity; and 'product', which is related to the type of outcome in terms of the result from the given mental task. Each of these three components is extended as follows:-

Mental Operations consist of five different types of mental activity in the form of – cognition; memory; divergent production; convergent production; and evaluation. Contents also consist of the five different types of activity in the form of – visual; auditory; symbolic; semantic; and behavioural. Products consist of six different types of classification in the form of – units; classes; relations; systems; transformations; and implications.

By multiplying the five 'mental operations', with the five 'contents' and then with the six 'products', a total of one hundred and fifty different cognitive factors can be formed and assessed in relation to any given task.

Gardner (1985) in his Theory of Multiple Intelligence proposed the idea that intelligence can be viewed in terms of a number of different intelligences, each one exhibiting a particular cognitive or humanistic skill. There are in this model, seven types of intelligence as follows:

Linguistic Intelligence	-	Used when reading, writing or comprehending speech.
Musical Intelligence	-	Used in musical appreciation, composition and performance
Mathematical – Logical Intelligence	-	Used in arithmetic, numerical calculation and logical reasoning.
Spatial Intelligence	-	Used in arranging objects spatially, as well as in visual art and finding one's way around.
Bodily – Kinaesthetic Intelligence	-	Used in sport, dancing or simple everyday movement(s) and dexterity.
Interpersonal Intelligence	-	Used in relating to others, interpreting social signals and predicting social outcomes.
Intrapersonal Intelligence	-	Used in understanding and predicting one's own behaviour, and in identifying aspects of the self and one's own personality.

(As cited by Hayes (1998))

In more recent times Gardner has formulated a spiritual intelligence component to his theory of multiple intelligences.

Gardner's model of intelligence(s) is not devised from the statistical analysis of test scores but on developmental (change in attitudes and skills as the individual ages); brain damage studies (individual's suffering damage in particular parts of the brain which affect certain skills and abilities, and, within this category, extreme cases of cognitive functioning such as 'idiot savants' or individual's perceived as 'geniuses' by society); and evolutionary evidence (taking into account how a specific aptitude or ability has evolved).

Gardner's theory recognises a range of human abilities and promotes groups of abilities or an over-riding particular intelligence to a high level of development. This classification of intelligence, removes the traditional view that intelligence is only associated with academic skills and attainment, rendering other skills and abilities less important within society in general. The idea of multiple intelligences also takes account of and gives credence to the notion that intelligence or intelligent behaviour can take many forms.

Sternberg's Triarchic Theory of Intelligence (1985) takes into account a wide range of human abilities and experiences, which can be arranged into three broad categories, of 'contextual intelligence'; 'experiential' intelligence'; and 'componential intelligence', which consist of the following:-

Contextual Intelligence

This is concerned with intelligence within a socio-cultural setting, i.e. mental activity which is directed towards activities within the real world between individuals. Within this context individuals respond to and select stimuli which enable them to organise their environment(s) to meet personal or cultural needs, as well as allowing them to adapt to relevant environments and contexts which they encounter in the everyday activities of life. Therefore, this aspect of Sternberg's 'theory of intelligence' is not abstract or free from context; actions taken are as a response to a particular context, which is made for a reason. The contexts experienced and the responses made to them, dictate the type of response and how the response is performed.

Experiential Intelligence

As the name of this component of the Triarchic Theory of Intelligence suggests, it is concerned with an individual's past experiences and how these experiences influence the approach adopted to a given task or situation. Therefore, the accumulation of skills and knowledge as a consequence of personal life–experiences enables the individual to respond to tasks and situations in a unique way.

Sternberg categorises life experiences in terms of how they relate to intelligence via the development of two fundamental skills. First is the ability to cope with situational demands, and secondly, is the ability to automatise information processing.

Obviously, different types of life-situations require different responses and make different demands on each of us as individuals. If we are faced with a situation, a situation demand as Sternberg designates it that is outside of our experience, we are going to find it more difficult to deal with it than if we had experienced the same or a similar situation before. Also, the greater the range and diversity of situations and circumstances experienced, the more equipped is the individual going to be to deal with a wider range of different or unusual events, and the variety of circumstances and interactions inherent in them.

The ability to 'automatise information-processing' involves the development of a range of habitual routines, thus reducing cognitive demand on tasks that are associated with and therefore, utilise the habitual routines, e.g. learning to drive a car or learning to read words and text.

The personal-life experiences of the individual, will, for the majority of individuals, have provided the opportunity for a number of different skills to have become 'routinised'. Also, practise enables this process to be established and consolidated, and likely, with some individuals, to be achieved at a faster rate and to a more advanced level for a given skill.

Sternberg emphasises the importance of the variation in the life-experiences of individuals and to what extent life-experiences are influential in the development of a range of fundamental skills. In addition, any theory of intelligence needs to recognise and explore the nature of this variation and the influence it has.

Componential Intelligence

This part of the Triarchic Theory of Intelligence takes account of the cognitive mechanisms which underline intelligent functioning. Sternberg classifies components of intelligence in two ways. First in terms of function of what is actually done; and secondly in terms of level of specificity or generality of set targets; These broad facets of the theory are refined, by the proposal of these types of cognitive components, i) meta-components; ii) performance components; and iii) knowledge or acquisition components.

i) Meta-components in this model / sub model of intelligence are higher order processes that constitute mental activity and actions such as planning or decision making.

ii) Performance components are those which enable tasks to be carried out, such as the ability to count, calculate or reason logically.

iii) Knowledge-acquisition components are concerned with the processes involved in acquiring or learning new information; formulating strategies for the identification of significant features or the organisation of new knowledge, and curiosity.

In general terms, Sternberg's Triarchic Theory of Intelligence attempts to take account of several aspects of human learning and behaviour, including cultural influences and learning through experiential influences, which traditional assessments or measurements of intelligence do not. Also, the whole notion of the reliability and validity of measurements of human intelligence based on statistical formulations are avoided; and associated with this approach, the actual questions asked and how they are asked in the approach used, as well as the possible inclusion of a 'time factor', can be influential.

However, Riding and Pearson (1994), have shown that cognitive style in the form of field dependence – field independence, using the Test of Embedded Shapes (TES) (Pearson, 1994), is independent of intelligence, as measured by the British Ability Scales (BAS1); and Riding and Agrell (1997), have shown a similar result using a different means of measuring field independence – field independence and intelligence.

The recognition of 'g' and 's' factors in the early development [Howe (1998) considers that a range of abilities and characteristics of children are strongly influenced by parental interaction and social values, as well as the ways in which a society reacts to children, i.e. encouraging and supporting or repressing abilities and talents] of 'intelligence measurement' gave a strong indication that human intelligence is the product of many factors which include neurological, physiological, cultural, and experiential. Thurstone (1938) and Guilford (1967) and more recently Gardner (1985) and Sternberg (1985) have attempted to take account, in increasing detail, many factors that appear, on scientific sometimes as well as circumstantial evidence, to contribute to an individual's intelligence.

3.5 Creativity

Creativity as a psychological subject or attribute is arguably linked to perception, i.e. what is seen as the initial context and parameters of a given problem; memory, i.e. assessing past experiences of similar problems, (long term memory) and the immediate consideration of possible combinations or alternative organisations of the initial information associated with the problem (short term or working memory); intelligence or ability, i.e. the skills necessary in analysing and synthesising the given information; personality and self, i.e. being bound on restricted by conventions or being comfortable to 'risk take' in terms of thinking unconventionally; cognitive style, i.e. approach and modality (wholistic / analytic and verbal / spatial), as far as Riding (1991 and 2000) is concerned, and Witkin (1969) in terms of field dependence – field independence, applied to both cognitive and social situations; and the motivation to start to search for possible solutions to a given problem.

However, in spite of the above connections between creativity and the other psychological attributes cited, the process of creativity is worthy of consideration in its own right, forming as it does, a linkage between several other cognitive processes.

Jackson and Messick (1965) proposed that creativity should be judged by the criterion of novelty, appropriateness, transformation and condensation. By novelty Jackson and Messick referred to the unusual and original nature of an outcome, while at the same time being suitable or appropriate to a given context, display a radial shift or transformation in manipulating material or approach to a subject, and related to these considerations, there should be a quality of condensation or 'summary power' of the outcome, to enable a continuation of the development of the outcome, so is not to exhaust its implications and applications.

A further definition of creativity includes the factors of fluency, flexibility, originality and elaboration (Guilford, 1967). The factors are contained within the broad range of abilities known as 'divergent production', which is one of the 'mental operations' within Guilford's 'Model of the Intellect'.
Guilford defines fluency (of thinking) in the above context, as:

"the ease with which one uses stored information when one needs it; flexibility, the way in which one alters one's mental approach to a problem; originality, the unusual or rare response / solution to a problem; and elaboration, to the number of additions / configurations that can be made to a given (simple) stimulus to a problem".

It's difficult to separate creativity from intelligence or the notion of 'giftedness'. Getzels and Jackson (1962) state their overall argument for a distinction between creativity and intelligence, in relation to 'giftedness', in the following way.

"Giftedness in children (or adults) has most frequently been defined as a score on an intelligence test, and typically the study of the so-called gifted child has been equated with the study of the single IQ variable. Involved in this definition of giftedness are several types of confusion, if not of outright error. First, there is the limitation of the single metric itself, which not only restricts our perspective of the more general phenomenon, but places on the one concept a greater theoretical and predictive burden than it was intended to carry. For all practical purposes, the term 'gifted child' (or adult) has become synonymous with the expression 'child (or adult) with a high IQ', thus blinding us to other forms of excellence. And second, within the universe of intellectual functions themselves, we have most often behaved as if the intelligence test represented on adequate sampling of all natural abilities and cognitive processes. Despite the already substantial and increasing literature regarding the intellectual functions closely allied to creativity, we still treat the latter concept as applicable only to performance in one or more of the arts to the exclusion of the other types of achievement requiring inventiveness, originality and perfection. The term 'creative child' (or adult), is becoming synonymous with the expression 'child or adult with artistic talents', has limited or attempts to identify and foster cognitive abilities related to creative functioning in areas other than the arts".

Getzels and Jackson (1962) cite Thurstone in relation to the dilemma between creativity and intelligence as follows:

"To be extremely intelligent is not the same as to be gifted in creative work. This may be taken as a hypothesis.
It is a common observation in the universities that those students who have high intelligence, judged by available criteria, are not necessarily the ones who produce the most original ideas. All of us probably know a few men (or women) who are both creative and highly intelligent, but this combination is not the rule.
The confusion between intelligence and creative talent is common. For example, Quiz Kids (or adults) are often referred to as geniuses. They would undoubtedly score high in memory functions, including incidental memory and rote memory. But it is doubtful whether they are also fluent in producing original ideas".

Therefore, Getzels and Jackson (1962) define creativity as follows:

"- - - the term 'creativity' refers to a fairly specific type of cognitive ability reflected in performance on a series of paper and pencil tests. Unlike the populous definition, our use of the term does not assume that this type of intellective ability is characteristic only of persons judged to be creative in the artistic and scientific sense. Application of the popular criterion would of course make the empirical study of creative thinking in children (or adults) almost impossible. Rather, we shall start with the assumption that these creative thinking abilities are found to some extent in all persons – children and adults, sculptors and astronomers, architects and artisans".

From their study into creativity and intelligence (Explorations with Gifted Students), Getzels and Jackson (1962), produced two broad outcomes to show a relationship between creativity and intelligence. These can be summarised as follows:

1. High Creativity Group – subjects who were in the top 20 percent of measures of creativity were below the top 20 percent on a measure of intelligence (IQ).
2. High Intelligence Group – subjects who were in the top 20 percent on a measure of intelligence (IQ) were below the top 20 percent on measures of creativity.

Each group were compared with individuals of the same age and sex.
A further, more detailed study into creativity and intelligence (Wallach and Kogan, 1965), which took into account a greater range of qualitative and quantitative measures, produced the following four groups as a basis of their investigation;

1. High Creativity, High Intelligence (IQ)
2. Low Creativity, Low Intelligence (IQ)
3. High Creativity, Low Intelligence (IQ)
4. Low Creativity, High Intelligence (IQ)

Each of the four groups was established for both males and females.
One of the major differences between the Wallach and Kogan study and that of Getzels and Jackson, was that the groups were established from divisions at the median and not the extremes of the sample distributions of creativity and intelligence scores.

In attempting to define, and measure, creativity and distinguish it from intelligence, Wallach and Kogan (1965) posed two questions. These were –
"the question of dimensionality within the creativity domain, and the question of task context"
Such questions relate to operational issues that are concerned with what is measured and in what manner, and they become an integral part of how creativity can be defined in terms of a psychological/cognitive ability or attribute. Guilford (1959c, 1963) considered creativity and divergent thinking to be co-extensive. Thorndike (1963) found that there was little correlation between a variety of divergent thinking tasks and that the correlation obtained with general intelligence tasks was about the same.
After a consideration of a variety of evidence, Wallach and Kogan (1965) arrived at the conclusion that –

“there is questionable warrant for proposing the very conceptualisation which most researchers have proposed: that creativity is not intelligence , and that individual differences in creativity possess the same degree of psychological pervasiveness as individual differences in general intelligence”

As a consequence of this conclusion, Wallach and Kogan (1965) considered the question of whether or not the conceptual analysis on which the measurement of creativity had been based was appropriate. They decided it was not and therefore, adapted Mednick’s (1962) Remote Association Theory. Within this theory, Mednick defines creative thinking as:

“...the forming of associative elements into new combinations which either meet specified requirements or are in some way useful.” (as cited by Wallach and Kogan, 1965).

By adapting the Remote Association Theory, Wallach and Kogan gave greater consideration to the time allowed for the completion of creative tasks, as well as the procedure relating to the measurement of creative tasks in terms of conditions and attitudes that accompany them, e.g. measurement undertaken in a relaxed and not an examination like atmosphere, and assuring the individual that they are at liberty to allow their imaginations to be free from any restricting conditions.

A further consideration was that of presentation in terms of how the ‘associations produced’ were going to be communicated. Wallach and Kogan refer to verbal (or conceptual) and visual (or perceptual) in this context, including both modes of presentation in their measurement of creativity.

They cite Mednick (1962) for having made the suggestion:

“...that there may be substantial differences in a person’s associational productivity, depending upon whether the given task is cast in verbal or visual terms, or in conceptual or perceptual terms. Some people, he notes, are ‘verbalisers’, others are ‘visualisers’. Hence he expects that the former should thrive when the mode of task presentation is verbal; the latter, when it is visual.” (Wallach and Kogan, 1965).

This raises the question of how analogous creativity is to general intelligence or ‘g’ in terms of verbal and visual/spatial skills, since both of these skills correlate highly within assessments of intelligence (Riding and Pearson 1994). Wallach and Kogan (1965) concluded that test-like procedures designed to assess creativity have not:
‘revealed a dimension of individual differences that, on the one hand, is cohesive and unitary, and, on the other, is relatively distinct from general intelligence’ - because of the structure and

procedure used with many creativity measures. Therefore, through their approach and measurement of creativity, Wallach and Kogan (1965), demonstrated that

1) As the number of associates produced increased so did the number of unique associates, and
2) There was substantial correlation between verbal and visual indices of creativity. When these results were correlated with measures of intelligence, the correlations were low, leading Wallach and Kogan (1965) to the view
   'that the creativity and intelligence measures are relatively independent of each other'

Among many quantitative and qualitative factors taken into consideration by Wallach and Kogan (1965) as part of their investigation into the definition and measurement of creativity, was the difference of anxiety and defensiveness. They defined anxiety in terms of:
'- viewed as an experiential state giving rise to various coping reactions...'
And defensiveness as:
'- a particular pervasive style of coping with anxiety'.
However, by relating anxiety and defensiveness factors to creativity and intelligence scores obtained in their study, Wallach and Kogan (1965) were able to show causal relationships, citing the work of Sarason et al (1960) as the basis for evidence of a causal relationship between anxiety and intelligence.

Also, Wallach and Kogan (1965) relate their findings to the relationship between anxiety and achievement as expressed by the Yerkes-Dodson function. Although the definition of the relationship between intelligence and creativity remains, unresolved to a large extent, in spite of the work of Wallach and Kogan (1965), arguably the best approximation to these two styles or modes of thinking can be viewed in the form of convergent and divergent thinking.

Hudson (1966) considers that convergent and divergent modes of thinking exist, which he relates to characteristics of personality type and subject (sixth form and university) and career choice. For Hudson (1966) individuals who achieve good results on intelligence type tests, are 'convergers' and individuals also achieve good results on creativity type tests are 'divergers'. In addition to these two categories, are 'all-rounders', individuals
'who are more or less equally good (or bad) on both types of tests' (Hudson, 1966)

However,
- "the convergence/divergence dimension is a measure of bias, not level of ability....it is logically possible for a converger actually to have a higher open-ended score than a diverger,

either by virtue of having a quite exceptionally high I.Q. score, or by virtue of the diverger's I.Q. being exceptionally low.
- it is the measure of bias which produces the really striking discriminations, not the measure of level." (Hudson, 1966)

In terms of subject choice, Hudson (1966) found that many arts specialists, who were weak at intelligence (I.Q.) type tasks, i.e. requiring a single answer or solution, were much better at creative or open-ended type tasks, i.e. requiring many answers or solutions which could all be equally acceptable. The reverse was true for most science specialists. Such a situation poses the question of why particular modes of thinking should be associated with particular subjects or groups of subjects, and is subject preference related to certain personality characteristics or type? The same question can be posed for career choice.

There can be the assumption that divergent thinkers are synonymous with creative thinkers or people and that such people are flexible and unconventional who push back the frontiers of knowledge. In contrast, convergent thinkers are synonymous with non-creative thinkers or people who are inflexible, authoritarian, and follow continuously behind their creative counter-parts.

The studies of Roe (1951a, 1951b, 1951c, 1953) and Mackinnon (1962a, 1962b), investigating the notion of 'originality' among adults, indicate that the relationship between divergent thinking and 'creativeness' is complex. Personality, attitudes, biography and intellectual ability of a number of famous people, distinguished beyond reasonable doubt, were taken into account by both studies. The sample used by Roe consisted of scientists (physical, biological and social) and the sample used by Mackinnon included architects and writers as well. Roe found that the physical scientists of her sample strongly resembled the 'convergent', whereas Mackinnon found that the creative men and women of his sample, from all subjects, were more 'divergent' than their non-creative colleagues.

Hudson (1960) refers to the conclusions from the Roe and Mackinnon studies as follows: 'These two conclusions can only be reconciled by assuming that the openness and inhibitedness to which Mackinnon refers exists within a relatively narrow range. On this argument, all scientists are inhibited, the creative ones less so, the non-creative more. One can only make sense of this evidence- by assuming an intellectual spectrum in which each occupation (litterateur, historian, psychologist, biologist, physicist and so on) attracts individuals of a particular personality type. The convergers are naturally attracted towards one end of the spectrum and the divergers to the other. Each field has its own waveband of emotional openness; only within the range of openness which each ends affords are certain degrees of openness or restriction more conductive to good work than others' (Hudson, 1966) This suggests that the scientist is the one who possesses some of the divergent qualities of the artist, and that the successful artist is able to apply, to his or her work, some of the rigour and dedicated single-mindedness of the scientist.

Some of the characteristics of creative or divergent thinking are transformed by de Bono (1969) into the concept of 'Lateral Thinking'. This involves the individual's ability to think beyond habitual modes and patterns of thought so as to generate a solution to a problem or situation that is original or unique.

Although not unlike Hudson's (1966) concept of divergent thinking, 'lateral thinking' advocates and encourages thinking to take place outside of the conventional or established frame of reference or thinking accepted or appropriate in relation to particular contexts or situations. de Bono (1977) encourages the individual to consider the assumed or accepted limitations to a given problem, and then to try to approach the problem in a new and radical way. This approach addresses the restrictions in which 'mental set' can limit thinking and by doing so, encourage new and extended thinking to old and new problems alike.

Whatever the nature of creative thinking, a further consideration of it would be to pose the question, does it take place immediately after a problem is presented, or does it require time to form, in the mind of the individual, before a solution is acquired? It is probable that the more complex the problem, the more necessary it is to have time to consider the problem before the production of a solution.

Wood (1981) investigates a series of interviews and biographical writings complied by Ghiselin (1952), which gave accounts of the creative experience of a number of eminent artists, musicians, and scientists. From his investigations Wood identified four consistent themes. These included, a dialogue between the conscious mind and some other aspect of 'the self'; although there was an awareness of an evolving idea, it was as though the creative person at the centre of it was a spectator to the process; as the idea evolves the creative person feels an insecurity of trying to express it verbally, having a strong feeling of a distrust of words, which Wood associates with the novelty of the idea and therefore, it is difficult to put it into words which would tend to link it with an existing structure; and the notion of practice, i.e. irrespective of the field in which creativity was taking place, the creative person would be fully conversant with the techniques of their specialism and so, once the idea was fully formed, they were able to give a full expression of the idea. This model of creativity suggests that it is perhaps better to concentrate on the development and acquisition of expertise, in any field or specialism, and not the creative act itself as the best way of encouraging creativity.

A model of creativity which predates that of Wood (1981) but which tends to confirm Wood's model, is that of Patrick (1930). Patrick investigated the writing of a poem, the painting of a picture, and the solving of a scientific problem. The experimental arrangements included, two groups, one consisting of trained professionals and the other of non-specialists; both groups were homogeneous with regards to age, sex and intelligence; each individual was given a stimulus related to the task they were required to do, e.g. poets were given a landscape painting and painters a poem; while they worked, all individuals were encouraged to talk about their task in terms of problems and how they approached it; there was no time limit; and at the end of each working session, each individual was asked to complete a questionnaire on 'methods and problems of work'.

From the above investigations into the creative process, Patrick came to the conclusion that creative thinking proceeds through a series of stages. Thomson (1966) cites these stages as follows:
"Preparation
Here the subject makes himself (or herself) familiar with his (or her) situation and its materials.
Incubation
The problem begins to be defined. Suggestions occur, and fragments of the final product appear.
Illumination
A specific goal is envisaged and the subject begins to work towards it.
Verification
The results are worked artfully, revised, altered, completed. (Testing – in case of hypothesis)."

Thomson goes on to say:

"Other investigations tend to confirm Patrick's findings. Only one modification has been suggested: namely, that the four phases of activity do not necessarily occur in a well-defined sequence. There is sometimes a sudden continuous movement which embraces all phases in one: or else the thinker may work backwards and forwards over the four 'phases' before suddenly winding-up with a flourish. Thinking is a dynamic, intense, and highly personal activity which cannot be tied down to any formula or pattern which fits any individual case. Some creative thinkers are systematic, orderly, thorough and apply their techniques with deliberate purpose: others follow impulse from start to finish and give 'inspired' performances."

The Patrick model could well explain insight, inspiration or a 'eureka' moment, not something that happens, seemingly from no-where, but as a consequence of both a conscious and sub-conscious process within the creative individual.

Therefore, could it be that the creative act can take two forms within Patrick's general model? One form has an immediate focus, the solution of a problem, which while new, does not alter established concepts; and the other form, a long term form, where the solution of a problem would be very radical, resulting in established concepts being challenged and eventually changed.

The difference between these two 'forms' could relate to the level of complexity and resulting consequences for the solutions found, which would be influenced by the type of problem itself in the first place.

An example of the first form could be an improved design for a car engine in terms of fuel consumption efficiency but it remains a conventional engine whereas for the second form, Newton's laws of motion would suffice because they enabled a greater understanding of the natural world to take place, as well as developments in the man-made world and society in terms of machine design and space exploration, due to their fundamental nature.

3.6 Memory

Attempts to explain and understand human memory has been, and continues to be, a subject of significant research within the history and development of psychology.

"- by assuming that science is attempting to understand and represent nature, ---- to understand human memory, and to express that understanding in some coherent way: a theory, a law on a model. Secondly and crucially, --- that science operates by attempting to expose such conceptualisations or models to empirical test, that is to see if they actually work when applied to a situation that is novel. The experimental method is the principal way of testing theories, typically under conditions where as many extraneous factors as possible are controlled or ruled out by the experimenter." (Baddeley, 1990)

Ebbinghaus (1885) can be considered to be the first major researcher into the study of memory, who established a meticulous and experimental approach, the influence of which extended into the 1920s. He proposed that memory consisted of three essential processes, namely encoding, storage and retrieval. As the names of these three stages suggest and indicate, there is need for received information to be converted into a form in which it can be stored and retrieved as and when required. The details of the mechanisms by which these three processes take place and are inter-related are the subject of continuing research and informed speculation, but from Ebbinghaus onwards, the idea developed of ‘spaced practice’ as a more efficient and effective way to learn, and therefore, to be able to remember and retrieve information, than ‘massed practice’; i.e. short periods of study over a length of time, as opposed to a single long period of study, respectively, to explain encoding. Also, this approach to learning applies equally to the acquisition of physical skills as well as that of factual or abstract information.

Ebbinghaus is credited with the idea of ‘primacy and recency effects’, which is related to how information is presented and subsequently encoded. ‘Primacy effects’ refers to the way that initial information experienced is remembered, and ‘recency effects’, the way that the last elements or parts of the information experienced is remembered. In other words, with any piece or set of information, only the first and last parts are remembered. Murdock (1962) illustrated this phenomenon by asking a sample of individuals to remember a set of twenty words, presented one at a time, and to write down as many as they could remember. His results showed that most of the words remembered by the sample members were those that occurred at the beginning and end of the list. ‘Primacy and recency effects’ are also applicable to social impressions. Luchins (1959) showed that a reported description of a person could be changed if the information given about the person was reversed, e.g. from extraverted to introverted and vice versa.

Primacy and recency effects are now thought to be associated with the idea of different kinds of memory store i.e. ‘short term memory’ and ‘long term memory’ (Glanzer and Cunitz, 1966).

Bartlett (1932) considered ‘memory’ to be an active process and not merely a factual record of events. The important idea proposed by Bartlett was that memories are organised to mesh with existing knowledge and expectations. The implication of such a process is that human beings do not necessarily remember exactly what happened in a given event. In an attempt to account for the differences between this actual event and what may be remembered about the event, Bartlett developed a methodology known as ‘serial reproduction’. This consisted of an individual reading or listening to a story, then reproducing what they had read or heard, and the two accounts compared for possible differences. The idea that new material or information is remembered in relation to existing memories or structures, Bartlett termed schemas or schemata.

Baddeley (1990) describes this idea or concept as follows:

"To Bartlett, a schema referred to as an organised structure that captures our knowledge and expectations of some aspect of the world. It is, in other words, a model of some part of our environment and experience. Bartlett regarded the processes of learning and remembering as essentially active, with the subject showing a constant effort after meaning. Applying a schema encapsulates what he knows of the world. However, when material is presented that is not readily incorporated into a schema, distractions will occur."

The two different approaches formulated and adopted by Ebbinghaus and Bartlett, i.e. memory in terms of cognitive processes and memory in relation to everyday living respectively, continue to provide a distinction within memory research. Baddeley and Atkinson are concerned with cognitive structures and processes of memory, and others, such as Loptus and Meisser are concerned with how memory is used and modified as a consequence of human experiences.

The concept of a schema has been developed in more recent times. Baddeley (1990) refers to Minsky (1975) as one who:
"- introduced a schema-like concept which he termed the 'frame', supporting it with the following argument:
'It seems to me that the ingredients of most theories both in artificial intelligence and in psychology have been on the whole too minute, local, and unstructured to account – either practically or phenomenologically – for the effectiveness of common sense thought. The 'chunks' of reasoning, language, memory, and perception ought to be larger and more structured, and their factual and procedural contents must be more intimately connected in order to explain the apparent power of mental activities.'"

Baddeley also refers to Rumelhart (1975) who developed an elaboration of Bartlett's notion of a schema, and Schark (1975) 'who introduced the concept of scripts, schemas that encapsulate much of our knowledge of social activity'. All three of these ideas, while not identical, have a lot in common, the broad characteristics of which are summarised by Rumelhart and Norman (1985) and cited by Baddeley (1990) as follows:
"Schemas have variables

Schemas are pockets of information that comprise a fixed core and variable aspects.

- Schemas can Embed One Within Another.
  Schemas are not mutually exclusive packages of information, but can be nested.
- Schemas Represent Knowledge at All Levels of Abstraction.
  The concept of schema is very broadly applicable, from abstract ideologies and concepts such as justice, to very concrete schema such as that for the appearance of a face.
- Schemas Represent Knowledge Rather than Definitions.
  Schemas comprise the knowledge and experience that we have of the world; they do not consist of abstract rules.
- Schemas are Active Negotiation Devices.
  This is reminiscent of Bartlett's original emphasis on effort after meaning."

A schema is in essence a cognitive framework which is gradually built up through an individual's experiences of life both educationally and socially. Such a framework allows information to be organised into related groups having similar ordinate or super-ordinate features. This in turn allows efficient access to information to aid learning and the acquisition of additional knowledge as well as reacting in a social acceptable manner or an appropriate manner in various contexts and situations. Fishe and Luville (1980) have argued that the concept of a schema enables human beings to think because it simplifies access to a vast amount of information, cognitively and socially.

However, how is the information, of whatever type, understood and retained in a schema like framework? The answer to this question includes a consideration of the processes involved in language and spatial understanding, and how they relate to memory and its retention.

A possible explanation of these issues and processes is provided by the 'Working Memory Model' (Baddeley, 1990). This consists of three parts, the visio-spatial sketch pad, central executive and phonological loop. Baddeley describes this model as follows:

"a model of working memory in which a controlling intentional system supervises and coordinates a number of subsidiary slave systems. We termed the additional controller the central executive and chose to study two slave systems in more detail, the articulatory or phonological loop which was assumed to be responsible for the manipulation of speech-based information, and the visio-spatial scratch pad or sketch pad, which was assumed to be responsible for setting up and manipulating visual images".

The central executive, then coordinates the input and output of information, to and from the phonological loop and the visio-spatial sketch pad, and controls the processes involved. Also, the central executive is responsible for:
"the regulation of information flow within working memory, the retrieval of information from other memory system(s) such as long term memory and the processing of storage of information" (Gathercole and Baddeley, 1993/4 op cit. Riding, 2003).

The phonological loop is described by Baddeley (1986; 1990a) and Gathercole and Baddeley (1993) as having a limit capacity and consisting of a temporary phonological store (this holds information in a phonological form) and an articulatory control process (this maintains decaying representations in the phonological store).

The visio-spatial sketch pad processes and stores visual and spatial information, and verbal information that becomes encoded in imagery form (Gathercole and Baddeley, 1993). Baddeley also states that the visio-spatial sketch pad, like the phonological loop,
'- can be fed either directly through perception, in this case visual perception, or indirectly, in this case though the generation of a visual image' (Baddeley, 1990b).

Riding (2002) has described the visio-spatial sketch pad as containing:
'- visual or spatial information rather than the phoneme information used by the phonological loop.'

and goes on to say that:

'Researchers have argued that the visual (the visual cache) and the spatial (the inner scribe) components of working memory are functionally separate systems (Baddeley, 1990b, Baddeley and Logie, 1992; Logie 1995). Accordingly, the visio and spatial working memory is assumed to be a visual temporary store and a spatial temporary store.'

Therefore, information from the senses, particularly seeing (images and spatial arrangements) and hearing (phonological material), enters the 'working/short term memory', in the case of some information, before becoming encoded and stored in the 'long term memory'.

Riding (2002) argues that information to be learnt follows the above sequence with the addition of the application of cognitive styles, e.g. Cognitive Styles Analysis (Riding, 2000), in the learning/teaching context, to assist working/short term memory and the establishment of long term memory, i.e. the retention of the information attempted to be learnt.

Also, the level of field dependence – field independence because of its perceptual nature, is likely to be associated with the spatial aspect of the visio-spatial sketch pad in terms of an individual's ability to think and process information spatially.

Since the phonological loop and the visio-spatial sketch pad are managed by the central executive, it has a limited capacity. This capacity can be thought of in terms of an energy source which can be different from one person to the next. Also, the different functions, of the phonological loop, of control, coordinating, processing and storage, compete for a limited capacity. Therefore, the more complex the processing involved, with a given task, less information can be stored and maintained in working memory.

'Consequently, when greater effort is required to process information, less capacity remains to store the products resulting from that processing. Thus, the information processing operation of working memory is limited in two ways; capacity and speed (e.g. Baddeley, 1999)' (op cit. Riding, 2002).

The idea of competition between different types of processes and operations in relation to an individual's capacity and speed of their working memory, could be influential with regards to their placement on the field dependent – field independent continuum, i.e. the necessity to remember the simple figure or shape before attempting to locate it within the complex figure or shape by analysing the complex figure or shape, within a limited time. However, it could also be possible that an individual's level of capacity and speed of their working memory relates to their general level of ability, which some research, e.g. Riding and Rayner, 1998, would suggest explains why some individuals are deemed field dependent and others field independent.

An aspect of memory that has been known for a long time relates to 'primacy and recency effects'. Primacy effects relate to the way in which an individual remembers the first part or parts of a piece of information encountered, and recency effects relates to the individual remembering the last part or parts of the same information (Murdock 1962). Primacy and recency effects are not only evident in the context of the performing of cognitive tasks, but also social situations (Luchins, 1959).

One possible explanation of this phenomenon is a linkage between short term memory and long term memory, i.e. in short term memory pieces of information can fade quickly, after a few seconds, due to the demands placed upon the central executive, and long term memory which encodes and stores pieces of information over long periods of time (Cunity, 1966; Glinger and Cunity, 1966).

Primacy and recency effects influence meaningful learning (Ausubel, 1968), i.e. new information given a relevance to what is already known, schemas and working, short term and long term memory have implications for learning in terms of the overall organisation of information and exposure, or practice to it over time.

With regards to learning and practice, Ebbinghaus (1885) developed the ideas of 'distribution of practice' and 'total time hypothesis', i.e. learning becomes more effective if it is attempted over several periods of time; and the amount learnt is directly proportional to the time spent on learning, respectively.

The ideas of organised and regular periods of learning relate well to the learning style of deep/surface learning (Entwistle,2004).

Baddeley refers to several ideas in memory research as follows:

"Just as different kinds of maps of London occur and are used for different purposes, so different kinds of theory of memory occur, concentrating on different aspects of the memory system. A theory giving a successful account of the neuro-chemical basis of long term memory, though scientifically extremely valuable, would be unlikely to offer an equally elegant and economical account of the psychological characteristics of memory. While it may in principle one day be possible to map one theory onto another, it will still be useful to have both a psychological and a physiological theory." (Baddeley, 1990)

3.7 Theories of Personality

A major component of individual differences is so called 'personality', models of which help to explain and make a contribution to the understanding of human behaviour in an overt, social sense, and is also influential in relation to cognitive behaviours in terms of problem solving and thinking.

Different models of personality have particular emphasis which is partly the consequence of their origins, theoretical basis, developmental and the methodology used to formulate them, which try to describe the whole person in terms of social and cognitive functioning.
Models of personality can be broadly classified into three groups which are psychoanalytic theories, trait theories and phenomenological / humanistic theories. The most influential of the psychoanalytic theories are those of Freud (1901) and Jung (1953 and 1978); the trait

theories, Eysenck (1947) and Cattell (1940); and the phenomenological / humanistic theories, Rogers (1961) and Kelly (1953).

Freud's approach to human personality establishes the idea of the conscious, pre-conscious and unconscious mind and the relationship and interaction between the three. Also, as far as Freud is concerned, early childhood experiences, whether positive or not, have major influences in adulthood in terms of behaviour and thinking, i.e. how the individual sees himself or herself as a person and in their relationship with society.

In Freud's model of adult human personality there are three basic components of the 'id', 'ego', and 'super-ego'. The 'id' and the 'super-ego' reside in the unconscious and the ego in the conscious, and represent between them the full range of human emotions. The 'id' is the primeval, impulsive, aspect of human personality, demanding instant gratification, immediate satisfaction, which Freud described as the 'pleasure principal'. The 'ego' in comparison, tries to pacify the 'id' and make compromises between the 'id' and reality, the realistic demands and expectations made by society, the outside world, on the individual. For this reason, Freud labelled the process, the 'reality principle', which attempts to balance the demands of the 'id', within the unconscious mind and the practicalities of human behaviour within society. The 'super-ego' also, existing in the unconscious in many respects is as unrealistic as the 'id', because it demands a total commitment to imposed, by the individual, strict rules of conduct and behaviour, even to the detriment of the individual in terms of health or 'self'. Again, as with the 'id' the ego balances these conflicting thoughts, desires and potential behaviour between the 'id' and the 'super-ego' in the individual. Freud named this process 'dynamic equilibrium'.

Therefore, in Freud's model of the mind or personality, the unconscious in the form of the 'id' and 'super-ego' and in constant conflict with the conscious and reality, and the ego, the conscious mind, is maintaining balance and order and a sense of reality. However, this situation places the 'ego' under threat, which comes from the three sources, i.e. the 'id', the 'super-ego' and reality itself. To cope with these threats, the 'ego' develops what Freud called 'defence mechanisms' or 'ego defence mechanisms', e.g. denial, repression, regression and projection.

There are many more major aspects to Freud's model of personality which include 'association', the 'interpretation of dreams', 'sexual energy (libido)' and 'sex role identification'.

From a problem solving and thinking perspective, it is interesting to suggest links between the subconscious and creativity, i.e. a solution to a problem evolving over time or in a dream, free association within a group activity, which in turn could be linked to divergent and lateral thinking as well as creativity; and links between 'ego defence mechanisms' and self-esteem i.e. having the confidence to 'have a go' at something, to take a risk, in an attempt to find a solution to a problem, whether it be social or cognitive.

Jung's model of personality, in its widest sense, like Freud's uses the idea of the conscious, pre-conscious and unconscious mind, but has an additional unconsciousness which he called the 'collective unconscious'. The 'collective consciousness' is the deepest level of the unconscious, and is shared by all human beings, all races, and extends back to our primeval ancestry. Jung argued that particular events or circumstances produce a sort of empathic response in all of us, through all of our levels and types of consciousness, which make contact with something within the 'collective unconsciousness', something powerful which no-one can ignore. He called this process 'synchronicity' and cited archetypes as powerful expressions of it, with an added dimension to their physical properties, e.g. earth-mother, the sea or the sun. Consequently, these archetypes are symbols which are found in all human cultures, and therefore mythologies having a profound significance for them. Jung believed that the reason why these archetypes are found in all cultures is because of the 'collective unconsciousness', and our powerful reaction to them, e.g. the sea, is because of 'synchronicity'.

Certain aspects of Jung's model of personality relate to what he called 'persona'. This is the name he gave to the overt personality or characteristics of people which they display as part of their day to day interactions. As part of the general description of the 'persona' Jung was the originator of the description of people as 'extroverts' or 'introverts', i.e. sociable and at ease with other people, as opposed to preferring one's own company. However, Jung did not attribute fixed qualities to the 'persona' but saw it as something which was responsive to the demands of different situations and how individuals' inclinations respond to these. Also, he considered that the unconscious mind was a mirror image of the conscious mind, e.g. someone with an 'extrovert persona' would have an 'introvert unconscious' and vice versa. For Jung, each individual had an opposite 'inner self', which he named 'anima' or 'animus', which is the masculine in a woman and feminine in a man, e.g. the timid person is unconsciously brave and the strong person is unconsciously weak.

Jung's view of personality was one of complexity with many facets of human attitudes, e.g. intuition, emotion, thinking and motivation, but as indicators of potential and not as fixed qualities.

Apart from the idea and description of the 'collective unconscious' and the 'persona', Jung's model of personality is different from Freud's in several ways. Jung's concept of a 'life force' or libido was different from Freud's in that he believed it encompassed not only the basic energy for motivation, pleasure, and sexuality. Jung's model of sexual development is very different from that of Freud, but also religious and mystical life-affirming experiences.

In spite of Jung's belief that personality characteristics were not fixed, some of the personally characteristics he describes have been used by some of his successors to provide a way of assessing and as an indicator of personality type, e.g. the Myers-Briggs Type Indicator (MBTI, 1962). However, in contrast to this use of some of Jung's ideas and formulations of human personality, there is some doubt about the consistency of the concept of 'extroversion' and 'introversion' in that a person is able to switch from one type to the other type depending on the sort of situation they find themselves in, e.g. act as an 'extrovert' in one situation and act as an 'introvert' in a different situation. One of the strengths of Jung's model of personality is that it integrates a range of human experiences, skills and abilities, in trying to explain the human behaviour, both socially and cognitively. Therefore, thought, motivation and potential, i.e. skills development, are considered as well as social behaviour, as part of the whole person with one collection of human attributes influencing the other on a continuous basis.

Eysenck formulated his model of personality from answers given to questions about behaviour e.g. personal preferences and particular reactions to different contexts and situations, by a very large sample of individuals, but individuals with similar experiences, i.e. they were all soldiers who were being treated for neurotic disorders in hospital. Eysenck discovered that certain answers appeared to have an association with each other, which suggested that they indicated a particular personality trait or characteristic. These, Eysenck labelled first-order personality traits, which included behaviours such as impulsiveness, anxiety and intolerance, and then through the use of ‘factor analysis’, demonstrated that the first-order personality traits, clustered together to produce two main groups. Eysenck argued that the foundation of these two groups indicated two major personality dimensions, which he called second-order personality traits or personality dimensions.

The first of these dimensions Eysenck named ‘introversion – extroversion’, after Jung who had originally developed this bi-polar construct, because they described how sociable or unsociable people appeared to be, which in turn related to Jung’s description of self-sufficiency (introvert) and outgoing and sociable (extrovert).

Eysenck regarded personality characteristics as a consequence of inherited physiological tendencies, with environmental factors having only a minimum influence. With evidence to support the whole idea of the introversion – extroversion dimension, Eysenck further argued that it resulted from inherited individual differences in the ‘reticular activating system of the brain’. This is essentially a ‘switching’ mechanism for large areas of the cerebral cortex, and therefore linked to thinking and attention, which acts as an excitatory mode, stimulating brain (cortex) activity, or in an inhibiting mode, reducing brain (cortex) activity.

EXTROVERT		
	sociable outgoing talkative responsive easy going lively carefree leadership	active optimistic impulsive changeable excitable aggressive restless
	(SANGUINE)	(CHOLERIC)
STABLE		NEUROTIC
	(PHLEGMATIC)	(MELANCHOLIC)
	calm even-tempered reliable controlled peaceful thoughtful careful passive	moody anxious rigid sober pessimistic reserved unsociable quiet
INTROVERT		

Personality Types in Eysenck’s Model of Personality

As Hayes (1998) states:

'Eysenck proposed that introverts inherit a nervous system in which the reticular activating system has a bias towards excitation rather than inhibition. This means that incoming information tends to excite more nerve cells, and the excitation does not die away so quickly. The consequence is that introverts do not need as much stimulation to maintain their optimal level of brain activity, since the neural activity resulting from a set of stimuli will last for much longer with these people than it does with others. Extroverts, on the other hand, have inherited a nervous system which tends to produce inhibitory responses. This means that they need much more stimulation than introverts, to achieve the same level of brain functioning'.

The consequence of these physiological differences, Eysenck argued, is that extroverts can quickly become bored, and will tend to seek out novel sources of stimulation. Introverts, on the other hand are happier with a less intense level of stimulation; an introvert would be happy settling down with a book for an evening, whereas an extrovert would be restless and bored.

Hawkins and Green (1975) found evidence in support of Eysenck's arguments, which found that introverts are able to maintain attention to tasks which are considered to be long and boring, whereas extroverts are not. The explanation for this is that introverts can maintain an optimal level of cortical functioning more easily under conditions of minimal stimulation in comparison with extroverts.

The behaviour characteristics of introverts and extroverts pose a number of questions for learning activities and teaching techniques, and the management of learning materials in terms of pace and type; quantity and variety, respectively. Also, the interface and relationship(s) to cognitive style in the form of convergent and divergent thinking, lateral thinking and creativity, and the associated problem solving activity that are integral to cognitive activities in the classroom or lecture theatre

The second of Eysenck's personality dimensions or second-order personality factor was 'stability – neuroticism', which included a number of different first-order traits, e.g. anxiety and hostility. Again, as with the dimension of introversion – extroversion, Eysenck argued that it had a physiological basis, which he considered was related to the autonomic nervous system. In individuals designated 'neurotic', their autonomic nervous system is easily activated at the least indication of any threat, i.e. alarming or stressful stimuli. Whereas in individuals designated 'stable', their autonomic nervous system requires a much greater intensity of threat for it to become activated, or to take longer for it to be activated, if the threat is small.

The two dimensions, i.e. introversion – extroversion and stability – neuroticism are independent of each other and can be depicted graphically as shown in Figure __
It can be seen from Figure __ that in between the two dimensions in each of the four quadrants so created, are the corresponding 'personality humours' of antiquity, and in-between the extremes of each dimension, a number of descriptors that reflects different types of human behaviour and attributes.

Eysenck's adoption from Jung of the concept of introversion and extroversion and his attempts to given them a quantitative basis as well as suggesting neurological and physiological mechanisms to explain these types of behaviour, socially and cognitively, have helped to establish them as important reference points in psychological and educational research.

Cattell's theory or model of personality describes human personality in terms of a number of constituent traits, devised from answers given to questions about behaviour or through a personality inventory.

Cattell obtained his data from three sources; L-data (this relates to the life records of the individual and includes information from their academic record at school, and attendance record from employment); Q-data (self rating of perceived personal personality characteristics and the likely type of behaviour, response to particular situations; from the completion of pre-set questionnaires); and T-data (questions related to objective tests but the individual providing the answer is unsure of which aspects of personality is being measured).

Cattell analysed the L-data and T-data, using 'factor analysis' to compare the two types of data for each individual, looking for any relationship between the two. If any two measures showed a high correlation, Cattell reasoned that they were indicating related aspects of personality, a similar approach adopted by Eysenck to identified first and second order- order personality traits in his model. The conclusion reached by Cattell from this analysis was that there were two distinct types of personality trait, surface traits and source traits. Surface traits refer to the outward behaviour displayed by an individual and source traits, to which Cattell placed the more importance, as an indication of why an individual displays particular behaviours.

Having obtained the trait sources from the L-data and T-data, Cattell compared these to data results for each individual. From this additional analysis, Cattell concluded that there were sixteen major personality traits which could give an adequate description of personality. Also, a psychoanalytic test of personality could be formulated to provide an individual's personality profile, which would give a more detailed description of the individual. Obviously, this is a very different to Eysenck's model of personality which only gives two sources.

Cattell developed his initial research results into the Sixteen Personality Factor Inventory ( ) which became known as the 16PF. This was constructed from twelve traits identified from the L-data and an additional four from the Q-data. The names used for each of the factors are associated with the origin of each trait. Each of the sixteen traits and their designated name (i.e. letter) are shown below:

Cattell's 16 Personality Traits

Reserved	A	Outgoing
Less Intelligent	B	More Intelligent
Affected by feelings	C	Emotionally stable
Submissive	E	Dominant
Serious	F	Happy go Lucky
Expedient	G	Conscientious
Timid	H	Venturesome
Tough-minded	I	Sensitive
Trusting	L	Suspicious
Practical	M	Imaginative
Forthright	N	Shrewd
Self-assured	O	Apprehensive
Conservative	Q1	Experimenting
Group-dependent	Q2	Self-sufficient
Uncontrolled	Q3	Controlled
Relaxed	Q4	Tense

Cattell believed that although his sixteen personality factors could provide a description of a person's common traits, they could never give a complete description of a person because everyone has some unique trait or quality that cannot be measured by any personality test. Therefore, a personality profile should always include a description of this unique trait for it to give a comprehensive description of someone's personality.

The personality models of both Eysenck and Cattell provide a significant departure from those of Freud and Jung in that they measure variables and use statistical techniques to quantify and generalise the outcomes. Also, they mark the beginning of attempts to explain and show relationships among a range of human behavioural characteristics.

Developments in personality research together with advances in the application of psychoanalytic techniques have identified many more personality traits to those of Cattell and Eysenck, which have clustered, through the application of factor analysis, into five basic factors. Norman (1974) named these factors as 1) surgency (a trait similar to Eysenck's extroversion; 2) emotional stability (a trait similar to Eysenck's neuroticism); 3) agreeableness (this includes traits of generosity, stubbornness and a tendency to criticise); 4) conscientiousness (this includes traits of hardworking, negligent, disorganised and dependable); and 5) culture (which includes scales of curiosity, creativity, intelligence, perceptiveness and knowledge ability).

Costa and McCrae (1976) produced a model of personality, i.e. the NEO Model, which contained three basic factors of N for neuroticism; and E for extroversion (both very similar to those of Eysenck); and O for openness to experience. The authors of this three factor model argued that the 'openness to experience further' was evident in Rorschach's (1960) 'dogmatism' scale and Holland's (1966) 'artistic interests' scale. However, McCrae and Costa (1985) added a fourth factor to their three factor model, which they named 'control' because it was devised from scales that assessed consciousness, super-ego strength and persistence. Also, they concluded that their now four factor model was very similar to the five factor model except for the absence of any measure of 'agreeablenesses'.

Nolley, Law and Conrey (1987) compared responses to the items from the Cattell's 16PF; Eysenck's Personality Inventory; and Conrey Personality Scales, and found that all of the item responses clustered into five basic factors. Therefore, there appeared to be strong evidence to support the five factors identified by Norman, although there was some minor variations in the names used for the traits belonging to each factor, which became known as the 'five robust factors' of personality.

Later, McCrae and Costa (1985) classified the culture dimension by arguing that it was a sort of composite that lay between 'openness to experience' and intelligence, and if all intellectual skills were taken out of the outcome dimension, 'openness to experience' would be left. This suggests that intelligence should be considered as a separate entity and not as a dimension of personality, although it could be influential in the manifestation of certain personality traits and the consequential behaviours of the individual.

The phenomenological and humanistic personality theory of Rogers (1961) and Kelly (1955) are concerned with (as the broad name of this type of personality theory states) the way people react, and therefore behave, to their situations, i.e. the way people interpret the world, their world , the conclusion they reach will be influential on the way they react to it.

Rogers developed a theory of personality which was based on two basic needs that he considered all human beings required for healthy development and interaction with other human beings.

The first of these needs, Rogers, named 'self-actualisation'. This is concerned with a striving for personal development in terms of achieving something or to be reassured and content at the realisation of the reality of not being able to realise all that one would wish to, e.g. developing a skills to a high or very high level but perhaps not being the most accomplished person with that skill in the county or the world. Therefore, 'self-actualisation' is related to aspects of the 'self', a balance between one's real self and ideal self. Without this sense of striving and balance, Rogers argued that people would become restricted in their willingness to do things and form positive opinions about themselves, and as a consequence, psychological problems would follow.

In the learning context, this relates to confidence to have a sense of adventurousness, being prepared to 'have a go' because if the answer is wrong or the outcome less than expected, then the student or adult with a well-developed sense of 'self-actualisation', is not discouraged to the extent that they 'give up' or are reluctant to try again. Instead they review the situation, learn from the outcome and try or start again (even if others are advising them not to try again, either with the same task in the same or a similar situation). The second of the basic needs in Roger's theory of personality, he named 'positive regard', which encompasses the attitude (positive), respect, concern or affection from one person to another or to people in general. 'Positive regard' is very closely linked with 'unconditional positive regard' which means that the application of 'positive regard' is not dependent on a person displaying 'good' or 'approved of' behaviours. This is in contrast to 'conditional positive regard', which means that positive regard is only given when requested conditions, designated by the giver of positive regard, are met by the recipient of the 'conditional positive regard', e.g. in the learning situation, an expectation on the part of the teacher that the child or student (pre-university) will think and organise their learning in a certain manner. Rogers considered that the dilemma this situation would cause, on the part of the recipient of 'conditional positive regard', would result in psychological damage, because there would be created a conflict between the 'ideal self' and 'real self' preventing the child or adult in question (recipient of the 'conditional positive regard') from satisfying the need for self actualisation. The 'ideal self' in this context relates to an idealised set of 'conditions of worth' which the child or adult tries to match to gain approval from a significant other e.g. a teacher or parent, or others in general.

Such a situation could be used to explain a possible adverse relationship, for example, between a 'creative child' or a child with a particular cognitive style, and their teacher, especially in the primary school. The creative pupil or student may be seen as a disruptive influence within the class, primary or secondary specialism, because they perceive and express new ideas in relation to the content of the lesson, or the pupil or student (post primary school) with a cognitive style that does not match that of his or her teachers, and as a consequence the teacher considers the pupil or student to be awkward or unable (or un-intelligent). In this situation, the pupil or student would not be able to exercise their need for self actualisation because for the pupil or student to gain the teacher's approval, i.e. 'conditional positive regard', they would have to compromise their 'real self' and attempt to display an 'idealised self', as far as the teacher is concerned. If on the other hand, the pupil or student decide to exercise their need for 'self actualisation', they would likely become disillusioned or disaffected educationally, adapting the view that their teacher or teachers do not value their work or contribution to the work of their class or classes..

Kelly's (1955) Personal Construct Psychology model of personality, like Roger's, places the individual at the centre of the mechanisms he devised to explain human behaviour and personality characteristics. Essential to Kelly's theory is the notion of the human-being as a scientist. This means that the individual is constantly making and testing hypotheses as he or she interacts with the world, and as a consequence of this, developing attitudes to explain their observations and reactions to events experienced.

The fundamental principle of Kelly's theory is 'constructive alternativism'. Kelly argued that the constructs or view of the world that everyone adopts, is individualistic and subjective, and does not reflect the objective reality of the world. Also, as part of this process, the individual develops a number of 'personal constructs' which become the explanation and description for a range of human interactions.

In many respects, Kelly is advocating that all human beings are products of their environments, and within their environments, the events that they experience, the interactions they have with it, and the people within it, form their views and attitudes to the world and the people in it. Difficulties can arise when such views and attitudes are so different from reality, that the individual's behaviours and reaction to reality becomes detrimental to their psychological well-being, i.e. their interaction with others or ordinary activities become impaired, e.g. in the case of a pupil or student in school, having the opinion that they are not able or clever enough to gain at least reasonable marks in a particular school subject, which could lead to anti-social behaviour towards peers or adults.

The above example illustrates the importance of Kelly's theory in terms of the need in the school, educational context, at whatever level, i.e. primary to secondary and with some individuals, beyond, to alleviate distorted perceptions of themselves and their ability to learn, and their frustration, through reassurance and support, by whatever means, to enable and facilitate learning progress and attainment and by using, in addition, as many learning and teaching techniques as possible, e.g. use of cognitive styles.

Witkin developed his ideas on personality as a consequence and extension of his research into perception together with the subsequent development of cognitive styles in the form of field dependence - field independence.

This interaction between personality and cognitive factors, that field dependence – field independence embraces, is summarised by Witkin (1978) in the following passage:
"- That field dependence – field independence have these qualities: a) they are process variables, describing ways of orientating and functioning, rather than success in attaining goals; b) they are pervasive dimensions of individual functioning; c) along with their pervasiveness, they account for self-consistency in behaviour, which is predictable across situations; d) they tend to be stable over time, which need not imply unchangeability; e) they are bipolar. Field dependent people have competencies distinct from those of the field

independent (one is not simply the absence of the other); and f) the bipolarity also points to the fact that these constructs are value neutral. (Neither field dependence nor field independence is better or worse than the other). Each pole has qualities that help people adapt under particular circumstances." (op cit Korchin in Bertini et al (eds), 1986)

Field dependent persons rely on external referents to enable them to achieve solutions. They have well developed interpersonal competencies and therefore, feel comfortable with people, whom they use, particularly in ambiguous situations to supply them with standards for judgement and action, being more interdependent with others. Consequently, field dependent persons prefer activities and occupations which are people orientated, e.g. social sciences and the human-helping professions. Field independent persons by contrast, utilise internal referents. They are able to display skills in cognitive restructuring, segregating and manipulating abstract concepts. Consequently, field dependents function more autonomously of others in a social situation. Therefore, field independent people favour fields such of mathematics and the sciences.

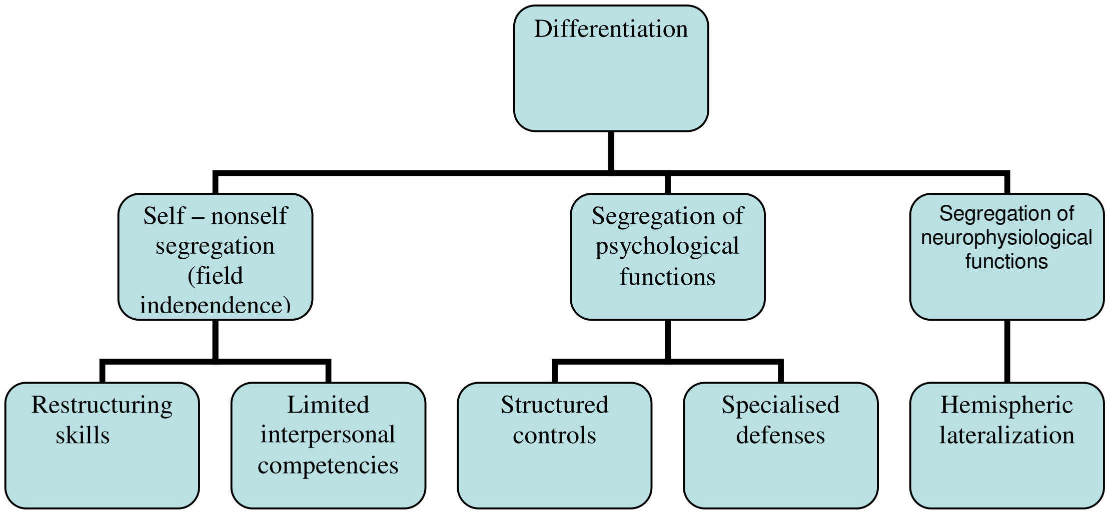
This difference between field dependent – field independent people conforms to the categorisation and characteristics of extroversion and introversion as formulated by Eysenck; and in relation to divergent and convergent thinking (Hudson 1966); in terms of approach to problem solving and level of social interaction.

However, Witkin (1978) developed further the construct of field dependence – field independence as a basis for a theory of personality by extending it to reflect a higher-order construct of self nonself segregation, which in turn related to a further, higher construct of psychological differentiation (Witkin, Goodenough and Oltman, 1979).

"A more differentiated person shows more self-nonself segregation; they are more definite and firmer boundaries 'between an inner core of attitudes, feelings and needs identified as the self, and the outer would, particularly other people.' (Witkin, Goodenough and Oltman, 1979). As part of a more segregated self are a more articulated body concept and a greater sense of personal identity. Overall, the more segregated the self, the more likely a person is to be field independent, having greater cognitive restructuring skills though fewer interpersonal competencies. As Witkin's earlier studies showed (Witkin, et al., 1962)."
(Korchin, in Bertini et al. (eds) 1986)

Therefore, self- non-self segregation is a balance between restructuring skills and interpersonal competencies, which is represented by field independence – field dependence, which forms one part of psychological differentiation because with subsequent developments of the idea of psychological differentiation, Witkin et al., 1979, included two major additional parts, namely, "Segregation of psychological functions (represented in more structured controls and more specialised defenses) and the segregation of neurophysiological functions, as seen in hemispheric specialisation" (Korchin, in Bertini et al.(eds),1986)

Model/Schema of Differentiation



(Witkin, Goodenough and Oltman, 1979, op cit. Korchin in Bertini et al (eds), 1986)

Witkin's (et al) model and concept of psychological differentiation provides a framework for the understanding of personality and social functioning. Also, it provides a link between the cognitive (perception and thinking) personal (likes and dislikes) and social (social interaction) attributes of an individual, as well as attempting to take into account neurophysiological functioning. However, although Witkin (et al) realised the potential of his theory to define the bipolar variables of field independence – field dependence, applying them to other psychological attributes as part of personality theory and taking account of the advantages and disadvantages of each, he also realised that its foundation was built on his methodology for assessing field independence – field dependence, which remains unidimensional, i.e. although each bipolar variable is value neutral, assessment performance is measured as either better or worse and not in terms of a difference. Also, while the consistency and stability of field independence – field dependence has been demonstrated since its original formulation, conditions under which an individual's cognitive style, i.e. field independence – field dependence (as well as other cognitive styles, e.g. divergent and convergent thinking), might change either through life, a particular set of circumstances or a particular context in which the individual would respond differently, brings into question the juxtaposition of fixity and mobility, Witkin's view (Werner Lectures, 1978) was that some people are only able to function in one mode, i.e. field independence or field dependence, while others are able to move from one to the other.

108In spite of the above doubts directed towards Witkin's personality theory, there is evidence from its application to clinical psychology, in terms of 'controls and defenses', that the social characteristics and level of interaction designated to field independent and field dependent people is more secure. Field – independent people are more differentiated which is characterised by more articulated controls and defenses, rendering expression e.g. body language, mood and feelings, to be more modulated and controlled. Also, field – independent people are more able to exercise motor inhibition, e.g. perform precision motor skills, and inhibit and control their behaviour. Therefore, with more structured controls go more specialised defenses such as isolation, intellectualisation and projection. Field – dependent people, in contrast to field – independent people are more likely to use denial and repression. Korchin in Bertini et al., (eds) 1986, summarises this difference from a social and personality perspective between field independent and field dependent as follows:

"The more field – independent, differentiated person uses defenses that are more differentiated and more advanced developmentally, such as intellectualisation and isolation. Such defenses are more congruent with the more abstract and conceptual orientation of the field – independent person, for they serve to protect the integrity of the intellectual processes against the intervention of potentially disturbing effects. Field – dependent persons have fewer conceptual resources to utilise such defenses and do not have as great a need to segregate intellectual from affective life because of their dominantly interpersonal rather than impersonal orientation".

It can be argued that the significance of Witkin's theory of personality is that it not only shows a relationship between the cognitive, emotional, and social functioning of an individual, but that it does so through perception, i.e. how the individual perceives a situation or problem whether it is a cognitive or social one, and simultaneously provides a bi-polar continuum having field independence and field dependence at its extremes.

Such a theory provides a possible alternative framework for learning and teaching in that it takes into account an individual perception and approach to a problem or task (cognitively) as well as their mental attributes or state to deal with it, effectively or ineffectively (emotionally) in a social context, thereby giving consideration to and taking account of the whole individual in the learning and teaching process.

3.8 Self Concept

Although the notion of what is now referred to as self-concept has been part of psychological thought and consideration for a long time (James, 1890) it is only comparatively recently that it has been studied in detail. The reason for this is in part due to reaction against behavioural theories and over-indulgent psychometric approaches to the study of the human condition. It is an attempt to understand the individual in terms of how he or she sees himself or herself as an individual, in relation to the society in which he or she lives and the world in general (Hilgard 1949; Roberts 1951, 1962; Coopersmith, 1967).

The way in which we see ourselves is strongly influenced by what we think others think of us. Social relationships and interactions tend to cause us to modify the way we see ourselves more or less continually. The self-image and/or self-esteem of each of us is formulated by the four determinants of 'looking-glass self', 'comparison with others', 'roles' and 'identification with models' (Lee and Williams, 1976).

The 'looking-glass or reflected self' (probably the major determinant of the self-concept) is concerned with the way in which we see ourselves. We are pleased or otherwise with what we see depending on what we should like to see or not see, and so imagine differences in our general character (i.e. appearance, manners, deeds, ambitions etc.), which we become affected by. Put another way, we find out what we ourselves are by the reactions of others in our social relationships. This suggests a viewpoint of personal perception that is concerned with what we think of as the reactions of others to ourselves which helps to form our self-concepts. An individual's interpretation of what others think of him or her is modified by what he or she thinks of others. In other words, he or she incorporates what others think of him or her into his or her developing self-concept. This leads to the idea of internalised order, which means that an individual forms a mental image of the people with whom he or she reacts as a result of social relationships. Although such an image may be false, it may help the individual to establish the looking glass self-image that he or she has, and determines the way he or she reacts to others in his or her social relationships.

The ‘comparison with others’ determinant is concerned with the way we see ourselves in relation to others (Argyle 1969, op. cit. Lee and Williams). For example, if we asked the question ‘Are we as good at a sport as others?’ in answering the question, we would not compare ourselves to professionals or small children because we would be far worse and far better respectively.

The third source of the self-image is that of ‘roles’. This means that the more we become associated with a particular activity the more we identify with it by adopting the characteristics expected of it by ourselves and by the general public. Such an activity would be a form of employment (doctor, policeman, labourer, etc.) or family (mother, father, etc.). Individual interests or pastimes can also be included, especially with children and adolescents, e.g. Boy Scouts, Girl Guides, etc. (Clifford and Clifford 1967, op cit. Lee and Williams).

The determinant of ‘identification with models’, in some ways, related to imitation (i.e. one person imitating the action of an adult) and is concerned with the process of one individual identifying himself or herself with another, usually of the same sex (Coopersmith, 1967, op cit. Lee and Williams). This is particularly applicable to identifying with the parent of the same sex.

Apart from the four determinants mentioned, a person’s background, environment and general experience of life are very important influences in the establishment and modification of the self-concept.

Although there are a variety of specific instruments to measure the self-concept, the most popular one is the ‘self-report’. The subject is asked to provide information about himself or herself, usually in the form of a verbal response or some sort of multiple-choice response.

Since the subjects of the samples to each of the Pilot Studies and Studies of the thesis were within the adolescent age range, it is interesting to consider self-esteem from the perspective of this age range, because their responses to the tasks they were asked to do, could have been influenced by their level of self-esteem at the time, although no assessment of their self-esteem was made. Also, at the time the individuals of each of the samples were in the latter part of their statutory education. Therefore, they may well have been experiencing self-esteem issues of both and educational (learning) and social perspective, as part of their continuing development i.e. varying degrees of self-consciousness, possibly positive and/or negative, in terms of were they providing the correct answer to the same extent as other members of their class or group.

The period of adolescence in human life could be described as a transitional stage between childhood and adulthood. The growth and development of adolescents can be viewed from six major points of reference as follows:

i) Adolescence is a time of increasing self-awareness, endeavouring to test his or her conceptions of self against reality.
ii) There is a tendency to struggle against relationships with adults due to status seeking as an individual.
iii) The adolescent is very concerned to be recognised and accepted by people of his or her own age in group relationships (i.e. peer group).
iv) This period of major physical development and growth (i.e. puberty), although universal to the human species, can bring problems to the individual.
v) Intellectual expansion and development is experienced at this time (Piagetian 'formal operational stage'). The adolescent finds he or she has to adjust to increasing academic and intellectual demands. He or she expected to acquire skills and concepts that may be useful at some future date, but often lacks necessary motivation. During this time, the experience and knowledge gained by the individual is used by him or her to reinterpret his or her environment.
vi) The development and evaluation of personal values takes place, producing conflict between youthful idealism and reality.

Each of these six facets of adolescent growth and development is reflected in the establishment of the individual's self-concept. The self-concept and self-esteem develop simultaneously, self-esteem being both biological and situational. The overall or global self-concept may be different from the academic self-concept. The global self-concept is defined in terms of appearance, general competence and popularity. The academic self-concept is defined as self-appraisals in terms of learning, work, habits, motivation and relationships with the teacher.

Related to these two concepts is the concept of the self-fulfilling prophecy. In a study of this concept, Good and Brophy (1972) showed that the following components were important to it:

a) Specific behaviour and achievement is expected by the teacher, based on stereotypes of assumed social class, ethnic background, initial achievement and classroom behaviour.
b) On basis of (a) the teacher reacts differently to different students.
c) In turn, the student reacts to his or her teacher (in terms of behaviour and achievement) in a manner that he or she believes to be expected of him or her by the teacher.

If this process continues (i.e. the student does not resist or change the type of reaction between himself or herself and the teacher) it will tend to mould in a fairly permanent fashion, the achievements and behaviours of the student. High expectation students will achieve high levels of performance and low expectation students will achieve low levels of performance.

The process of the self-concept can be a vicious circle. If the global self-concept and/or the academic self-concept can be affected so much by the teacher's assumptions and consequent attitudes towards the pupil or student, then such a vicious circle can be broken if the teacher adopts positive attitudes towards the student (i.e. believing that he or she can achieve better results and being prepared to help him or her towards such a goal).

The concept of a 'locus of controls', is an important one relating to the self-concept. This concept differentiates between those individuals who feel that they have little or no control over their behaviour, environment and influence over events because it is controlled by external forces (i.e. luck, chance, unknown, but powerful others, authority), and those individuals who feel they have complete control due to their skill, ability, experience and inherent potential (Rotter, 1966). This relates to feelings of personal inadequacy and adequacy respectively, which Roger's (1951) would refer to as a lack of 'self-worth' and a low 'self actualisation tendency'.

Many studies have shown a strong relationship between low self-esteem and anxiety. Homey (as cited by Burns, 1979) suggested the following conditions for this relationship:

- Unstable and alternating self-images of low self-esteem persons produces anxiety.

- Low self-esteem persons usually present a false image to the world, which creates strain and tension, resulting in further anxiety.

- The low self-esteem person is sensitive to evidence that confirms his or her inadequacy which in turn provides anxiety.

- Such feelings of worthlessness and inadequacy initiate isolation from others, both physically and emotionally which becomes another source of anxiety.

Other factors which can adversely affect the relationship between young people and their teachers, and therefore the self-esteem of young people, is their way of exploring and learning about the world, as well as the particular approach they adopt, i.e. Are they creative? Do they have a particular cognitive and/or learning style? Are such particular psychological attributes different to those of the teacher? and therefore, Is there a mis-match between the young person and their teacher, in the learning situation?

Obviously, many of the above aspects of self-esteem do not only apply to adolescents, they apply to individuals of all ages, in both a 'global' and academic (and training) context.

3.9 Motivation

Motivation is related to the idea of 'drive', which in its simplest form is the provider of the energy necessary for a particular behaviour to take place. Morgan (1993) made a distinction between different types of 'drive', which he termed primary (satisfaction of basic needs within the human being), and secondary (which relate to learnt or social behaviours). Morgan also subdivided primary drives into physiological (concerned with the physical necessities of living) and general (concerned with less specific goals such as exploration and affection).

Hull (1943) proposed the idea of 'drive-reduction', in which any organism is motivated to reduce a primary drive, e.g. hunger. For the organism to achieve its goal of satisfying a primary drive, learning has to take place. Hull's basic idea eventually led to the formulation of a model of learning with the sequence; stimulus – organism – response.

This formulation became the basis of Skinner's (1950)'Theory of Learning', where the individual (organism) responds to a given stimulus or problem through a series of attempts at responding appropriately to the stimulus/solving the problem. Each attempt provides the individual (learner/organism) with information as to why the previous approach had not provided a solution, which in turn enables the individual to modify the way he or she approaches the problem in a further attempt to solve the problem.

Primary and secondary drives, in a human context, are related to a variety of needs. Maslow (1959) developed a hierarchy of needs, which includes the major categories of physiological needs, e.g. food and safety; psychological needs, e.g. security and affection; and self-actualisation needs, e.g. cognitive and aesthetic; with 'self actualisation' at the apex of a pyramid depicting the range, necessity and importance of the different categories of needs.

The primary need, of Morgan's model, which is subdivided into physiological and general needs, is comparable with the physiological (same name) and psychological needs in Maslow's model; as is the secondary need and self-actualisation respectively.

This indicates the importance both Morgan and Maslow attach to the idea of self-actualisation, because it is associated with an individual's psychological and mental well-being. Without a robust state of self-actualisation, i.e. the ability to recognise one's own strengths and weaknesses, to be compatible with them and therefore have the ability to address positively, any situation or person that might challenge them, the individual's propensity to have a well-developed self-concept, the confidence to engage in new tasks and activities, cognitively and socially, is impaired. Also, the achievement of self-actualisation relates to a high level of self-worth, both of which form important parts of Rogerian 'personality theory' and 'model of learning' (Rogers, 1962).

It seems obvious to suppose that without the appropriate drives and needs, motivation is going to be limited, especially intrinsic motivation, i.e. engaging in a task not through a necessity but through a desire or interest to do so without any form of tangible reward. Intrinsic motivation is the opposite to extrinsic motivation, which refers to the engagement with a task which can be through necessity and/or the provision of a tangible reward.

In an educational context or learning situation, praise and rewards of some description can encourage further motivation to continue to learn and achieve, which in time can lead to economic and possibly social well-being, all of which encompass various types and levels of motivation (McClelland, 1961).

However, how can motivation be encouraged in the learning situation in addition to use of praise and rewards? Part of the answer to this question possibly includes the application of cognitive and/or learning styles in some form, which can help pupils and students, not only to engage in the learning process but also acquire the knowledge and/or skills intended through it. In addition, learning behaviour, or motivation, i.e. the engagement with the learning task or process and maintaining contact with the learning task or process, until a successful outcome has been achieved, can be increased (Riding and Rayner, 1998).

The cognitive style of field dependence - field independence could, I believe, be considered a cognitive style which offers greater potential for increased learning achievement because it takes into account the perceptual field of the task and the level of ability of the learner to see the major and minor components of the perceptual field, i.e. the actual learning task, or problem, in the surrounding context. Therefore, if the organisation of learning materials and their presentation could be designed to take these ideas into account, then learning motivation and success could be improved especially for field dependents.

Whether based on psychological theory and/or research evidence, or merely speculative, levels of motivation are inevitably linked to an individual's level of development in a number of other psychological attributes such as intelligence/ability, memory and personality, as well as social context and social expectations.

3.10 Conclusion

This chapter has been concerned with a range of major psychological attributes that can be viewed in their own right or linked to give relationships and possible insights into human cognitive functioning. In addition, a consideration of how human cognitive functioning might be related to the ideas and formulations of cognitive/learning styles, particularly the cognitive style of field dependence-field independence has also been attempted.

Wherever an individual might be placed on the field dependence – field independence continuum, it appears that the reasons for their placement are associated with a range of abilities and acquired skills. Abilities that are innate, that give a propensity to be able to perceive individual things in a contextual field, whether cognitive or social, are skills acquired through the development of the way in which an individual is able to analyse and synthesise information.

Chapter 4

Cognitive Styles; Learning Styles; Learning Strategies; Further Categorisations of Terminology and Developments; Overview; and Models of Unification.

4.1 Introduction

There are many cognitive styles and learning styles, as well as learning strategies and other attempts to define and classify the process of learning, i.e. cognitive controls, locus of control and, to an extent, 'attribution theory'. Many of these attempts are concerned with the approach of the learner to learning and the interaction that takes place between the learner and the task or information to be learned. With so many explanations there is a strong suggestion for there to be a synthesis or unification to provide a coherent model for the learning process, taking into account a range of associative and inter-related factors such as psychological – cognitive (e.g. intelligence/ability and memory) and affective (e.g. self-esteem and motivation); environmental (e.g. the conditions in which the learning takes place) and pedagogical (e.g. the structure of the learning materials and the quality of the teaching).

Therefore, the leading cognitive and learning styles are cited within the chapter, together with a number of models that attempt a unification of styles together with a number of psychological, environmental and pedagogical factors, in some cases. Very recent approaches to the idea of unification have attempted to include research findings from cognitive psychology and neuro-science in the formulation of a particular model.

The attempts at the unification of styles brings into question, or at least a review of, the theoretical background in terms of their formulation and definition, together with the amount and range of empirical research evidence, to support the claims that they make.

However, field dependence – field independence has been researched extensively, but opinion is divided as to whether or not it is a measure of cognitive style, a measure of ability, or both.

4.2 Cognitive/Learning Styles - Definitions

In addition to the cognitive style of field dependence – field independence, there exists a number of other cognitive styles and learning styles. One of the difficulties for researchers and educationalists is the answer to the question, "Are all of these styles referring to something that is fundamentally different in the process of learning and thinking, or are they referring to a small aspect of a bigger more complex model?" In a similar vein, a further question could be posed, i.e. "Why have two different names for styles in an educational context, are they the same or different?" Also, "How can cognitive style and/or learning style be defined?" Answer to these questions are not easy to formulate because of the complexity of cognitive and learning styles in terms of their characteristics, as defined by the researchers who first invented and developed a particular cognitive or learning style; the number of each of them; and how they are thought to relate to a range of psychological attributes, evident in the learning and teaching process.

There have been a variety of attempts to define cognitive and/or learning styles. For example,

1. "- the type (like the stereotype) was employed more as a subjective generalisation about people than as an empirical clustering of attributes, and the same weakness is apparent in many of the modern styles." Vernon 1973

2. "- a broad dimension of individual differences that extends across both perceptual and intellectual activities. Because what is at issue is the characteristic approach the person brings with him (or her) to a wide range of situations – we call it his (or her) 'style' – and because the approach encompasses both his (or her) perceptual and intellectual activities – we spoke of it as his (or her) 'cognitive' style." Witkin et al 1977.

3. "Cognitive styles are typically conceived as being multifaceted in their behavioural expression and dynamic in their interplay with situational and task requirements." Messick 1989

4. "- viewing cognitive styles as broad dispositions and higher-order 'meta-strategies' that influence the individual's attempts to adjust to situational demands" Miller 1987

5. "an individual's characteristic and consistent approach to organising and processing information" (Tennant, 1988)

6. "Cognitive style is an individual's preferred and habitual approach to organising and representing information." (Riding and Rayner, 1998)

7. "Is a common conceptual framework and language for styles even possible? I believe so, but only if one accepts the notion proposed by Briggs that styles are, in essence, approaches to learning and even life. The common conceptual framework I propose is through the *psychology of choice and decision making.* One thing all of the styles .. . have in common is that they represent choices. Individuals have preferences for certain styles." Sternberg, 2001.

8. "Cognitive Style Definition
Cognitive styles are individual differences in processing that are integrally linked to a person's cognitive system. More especially, they are a person's preferred way of

processing (perceiving, organising and analysing) information using cognitive brain-based mechanisms and structures. They are partially fixed and relatively stable."
And
"Learning Style Definition
Learning styles are an individual's preferred ways of responding (cognitively and behaviourally) to learning tasks which change depending on the environment or context. Therefore, a person's learning style is malleable." Peterson et al 2008

It can be seen from the above attempts at defining cognitive and/or learning styles, that there are a variety of perspectives that include, preference, an individual's ability, the processing, organising and representation of information, choice, neurological functioning, behaviour, environment and content.

Therefore, due to the complexity of cognitive and learning styles, as well as learning strategies and several additional factors/categorisations, that appear to be influential in the learning and teaching process, each of these groups, i.e. cognitive styles, learning styles, learning strategies and 'further categories' will be reviewed separately, with examples from each group being described and discussed.

4.3 Cognitive Styles

The following cognitive styles have been selected to describe and discuss because of their historical significance or association with subsequent developments in cognitive style theory and applications.

Field Dependence-Field Independence (Witkin, 1947)

Although field dependence – field independence was discussed in Chapter Two, it was in terms of its origins, formulation and general applications. Also, in Chapter Three in the section on personality, the consequent development of field dependence – field independence was referred to in relation to 'psychological differentiation' and arguably, a subsequent personality theory (Witkin et al 1962). In this Chapter /section, field dependence – field independence will be discussed by considering the three aspects of perception, spatial ability and cognitive style. Again, in Chapter Three in the sections on perception and spatial ability, reference was made to possible links between field dependence – field independence and these aspects of thinking. The unique characteristic of field dependence – field independence is that it takes into account the context or 'field' in which a particular problem, cognitive or social, is set. The 'style' then is the approach to the problem that the individual adopts in terms of identifying, 'seeing', the problem and then engaging with the problem by analysing the elements or parts of it. This is done through a process of disentangling or disembedding the relevant aspects of the problem from other aspects surrounding it.

The question as to whether or not all individuals have the ability to see the problem and then the ability to analyse the problem, enabling an individual to successfully solve it, remains an open one. Evidence can be contradictory, e.g. The Group Embedded Figures Test (GEFT) (Witkin et al 1972) in its measurement of field dependence – field independence correlates with ability; and IQ (intelligence) and field dependence – field independence are independent (Riding and Pearson, 1994). However, it would appear that the approach to a given problem adopted by an individual is an important step necessary before the ability to analyse a given problem is activated. There is, from the perspective of field dependence – field independence, a subtle interaction between the two aspects of perception and ability, which helps to partly explain conflicting evidence from studies into the role played by field dependence – field independence in problem-solving, thinking, learning and teaching skills.

Leveller-Sharpener (Holzman and Klein, 1954)

This cognitive style attempts to take account of and explain how individual's perceive and memorise images. Images in this context can be either derived from a story (verbal stimuli) or from a picture or file (visual stimuli).

The characteristic of Levellers is that they are not always aware of changes or inconsistencies in a sequence of information. As a consequence they tend to reduce and/or simplify information during recall. Also, they link new information with older information. Although this enables them to remember information more readily, that which is remembered is not always clear or accurate, leading to over-generalisation.

Sharpeners, on the other hand, are able to perceive and retain discrete and differentiated amounts of information, which in turn enables them to remember the original structure of the information (Holzman and Gardner, 1960). Also, Sharpeners, unlike Levellers, are able to disassociate recent memory from previous memory in relation to the retention of information. However, Sharpeners tend to rely more on rote memory, than do Levellers, and are likely to over-discriminate (Santostefano, 1978).

Individuals change from a Levelling to a Sharpening position, on the continuum between the two, during maturation or development. Riding and Rayner, 1998, describe this process as follows:

"This involved, more specifically, a movement away from 'fluid' to 'stable' memory structure, as well as from a 'global' to an articulated differentiation of past and present images and events."

The continuum of 'levelling – sharpening' is essentially concerned with processes of perception and the extent of assimilation, resulting in memory retention. In non-threatening circumstances, whether in a learning or social context, an individual's position on the continuum can remain relatively stable. However, this can change in a threatening context, of whatever sort. Jonassen and Grabowski, 1993, describe this potential change in the following manner:

'- an individual's levelling/sharpening style may change when confronted with an unusual or unexpected situation. Depending on the amount of control the individual feels during a highly stressful situation, he or she may move to either end of the continuum. The more control an individual feels in a situation, the more likely it is that he or she will process information in a distinct and differential manner,'

With regards to individual differences and possible links between 'levelling/sharpening' and field dependence – field independence, there appears to be an association in the way individual's perceive and process information.

Therefore, since field dependence – field independence (or field articulation)

"- describes the ability and approach used by individual's to articulate or separate relevant and irrelevant stimuli in an information field – 'levellers' should tend to be field dependent, whereas sharpeners should be field independent-" (Jonassen and Grabowski, 1993)

However, there is no direct research evidence to support this view.

Impulsivity – Reflectivity (Kagan, 1965)

The cognitive style of Impulsivity – Reflectivity, which is also referred to as cognitive tempo - conceptual tempo, describes an information processing continuum. Impulsivity defines the eagerness of an individual to respond to a question presented to him/her as quickly as possible, without first considering the validity or accuracy of their answer; and reflectivity defines the consideration or reflection an individual applies to a possible answer to a question before giving the answer.

As a consequence of each of these two approaches to answering questions, verbally or in written form, and learning activities in general, reflectives respond slower and produce fewer performance errors, than do impulsives (Kagan, 1965a, 1966).

The explanation for the difference in these two approaches or styles to learning is thought to be connected to the level of anxiety and self-confidence of the individual in a learning situation. Also, a further difference between the impulsive and reflective individual is their level of concern to minimise errors. Because Reflectives are less anxious and more confident, they are able to take longer to consider their answer before committing themselves. Impulsives, on the other hand, because they are more anxious about whether or not they may be judged as incompetent if they take too long to make a response, give a response without listening carefully enough about what they are being asked to do, and thinking sufficiently about their response before giving it (Black, Black and Harrington, 1974).

The different approach between Impulsives and Reflectives is also evident in problem solving activities. Reflectives are more systematic in information gathering and they are able to consider and analyse the validity of alternative solutions much more than are Impulsives. Also, the research evidence, associated with personality characteristics, has shown that Impulsives are more restless and less able recognise and follow rules, as well as respond to requests requiring an immediate response (Bucky and Banta, 1972).

A number of researchers have found significant correlations between 'Reflective' and field independent individuals (Campbell and Douglas, 1972; Keogh and Donlon, 1972; Massai, 1975 and Neimark, 1975). In a similar vein:

'Zelniker and Jeffrey (1979) drew attention to a parallel asymmetry in their style research. They found that Reflectives consistently performed better than Impulsives on tasks requiring detail processing, but that Impulsives usually performed only as well as Reflectives on tasks thought to require global processing.' (Op cit. Riding and Rayner, 1998).

The above findings are not entirely unexpected when one considers that the two bi-polar styles of Impulsive-Reflective and field dependence – field independence, respectively, require similar modes of approach to the processing of information.

However, the concept of Impulsivity – Reflectivity, is able to take account of social behaviour as well as cognitive behaviour of the individual in the learning/educational situation and context. Therefore, inclusion or exclusion of Impulsivity-Reflectivity in the educational process can have positive or negative implications.

"The complications of this research appear to open up issues about the relationship between cognitive style, self-perception as learner, and perceptions of the learning task" (Riding and Rayner, 1998).

Divergence – Convergence (Guilford, 1967; Hudson, 1966, 1968)

The essence of the cognitive style of Divergence – Convergence has already been referred to in Chapter 3, Section 4. Creativity is similar to cognitive style in terms of a particular way of thinking, i.e. divergently – the generation of several possible answers, or convergently – the formation of a single answer, to a given question. However, research evidence showing its relationship to measures of field dependence – field independence is somewhat mixed.

Spatts and Machler, 1967; Bloomberg, 1971; Noppe and Gallagher, 1977; and Monis and Bergum, 1978, found that Divergers were not necessarily field independent and Convergers field dependent.

This is not entirely surprising when one considers the overall different characteristics of the four components involved, i.e. divergent, convergence, field dependence and field independence, in terms of their similarities and differences.

Although divergent thinking is considered not to relate to field independence because of the articulated approach it adopts towards problem solving, i.e. devising a single solution; convergent thinking can relate strongly to field independence for the same reason and because field independence correlates highly with measures of ability (intelligence). It appears then, that where an individual produces a high correlation between a measure of convergent thinking and field independence, their analytical skills and ability to work within any structure, are similar to their perception or disembedding skills, to enable them to produce such an outcome.

Therefore, the relationship between divergent-convergent thinking; creativity; personality type; ability (intelligence); and field dependence – field independence can be shown as follows:

Divergent Thinking	High Creativity	Field Dependence/Global socially not cognitively
	Extrovert Low/High Ability	
Convergent Thinking	Low Creativity	Field Independence/Articulated cognitively not socially
	Introvert High/Low Ability	

The above categorisation of the relationships between the components of divergent – convergent thinking, Field dependence – field independence, creativity, personality characteristics and ability (intelligence) are not absolute. Divergent – Convergent thinking and Field dependence – field independence form a continuum between the two poles (of the bipolar construct) of their extremities; and creativity, personality characteristics, and ability (intelligence), have a range of measures which in the case of ability (intelligence) can give a normative 'average' relative to a chronological age as well as an 'average range', i.e. one standard deviation each side of the 'mean' for a given sample.

Holist – Serialist (Pask 1972)

Both the holistic and serialist components of this cognitive style are concerned with:

'- a measure of a bi-polar information processing strategy that describes the way that learners select and represent information' (Jonassen and Grabowski, 1993)

Pask, 1976; and Pask and Scott, 1972, found the use of one of two broad approaches when the learning of complex material is attempted. These include,

" - (a) building descriptions, or an overview of the topic and how topics interrelate, or
(b) building operations such as the detailed, underlying interrelationship of concept elements"
(Jonassen and Grabowski, 1993)

The approach of holists is to use a global or thematic approach to learning by taking account of the broad description of the material to be learnt, focussing on a number of aspects at the same time. This is followed by the application of complex links to structure the information using a top-down approach, and establishing

“Interconnections between theoretical, practical and personal aspects of a topic – made through the use of analogies, and anecdotes” (Entwistle, 1979; Lind, 1985). (op cit. Jonassen and Grabowski, 1993)

Pask himself, considered that there was a deficiency in the Holists approach to learning because they did not take account of sufficient detail, to which he applied the term ‘globetrotting’ (Pask, 1976).

Serialists, on the other hand

“- use an ‘operations’ approach to learning, concentrating more narrowly on details and procedures before conceptualising an overall picture” (Pask, 1976)
(Jonassen and Grabowski, 1993)

Through the above process Serialists consider small pieces of information, not necessarily the most important, which they arrange in a particular sequence, working from the bottom up. Such an approach to the learning of a given piece of information is impoverished by the emphasis it places on a

“- narrow framework, concentrating on well-defined and sequentially ordered chunks (of information) that can be related using simple links” (Jonassen and Grabowski, 1993)

Pask used the term ‘improvidence’ to describe what he considered to be the deficiency in the process of learning adopted by Serialists of omitting important connections within a given piece of information to be learned (Pask, 1976)

Pask, 1984, also added the term ‘versatile learner’ which he described as someone who used both a holist and serialist approach to learning. By using both approaches in conjunction with each other, Pask felt that the learner was able to benefit from both a global and detailed perspective in the learning situation. This in turn enabled the learner to achieve a deeper understanding of material learnt which included both descriptive and procedural components.

In terms of field dependence – field independence, theoretical considerations and research evidence would suggest that Holists are related to field dependents, due to the global or thematic perspective that they adopt and Serialists to field independents, due to the operational or articulated perspective that they adopt, to learning experiences, respectively.

Verbaliser – Visualiser (Richardson, 1977)

As the name of this cognitive style suggests it is related to how an individual thinks and processes information in terms of a preference for either verbal or visual material, although one is not totally exclusive to the other.

The visual dimension in the context of the verbaliser – visualise cognitive style is less complicated than its counterpart in the usual haptic (tactile interaction, i.e. touching or holding) cognitive style (Lowenfeld, 1949), where the visual dimension is characterised by the qualities of spatial relations, visual discrimination, figure-ground discrimination, visual closure and object recognition.

The term Visualiser in the present context can be characterised by the qualities of thinking taking place through the use of images and the thinking involved tending to be 'concrete', as well as the personalisation of information. Visualisers, therefore, prefer to learn using materials with pictures and text, diagrams, flow-charts and graphs.

Verbalisers in contrast to visualisers are characterised by a preference to learn through text, either by reading or listening. Verbalisers, therefore, think and process information through the use of words, and not images, tending to display a greater degree of objectivity in relation to the information they are learning.

As with all bi-polar constructs, some individuals find themselves in a middle position, and in the context of the cognitive style of verbaliser – visualise, this means that some individuals have an equal preference and skills, both as a verbaliser or visualise. Therefore, they can change from one style to the other depending on their reaction to a given piece of information to be learnt.

Equally, there are some individuals who find themselves at/or towards the other end of the 'verbaliser – visualiser continuum'. This has led to the adoption of a high and low imagery category. The high imagery category, corresponds to the visual qualities/skills associated with the visual-haptic cognitive style (as stated above), processing information through images; and the low imagery category, includes individuals who tend to be verbalisers and therefore, process information through language symbols (Hollenberg, 1970; Stewart, 1965).

Jonassen and Grabowski, 1993, describe the development and establishment of the verbaliser – visualiser as follows:

"Prompted by Paivio (1971) work which defined the role of visual and verbal processes in learning, Richardson (1977) attempted to further delineate this cognitive style. He traced the developments of the construct to *experimental* evidence reported by Griffiths (1927), who found differences between concrete , visual types and auditory, verbal types, and Roe (1951), who found differences in learning preferences by profession; *physiological* differences relating breathing patterns and lateral eye movements to visual/verbal preferences (Bogen, 1969; Golla and Antonovitch, 1929); and *finally, behavioural* evidence investigating perceptual and memory processes and verbal/visual habits (Bartlett, 1932). Behaviour patterns distinguished verbalisers as those who reported a general class of objects and problem-solving strategies with no imaging, while maintaining an 'objective task orientation', and visualisers as those who mentioned more personal and concrete objects, using a 'subjective, self-orientation"(cited by Richardson, 1977).

Riding and Rayner, 1998, in reference to the work of Richardson and the need for the further development of the verbaliser-visualiser (Imager is interchangeable with Visualiser) cognitive style in terms of definition and measurement, state:

"- acknowledging the strong construct validity of the verbal-imaging continuum. Richardson thought imagery 'is not an epiphenomenon but a genuine phenomenon that has psychologically significant consequences. These consequences define its adoptive functions' (Richardson, 1991). In a similar light, the interrelationship between verbal and visual modes of representation and the construct of a cognitive style dimension infer considerable applications. What is required is

- the integration of the verbal-imagery continuum into a more fully developed construct of cognitive style.
- the development of an objective measure of the verbal-imagery dimension."

The characteristics of the 'verbaliser' are considered to relate more to those of field independence than field dependence; and vice versa for the 'visualiser' (imager). This is perhaps somewhat surprising because one would naturally associate visualisation skills with field independence due to the ability to disembed the simple figure or shape from the complex figure or shape, which is obviously of a spatial and visual (image) nature. However, this association could be explained by level of ability and the analytical skills on the part of some verbalisers.

4.4 Learning Styles

The following learning styles have been selected because of their prominence in the field and because of their characteristics in terms of them providing a basis for applications, not only within, but beyond, i.e. business and industry, the context of primary, secondary and to an extent further and higher education.

Learning Styles Inventory (LSI) (Dunn and Dunn, 1974; Dunn, Dunn and Price, 1979, 1984, 1989a)

Dunn and Dunn base their Learning Style Inventory not on a single or bi-polar cognitive attribute but on the interaction of a variety of emotional sociological environment and physical factors, linked or associated with whatever preferred cognitive style the individual may bring to the learning situation. The above four factors are sub-divided as follows:

Emotional (developmental) – motivation, responsibility, persistence, need for structure

Sociological – (adults) learning in groups, presence of authority figures, learning in several ways.
(children) - as above plus motivation from adults

Environmental (biological) – sound, temperature, light, seating/furniture design

Physical – modality preferences, e.g. auditory, visual, tactile, kinaesthetic, intake e.g. eat, drink, chew, time of day, mobility

There is a fifth factor termed psychological, which comprises of the following elements; global versus analytic, i.e. structural teaching and materials to suit the learner(s).

Impulsive versus reflective, i.e. the opportunity for either to be applied linked to discovery/structured/programmed teaching to suit the learner(s).

Hemispheric dominance, i.e. structured activity(ies) to engage left/right side of brain processing, to suit the learner(s).

Therefore, Dunn and Dunn hold the view that by taking into account all of the above variables in the learning situation, the learner will achieve improved learning behaviour, i.e. motivation/positive approach to the learning task, and performance/achievement.

The Learning Style Inventory is the outcome of a systematic factor analysis to derive the four major variables of emotional, sociological, environmental and physical. However, since the Learning Style Inventory uses a 'self report' format, it does not attempt to measure underlying factors, e.g. psychological/cognitive, values or attitudes, or why a learner displays particular learning preferences.

"It also does not assess whether or not learners possess the skills that enable them to use their preferred mode of learning. For example, the skills that are specific to successful learning by oneself or in groups are not indicated by this instrument. These factors denote learner preferences for various external learning conditions, rather than specific cognitive abilities for perceiving and internally manipulating information" (Jonassen and Grabowski, 1993).

Although research continues to be done on the composition and application of the Learning Styles Inventory, because it consists of so many variables and sub-variables, it obviously generates a lot of information which is not always easy to interpret or apply on behalf of an individual learner or groups of learners. Also, the fact that it does not measure any cognitive ability or attribute, its findings cannot always be focused to a specific learning issue. However, it does remind learners and teachers of the importance of the conditions where learning is to take place, as well as the level of comfort of the learner and teacher at the same time.

Learning Styles Inventory (Kolb, 1976)

Kolb's model of learning styles is based on a four-stage cycle, which places an emphasis on experience. Each stage, which Kolb identified and described has an adaptive learning mode, are as follows:

Concrete Experience (CE) - reliant on or, very influenced by the nature of immediate experiences;

Reflective Observation (RO) – displaying intentions as a consequence of internal reflection on the external world;

Abstract Conceptualisation (AC) – the comprehension of information conceptually and symbolically; and

Active Experimentation (AE) – an extension of the environment by external manipulation.

Through these four stages, Kolb argues, that the manner in which an individual prefers to perceive and process information, can be explained. Also, the four stages can be combined to give two continua, which are able to account for extreme performances, both in terms of the perception and processing of information, i.e. concrete experience and abstract conceptualisation continuum, gives concrete extremes of perception of the environment or experiences of the world; and reflective observation and active experimentation gives extremes of processing or transforming immediate information, respectively.

Kolb further differentiated these two continua into four basic ways for the individual/learner to interact with the world, which in turn become four different types of learning style, i.e. divergers; assimilators; convergers and accommodators. Each of these can be defined as follows:

Divergers – experience is grasped concretely through feelings (apprehension) and transformed through thought (intention) – combining concrete experience with reflective observation.

Assimilators – experience is grasped through abstract comprehension (conceptualising) and transformed through thought (intention), combining the characteristics of abstract conceptualisation and reflective observation.

Convergers – experience is grasped through abstract comprehension (conceptualising) and transformed through action (extension), which combines abstract conceptualisation and active experimentation.

Accommodators – experience is grasped concretely through feelings (apprehension) and transformed by action (extension), which combines concrete experience and active experimentation. (Kolb, Rubin and McIntyre) (op cit. Jonassen and Grabowski, 1993)

Also, there exists a range of strengths and weaknesses, for each of the above four learning styles which help to illustrate the differences and similarities between them, and the basis between the two continua dimensions that encompass them.

The particular learning style preference adopted by an individual is a consequence of their heredity; life experiences, i.e. the socio-economic, environments and educational; and socialisation experiences from family and school.

Kolb's two continua dimensions correspond to Piaget's model of figurative and operative aspects of thought, i.e. figurative in relation to perception and imitation are associated with the comprehension process; and operative in relation to action associated with the process of intention. Kolb's theory of experiential learning is the amalgamation of Lewin's, Dewey's, and Piaget's model of learning and subsequent cognitive development, re Lewin – conflicts between concrete experience and abstract concepts, and observation and action; Dewey – the association between ideas and motivation; and Piaget – the process of linking ideas (accommodating) to the outside world and absorbing (assimilating) new experiences into existing concepts.

Together, the three models of experiential learning form a unique perspective on learning and development that is characterised by the following propositions:

"1. Learning is best conceived as a process, rather than in terms of outcomes –
2. Learning is a continuous process grounded in experiences;-
3. The process of learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world;-
4. Learning is a holistic process of adaptation to the world:
5. Learning involves transitions between the individual and the environment.
6. Learning is the process of creating knowledge" (Kolb, 1984)

The summative conclusion of these propositions is a working definition of experiential learning: "learning is the process whereby knowledge is created through the transformation of experience" (Kolb, 1984). (op cit. Jonassen and Grabowski, 1993)

While the value of experience cannot be denied, particularly positive experience in a learning/educational setting, e.g. quality teaching at any educational level, it does not necessarily fully explain the development of neurological structures and cognitive mechanisms that it undoubtedly influences. Also, the question remains, 'Does an initial neurological structure dictate subsequent development or vice versa?' Not all individuals react in the same way to the same learning/educational experience.

Style Delineator (Gregorc, 1982)

The Style Delineator consists of bi-dimensional style preferences in which the individual perceives and structures information. The bi-dimensional styles are as follows:

Abstract random	Concrete random
Abstract sequential	Concrete sequential

Therefore, perceptual preference can take the form of either an abstract or concrete mode or a combination, where abstract perception describes the processing of information through reason as well as intuition, and concrete perception, is related to the physical aspects of information through the senses. With the structuring of information, again, an abstract or concrete mode or a combination is adopted, by the individual, where abstract sequential refers to the organisation of information in a network or individualised arrangement; and concrete sequential, in a linear or step by step arrangement.

Twelve variables associated with the perceiving and organisation of information have been delineated between the four types of learning styles within the Style Delineator model. These include:

"world of reality, ordering, ability, view of time, thinking processes, validation process, focus of attention, creativity, approach to change, approach to life, environmental performance, use of language, and primary evaluative words"
(Gregorc, 1982) (op cit. Jonassen and Grabowski, 1993)

It can be seen from the above list, that although some of the items appear to be a little vague, e.g. environment performance, others extend the classification of thinking skills, e.g. creativity.

Each of the four learning styles preferences are characterised by a range of different qualities which do not describe the extremes of their bi-polar continuum. Instead, individual learning preferences are placed within a range on each component of both the bi-polar/dimensional style, i.e. abstract random/abstract sequential, concrete random/concrete sequential, within abstract-concrete and random-sequential.

For Gregorc, an individual's learning style is influenced by:

"- the belief that individuals possess internal, subjective patterns of learning that include general qualities held in common by others, as well as specific physical, emotional and mental qualities that are unique."
(Jonassen and Grabowski, 1993)

The Gregorc Style Delineator evolved from:

"extensive observations, in-depth interviews, and subsequent analysis of data from students and teachers – involved in learning and teaching style activities" (Keefe, 1987)

All of which assisted the study of teaching materials and techniques, and the implications for individual learners. Therefore, it is no surprise that Gregorc places an emphasis on the importance of teaching materials and teaching style matching that of the learner. Where there is a 'match', the learner usually reacts favourably.

Learning Styles Questionnaire (Honey and Mumford, 1982, 1986 and 1992)

Kolb's experiential model of learning and learning styles was influential in the development of Honey and Mumford's (1986) Learning Styles Questionnaire, which 'was an attempt at a practical application of learning style theory in the management of the workplace.' (Riding and Rayner, 1998)

The Learning Styles Questionnaire explores a style model which consists of the following four types of learner: activists, theorists, pragmatists, and reflectors. Integral to these four types of learner is the implications for their individual and group management in a commercial context.

Riding and Rayner, 1998, define each of the four learning styles as follows:

"activists - enjoy new experiences, engaging in activity, intuitive decision-making and group work, but who dislike administration or the implementation of procedure

theorists- focus on ideas, logic, generalisations and systematic planning but who mistrust intuitive insight or social/emotional involvement

pragmatists- enjoy group-work, discussion, debate, risk-taking and practical applications which get results, but who avoid reflection, observation and levels of deeper understanding

reflectors- focus on understanding meaning, observing and describing process or predicting outcome, and who are concerned with the 'what is' rather than the 'how' in any directed activity."

Honey and Mumford (1986) augment the above definitions by stating that for:-

activists - 'Their philosophy is: "I'll try anything once"'
'Their philosophy prizes rationality and logic.'

theorists - "If it's logical it's good". Questions they frequently ask are, "Does it make sense?" "How does this fit with that?" "What are the basic assumptions?"

pragmatists- Their philosophy is: "There is always a better way" and "If it works it's good!"

reflectors- 'Their philosophy is to be cautious. They are thoughtful people who like to consider all possible angles and implications before making a move.'

Also, Honey and Mumford (1986) consider each type of the above learning styles to be a connected stage or part of a continuous learning cycle.

Therefore, the Activist's preferences are well suited for 'experiencing'; Theorist's for 'concluding'; Pragmatist's for 'planning'; and Reflector's for 'receiving'. So placing the four types of learning cycles and their overall characteristics in a logical sequence to show the 'start to finish' of a learning process, would give the following arrangement:

Stage 1 Activist/experience – having an experience
Stage 2 Reflector/receiving – the experience
Stage 3 Theorist/concluding – from the experience
Stage 4 Pragmatist/planning – the next steps

The above process is applicable to a commercial or industrial team, engaged in the production of a product, where each specialist learning style has an important role to play, but equally, arguably, it could also apply to the learning of a given task by an individual, whether the context was academic, e.g. writing a book, or vocational, e.g. solving a management problem. However, in a team context, this combination of learning styles, not only maximise team productivity in terms of quality outcomes, but at the same time maximise the particular learning style preferences and characteristics of each team member. Also, the experience of working in a learning or problem-solving situation with other individuals, who have different and distinct learning styles, could help to extend a particular style as well as sharing the experience of thinking and learning in different ways, in relation to a solution of the common problem and/or objective.

4.5 Learning Strategies

Learning strategies differs from cognitive or learning styles in that cognitive style(s) is a relatively fixed entity within the individual that relates to the gathering and/or organisation of information; and learning style(s) belong to the learning-central tradition, which describe individual differences in the learning process. Learning strategies therefore,

"- are formed as a response within the individual to meet the demands of the environment. Learning strategies may thus be seen as cognitive tools which for the individual are particularly helpful for successfully completing a specific task. This approach leads to the concept of the strategic learner."
(Riding and Rayner, 1998)

The above statement leads to the idea of the development of strategic learning. This occurs when an individual realises that their preferred cognitive style is not suitable for a particular cognitive task, e.g. a verbaliser converting a piece of information presented in a graphical format into words, and vice versa for a visualiser, to assist understanding of the information for each individual. The conversion of learning material from one preferred mode of cognitive functioning to another, where and when-ever possible, will lead, over time, to the establishment of a repertoire of learning strategies.

4.6 Further Categorisations of Terminology relating to Cognitive and Learning Styles

i) Cognitive Control

Not all researchers are agreed on definitions of cognitive control when contrasted with cognitive styles in particular as well as learning styles, and learning strategies.

The concept of Cognitive Controls stem from mental abilities whereas cognitive and learning styles are related to learner traits. Cognitive Controls therefore,

" have the status of intervening variables that define principles by which motoric behaviour, perception, memory and other basic quantitative forms of cognitive functioning are organised as an individual coordinates himself (or herself) with his (or her) environment.' (Santostefano, 1928)
(op cit. Jonassen and Grabowski, 1993);

whereas Cognitive Styles are -

" characteristics self-consistencies in information processing that develop in congenial ways around underlying personality trends" (Messick, 1984)
(op cit. Jonassen and Grabowski, 1993):

and Learning Styles

" - as a construct is based on the assumption that learners' cognitive styles are accurately reflected in their own perceptions. This assumes that the learners are aware of how they process information and have developed some internally consistent constructs of themselves as learners."
(Jonassen and Grabowski, 1993)

" - Abilities are unipolar measures (less ability---more ability), whereas styles are bi-polar (visual---verbal): and abilities are value directional (having more is better than having less), whereas styles are value differentiated (neither pole is necessarily better). Cognitive abilities are affected by the content domain or the nature of the task, whereas styles are generalizable tendencies that cut across context – abilities enable learners to perform tasks, whereas styles control the way in which the task is performed."
(Jonassen and Grabowski, 1993)

In summary, cognitive controls (and abilities) are less specific than cognitive styles, which in turn are less specific than learning styles, because each measures a particular skill, processing tendency or individual preferences and perceptions of information processing, respectively.

However –

“ – although cognitive controls may be unipolar and value directional (as with cognitive abilities), unipolarity and value may, in some cases, be context sensitive. – (for) example, where reflective processing is a strength for deep thinking and problem solving, quicker, compulsive processing may be of greater value for surface level thinking and timed tasks. This is also the case with field dependence/independence. Although analytic, detailed, and independent thinking may be valued in one context, holistic, social (dependent) thinking is more worthwhile for other tasks and environments.”
(Jonassen and Grabowski, 1993)

In terms of the above definitions, field dependence – field independence would be considered to be a cognitive control rather than a cognitive style. But to take this view would amount to only accepting field dependence – field independence as a measure of ability and not as an indication of perceptual ability and personality characteristics and traits, which would be in conflict with Messick’s definition of cognitive styles above. This illustrates the complexity of attempting to define, ability(ies), cognitive controls, cognitive styles and learning styles, in general terms as well as providing boundaries of where each one begins and ends, assuming that such a task is possible.

ii) Locus of Control

Whatever an individual’s cognitive or learning style may be or whatever learning strategy adopted in association with them, the state of the individual’s feelings and emotions are an important factor in relation to their level of performance. Feelings and emotions in this context are a consequence of past experiences, confidence, and self-esteem, as they apply to the approach and completion of a cognitive task. Therefore, locus of control refers to an individual’s belief system in terms of their life events and who is responsible for the events they have experienced.

“ - Locus of control in relation to learning and instruction is an effective learning style, specifically an expectancy or incentive style (Keefe, 1987). That is, locus of control does not mediate learning directly, but it affects learning outcomes through the learner’s expectations of success and the resulting motivation to perform. Many factors, such as ethnic group, gender, education and socio-economic status interact with internality/externality to produce various effects”
(Jonassen and Grabowski, 1993)

An 'internal locus of control' is linked to the individual tending to attribute the causes of his or her success or failure, in the execution of a task, to him or herself. If success, it is the consequence of his or her motivation, effort or ability; if failure, it is due to a lack of these factors. In contrast, an individual tending to exhibit an 'external locus of control' is when he or she attribute the outcomes of his or her endeavours, in relation to a given task, to external forces and influences that are responsible for his or her achieving or not achieving success. When 'externals' experience failure, he or she attributes it to unfavourable circumstances and/or unreasonable expectations.

iii) Attribution Theory

An association has also been made between 'locus of control' and 'Attribution Theory', i.e. to whom or what does an individual attribute success or failure, and 'Does the attribution derive from internal or external sources and factors?' In attempting to answer these questions, Weiner (1971) added a further dimension of 'causality', arguing that some causes are constant or stable, and others variable.

The following diagram and explanation integrates 'locus of control' and 'attribution theory':

Attribution Theory
Causes of Success and Failure
Locus of Control

		Internal	External
Causes	Unstable	Effort	Luck
	Stable	Ability	Task Difficulty

" - Locus and control are, in fact, independent dimensions. Some internal factors, mood for example, may be perceived as uncontrollable, whereas others such as effort, may be controllable. Factors (effort, persistence) may be subject to volitional control or may be incontrollable, (fatigue, ability)."
(Jonassen and Grabowski, 1993)

Therefore, within the above model there are two dimensions, one of 'causality' and one of 'controllability'.

4.7 Further Developments

It can seem from the reference to and discussion of a variety of leading cognitive styles and learning styles, as well as the concept of a learning strategy, that there is overlap in terms of the identification of a particular cognitive attribute or skill. Although there are some similarities between various cognitive and learning styles, there are also differences. This overall situation is further complicated by the fact that cognitive attributes and/or skills cannot be addressed in isolation, either from the perspective of the learner or the educational environment in which learning is taking place without considering a range of additional psychological attributes, e.g. personality traits and factors, self-esteem issues and locus of control, as well and at the same time.

There is also the question of match or mis-match between the learners cognitive or learning styles and that of the educator (at whatever level), without ignoring the learning strategy(ies) of each, which can further complicate the act/experience of learning and teaching.

The large variety of style names, within each category of cognitive and learning styles, each with their own theoretical background, definitions (whole style and/or its major components) and applications, e.g. different stages of the educational process, i.e. primary, secondary, further and higher, or in commerce/industry, strongly suggest an urgent need for an integration or unification to clarify what it is they are actually describing. Such an integration or unification also needs to take account of personality, psychological and environmental factors, as well as suitability for particular applications, within the different stages of the educational process and the resultant experiences on the part of the learner.

Field dependence – field independence is arguably a promising candidate to provide a focus for a unified model of cognitive/learning styles, because of its strong associations with other leading cognitive styles/dimensions in particular, e.g. Wholistic – Analytic and Verbaliser – Imager (Riding and Cheema, 1991); personality theory (Witkin, 1962 and Eysenck, 1965) and ability (Thurstone, 1947).

The formulation of a unified model of cognitive and learning styles would also take into account the assessment of each style and perhaps category of style, i.e. cognitive or learning, in terms of their procedure and resulting construct validity and reliability over time, i.e. number of samples and age of sample members.

4.8 Overview – Cognitive Control Model/ Individual Characteristics

Rayner and Riding (1997) consider the construct of style in terms of its relationship and meaning/identification for cognition and learning. They state:

"The concept style represents a distinct notion of coherent singularity – in a variety of context – and might well reflect the need for a sense of identity which is arguably the essence of individuality"

Also, Miller, 1987; 1991; Riding and Cheema, 1991 and Riding 1997, agree with Tennant's, 1988, working definition/description of style (cognitive and learning):-

" - as a person's typical or habitual mode of problem solving, thinking, perceiving and remembering"

However, the problem of providing a definition for style within a cognitive or learning perspective, from the point of view of the individual, is further complicated when the context in which a given activity is taking place, is considered.

Grigerenko and Sternberg (1995) attempt to address the above problem by referring to three distinct traditions of 'style-based work in psychology', i.e. 'cognitive-centred approach', 'personality centred approach' and 'activity centred approach'.

The 'cognitive-centred approach' encompasses cognitive and perceptual functioning, associated with the two cognitive style families and corresponding fundamental dimensions of Wholistic-Analytic and Verbaliser-Imager, proposed by Riding and Cheema (1991). These two fundamental dimensions of cognitive style, attempt to account for how an individual first processes information and then represents information, in relation to thinking.

The Wholistic-Analytic cognitive dimension is derived from perceptual functioning. The major cognitive style model within this cognitive dimension is field dependence – field independence (Witkin and Asch, 1948b; and Witkin et al, 1962). The initial development of field dependence – field independence, in the form of the Embedded Figures Test, reflected research into perception by the Gestalt School of German Psychology (Gottschaldt, 1926) and the discrimination of shape (Thurstone, 1944). Later development produced the theory of 'psychological differentiation' (Within et al, 1962), which combines perceptual, cognitive and personality aspects of individual differences. The verbal-imagery cognitive dimension is related to verbal-visual representation. Paivio's (1971), 'dual-coding theory' formed the basis of further investigation and research into the characteristics of the cognitive processes within the Verbaliser-Imagery dimension (Riding and Taylor, 1926; Richardson, 1977; and Riding and Calvey, 1981).

Within the 'personality centred approach', there are no cognitive or learning styles per se, but arguably the cognitive style of divergent-convergent thinking could be cited, as a description of individual difference and behaviour that links aspects of cognition and social behaviour, i.e. divergent thinking is associated with extraversion, and convergent thinking with introversion (Eysenck, 1965; Hudson, 1966; 1968).

Also, personality theory has associations with learning styles or learning strategies, e.g. Kolb, 1976; and Entwistle et al, (1998) respectively, in relation to the way an individual approaches a learning task. Of equal importance is the level of anxiety (Yerks and Dobson, 1961); self-esteem and actualising tendency (Rogers, 1961); and motivation (McClelland, 1961), of the individual in relation to the confidence and willingness displayed to engage with a learning task and persist with it until a successful outcome has been achieved.

The 'activity-centred approach' can be considered to be synonymous with the 'learning-centred approach' because much of the research associated with this aspect of cognitive-learning styles, is derived from the interaction between learning and teaching.

Rayner and Riding (1991) include the following sub-categories within the 'learning-centred approach':

"Process-based Models of Learning Style
(e.g. Kolb, 1976, 1984);

Preference-based Models of Learning Style
(e.g. Dunn et al, 1989);

Cognitive skills-based Models of Learning Style
(e.g. Ramirez and Castenada, 1974; Hill, 1976; Keefe and Monk, 1986);

Learning style: theory into practice
(e.g. Messick et al, 1976; Miller, 1987; Riding and Cheema, 1991; Presland, 1994);
and
Fundamental Dimensions of Learning Style'
(e.g. Kogan, 1980; Messick, 1976, 1984; and Miller, 1987)."

In an attempt to unify and extend the many similarities and differences contained within the collective aspects of the above models and interactions between learning and teaching, Rayner and Riding (1997) state:

"It seems likely that many of the learning style models developed within the learning-centred approach might offer insights for the development of learning strategies. It is arguably useful to think in terms of cognitive style representing the core of an individual's learning style. The latter will, in turn, consist of a set of 'super-ordinate' dimensions of a personal learning style. It is possible that two further aspects of learning might reveal additional dimensions of learning style. The first is the effective aspect of learning; the second is the motivational aspect of learning, forming a third and fourth super-ordinate dimension of learning style".

The fundamental nature of cognitive style of learning style or something which encapsulates the two (as well as perhaps learning strategies) can only be derived from a consideration of a range of factors that include cognitive and experiential factors.

Riding (1997) developed the 'Cognitive Control Model', which begins to link with the cognitive style dimensions of Wholistic-Analytic and Verbal-Imagery, additional factors within the learning process.

Cognitive Control Model

External World	**Experiences**		**Observed Behaviours**	
Cognitive Input and Output	Working Memory		Learning and Coping Strategies	
Cognitive Control	Wholistic-Analytic and Verbal-Imagery Style			
Primary Sources	Knowledge and Cognitive History Memory of positive and negative experiences	Reasoning Ability	Personality Sources e.g. Anxiety and Activation	Gender

It can be seen from the above model, that Riding includes external influences which relate to experiences and the interaction of cognitive and personality factors, interacting with cognitive control and cognitive style(s).

Riding (1997) states:

"The perception of experience is probably moderated by the cognitive control level in interaction with the cognitive history and the primary personality sources", citing evidence for the model between the variables of intelligence, style and academic performance (Riding and Agrell, 1997; Riding and Sharratt, 2000); gender, style and effective learning (Riding and Al-Sanabaoni, 1998; Riding and Grimley, 1999); and personality sources, style and social behaviour (Riding and Wigley, 1997), within individual differences.

A further model of the interaction between cognitive style and other variables relating to individual differences or characteristics can be seen below.

Individual Characteristics

<table>
<tr><td>Previous Learning/Prior Knowledge</td><td rowspan="4">COGNITIVE STYLE</td><td>Learning Strategies</td></tr>
<tr><td>Intelligence</td><td rowspan="2">Degree of Self Control</td></tr>
<tr><td>Gender</td></tr>
<tr><td>Anxiety - Stability</td><td>Degree of Self Assurance and Coping Strategies</td></tr>
</table>

In this model Riding (2001) places an emphasis on the factors influencing the foundation and application of cognitive styles as well as the learning outcomes they help to produce. The inclusion of ‘intelligence’ in this model is of particular interest because it suggests the questions, ‘What is it? and How influential is it?’

“One position views intelligence as encompassing multiple abilities (Gardner, 1983), another considers it a wide range of behaviour (e.g. Sternberg, 1985); yet another conceives a much more narrow conceptualisation, with an emphasis on reaction time or inspection time (Kline, 1991). At the other extreme, some question whether intelligence even exists – (e.g. Howe, 1990). The view (of Riding) is that, at least, intelligence comprises information processing and resourcing ability.” (Riding, 2001)

Also, Riding and Pearson, 1994, found intelligence to be independent of cognitive style (the details of which are described in Study Four of this thesis).

4.9 Models of Unification of Cognitive/Learning Styles/Psychological Attributes

Unification

In an attempt to unify and classify the range of cognitive and learning styles, a number of models have been developed which incorporate several cognitive or learning styles in their own right, e.g. Curry (1983), Onion Model. Also, some researches into cognitive/learning styles have been motivated to look for and formulate possible fundamental cognitive/learning styles from an amalgamation of a number of individual cognitive/learning styles, e.g. Riding and Cheema (1991), wholistic-analytic and verbal-imager dimensions and Riding (1991, 2000), Cognitive Style Analysis. In addition, attempts by researches into cognitive/learning styles, to produce ‘unified models’ have made it necessary for them to include physiological, psychological and/or environmental factors, e.g. Dunn and Dunn (1974), Learning Style Inventory. It is in fact difficult to attempt to consider any cognitive or learning style in isolation from other factors associated with human cognition, e.g. Guilford’s Model of the Intellect (1967) which includes convergent and divergent thinking, or cognitive development (Piaget,1954). Therefore, the overlap between a cognitive process or development phase, and the description of a particular cognitive/learning style, is not always taken into account, with the cognitive process or the development phase, either not being acknowledged, described or related to the particular cognitive style at all or sufficiently. This situation can cause difficulties for cognitive/learning styles in terms of their acceptability into psychological and educational application and practice.

There is a need for a unification of the wide variety of cognitive and learning styles, either within each category or between each category. Also, the question as to ‘What place do cognitive and/or learning styles play in a comprehensive model of learning?’, needs to be asked in an attempt to produce a model of learning that encompasses a range of associated psychological, environmental and experiential attributes, with perhaps, cognitive and/or learning styles at its core.

Several researchers, e.g. Pask, Messick, Miller, Schmeck, have attempted to produce a model or models, but there remains the difficulty of such models being tested, rigorously, with appropriate sample numbers, so that the findings can be duplicated and eventually (hopefully) generalised.

Although the above statement applies to all models at the present time, some models, e.g. Cognitive Style Analysis (Riding, 1991, 2000) have been used in more research studies than others. However, when a model attempts to include more than cognitive functioning or style, it becomes more difficult to control all environmental variables involved, especially when such variables include the educational and learning aspects of the learning experience as well as experiential aspects of the members of the sample(s).

Curry (1983, 1987, 1991) expressed the point of view that:-

“ learning style theory is characterised by:

1. confusion in definitions

2. weaknesses in reliability and validity measurement (and failure in the)
3. identification of the most style relevant characteristics in learners and instructional settings."

(Riding and Rayner, 1998)

As a consequence of the above situation, she proposed an analogy between the various categories of cognitive/learning styles and the layers of an onion.

The Onion Model (Curry, 1983)

The Onion Model or Onion Style as it has become known consisted of three layers. Starting from the centre, these consisted of:-

" - a central core made up of personality-centred models
- a second stratum of information-processing models
- an outer layer of instructional-preference models of learning style.

The core of the onion, the 'cognitive-personality level', was understood to be fundamental to and interactive with the operation of other levels in the model" (Riding and Rayner, 1998)

The inner most layer would accommodate the styles such as those measured by the 'Embedded Figures Test' (Witkin, 1962); 'Myers-Briggs Type Indication' (Myers, 1962) and the 'Matching Familiar Figures Test' (Kogan, 1965).

This layer is connected to a cognitive personality style, defined as:-

"the individual's approach to adopting and assimilating information, which does not interact directly with the environment" (Riding and Cheema, 1991)

The next or middle layer consists of styles such as the 'Learning Style Inventory' (Kolb, 1976); 'Cognitive Preference Inventory' (Tamir and Cohen, 1980) and 'Inventory of Learning Processes' (Schmeck et al, 1977). This layer is concerned with 'information processing style', defined as:-

"the individual's intellectual approach to assimilating information and, because this processing does not directly involve the environment, Curry believes that measures of this style are more stable than instructional preference, but still modifiable by learning strategies" (Riding and Cheema, 1991).

The outer layer is associated with the styles of 'Learning Preference Inventory (Rezler and Rezmovic, 1981); Student Learning Style Scales (Reichmann and Grasha, 1924). This layer relates to an 'instrumental preference' style, defined as:-

"the individual's choice of environment in which to learn" (Riding and Cheema, 1991).

Curry (1990; 2000) has further explored aspects of the Onion Model by focussing on different layers of it, particularly the second and outer layer. In addition, she has emphasised the need to establish validity and reliability of the measurement and application of any learning style, from the perspective of both learner and teacher. Others, Eagleton and Muller (2011), have used the Onion Model as a basis for the development of an extended model applicable to a particular learning context, i.e. physiology. While the Onion Model is a useful model to have, providing as it does a global perspective and hint at possible interactions and relationship between broad categories of factors that influence, positively or negatively, the learning (and teaching) process, there is a need to understand in detail the relationships and interactions between cognitive and learning styles (and learning strategies), and with those of other cognitive and psychological attributes.

In attempting to reconcile cognitive styles and abilities, Messick, 1984, considered the components and characteristics of the learning functions and the methodology of measurement of each, in broad terms.

"Cognitive styles differ from intellective abilities in multiple and important ways so that the systematic contrasting of styles with abilities seems to illuminate the distinctive aspects of each. Dimensions of intellective ability essentially refer to the content, component processes, and level of cognition – to the questions of 'What?' and 'How much?' 'What kind of information is being processed, by what operation, in what form and how well?' – Cognitive styles, in contrast, essentially refer to the manner or mode of cognition – to the question of 'How?' Cognitive styles are not merely consistent individual differences in cognitive processing, as intellective abilities are, but rather consistent stylistic differences in the processes of individual cognition ….
The concept of ability implies the measurement of competencies in terms of maximal performance, with the emphasis on accuracy and correctness of response. The concept of style implies the measurement of propensities in terms of either typical or contrasted performance, with the emphasis on either customary or predominant processing mode" (Messick, 1984)

The following diagram illustrates the relationship between styles and abilities, devised by Messick, 1984.

Abilities								**Styles**
Content/Level	A				a	c	S	Manner/Form
Competencies	A			a		c	S	Propensities
Maximal	A			a		c	S	Typical or Contrasted
Unipolar	A	a	c				S	Bipolar or Bifurcated
Value Directional	A	a	c				S	Value Differentiated
Domain/Function Specific	A	a	c				S	Pervasive
Enabling	A	a				c	S	Organising/Controlling

A – abilities/ a - stylistic abilities/ c – cognitive controls/ S - styles

It can be seen from the above diagram that the characteristics of each category, i.e. styles, abilities, stylistic abilities and cognitive controls are contrasted with each other, to show their differences.

Kogan, 1973, proposed a threefold classification of cognitive styles in terms of the functional difference between a given cognitive style and the ability domain.

Type I styles are those assessed by maximal performance measures, i.e. accuracy or inaccuracy of response; e.g. field dependence – field independence.
Type II styles are those whose assessment outcomes cannot indicate accuracy or correctness of responses; e.g. impulsivity – reflectivity and cognitive complexity – cognitive simplicity.
Type III styles are those where accuracy of response and value directionality associated with a particular style dimension is not considered important; e.g. broad vases narrow categorising, i.e. neither pole has a cognitive advantage.

Miller (1987) approaches the unification or categorisation of cognitive styles by associating them with particular cognitive processes in an 'information processing model of cognition'. This model includes the cognitive processes of perception, memory and thought (thinking), which can be seen in relation to a range of cognitive styles, in the following diagram:

	-Pattern recognition	-Part/Whole attention	-Levelling vs Sharpening
Perception	- Attention	-Selective attention	-Field articulation
	-Representation	-Memory Codes	-Analytic vs Analog
Memory	-Organisation	-Conceptual Networks	-Conceptual complexity
	-Retrieval	-Search Strategies	-Convergent vs Divergent
		-Classification	-Serial vs Holistic
Thought	-Inductive Reasoning	-Analogical reasoning	-Tight vs Loose
		-Judgement	-Actuarial v Intuitive

The above model has within it two very important aspects. One is concerned with different types of thinking, which in turn relate to a stylistic difference, and the other to memory coding, i.e. words or pictures, preference. Millar refers to these two aspects of the above model as follows:

“- with this model – all of the cognitive styles are subordinate to, and reflect, a broad super ordinate difference. This generic style difference – represents an ancient dichotomy in thinking. As Nickerson, Perkins and Smith (1985) note:

- the view that there are two qualitatively different types of thinking is widely shared. Among the terms used to describe one type are analytic, deductive, rigorous, constrained, convergent, formal and critical. Representative of the terms used to describe the other type are synthetic, inductive, expansive, unconstrained, divergent, informal, diffuse and creative. No doubt the partitioning of thinking into two types involves something of an over-simplification, but possibly a useful one.’
- this generic style (h)as an analytic-holistic difference and suggest that all of the styles in (the above model) are different conceptions of this basic dimension.”

With regards to memory coding in terms of verbal-visual differences, Miller states that Riding et al (Riding and Anstey, 1982; Riding and Ashmore, 1980; and Riding and Calvey, 1981)

“-demonstrated consistently that ‘verbalisers’ are relatively slow in processing imagery items while being fast on verbal items, with the reverse obtaining for ‘images’. However, an investigation of the interaction between perceptual style (field dependence – independence), memory codes (verbal-imagery) and temperament (extraversion – introversion) by Riding and Tempest (1986) suggests that the relationships between verbal and analytical, as well as visual and holistic, processing are more complex than my model implies” (Miller, 1987).

Within this analytic – holistic stylistic difference dimension of cognitive styles, Miller (1991) arranged the major cognitive styles in terms of their bi-polar characteristic and related cognitive process. This produced the following arrangements:

Cognitive Process	**Analytic Style**	**Holistic Style**
Pattern recognition	Analytic	Holistic
Selective attention	Field independence	Field dependence
Representation	Verbal/analytic	Visual/analogue
Organisation	Conceptual differentiation	Conceptual holism
Retrieval	Convergence	Divergence
Classification	Serial	Holistic
Analogical reasoning	Tight	Loose
Judgement	Actuarial	Intuitive

Miller’s purpose in formulating the above arrangement was to attempt to show that the analytic-holistic dimension has within it a number of cognitive styles,

“each of which contributes to a consistent individual difference in cognitive processing” (Miller, 1991).

Cognitive Style Families

Riding and Cheema (1991) allocated cognitive styles into 'Cognitive Style Families', resulting in two distinct groups, each with a style difference. These are as follows:

Wholistic – Analytic Cognitive Style Family

Field dependence – independence (Within, 1962)

Impulsivity – reflectivity (Kogan, 1965)

Holistic – serialist (Pask, 1972)

Leveller – Sharpener (Holzman and Klein, 1954)

Simultaneous – Successive (Das, 1988b)

Divergence – converging (Hudson, 1966)

Tolerant – intolerant (Gardner et al, 1959)

Flexible control – constricted automatisation vs restructuring (Gardner et al, 1959)

Also, because of the bi-polar characteristic of the above cognitive styles, they 'split' as follows:

Wholists	**Analytics**
Field dependence	Field Independence
Impulsive	Reflective
Levellers	Sharpeners
Divergers	Convergers
Holists	Serialists

The above arrangement is similar to that of Miller, 1991, although not as far ranging in terms of the number of cognitive styles, or the allocation of them to cognitive processes.

Verbaliser – Imager Cognitive Style Family

Sensory modality preferences (Bartlett, 1932)

Verbaliser – Imager (Riding and Taylor, 1976)

Verbaliser – Visualiser (Richardson, 1977)

The above cognitive style family can be extended to include the following:

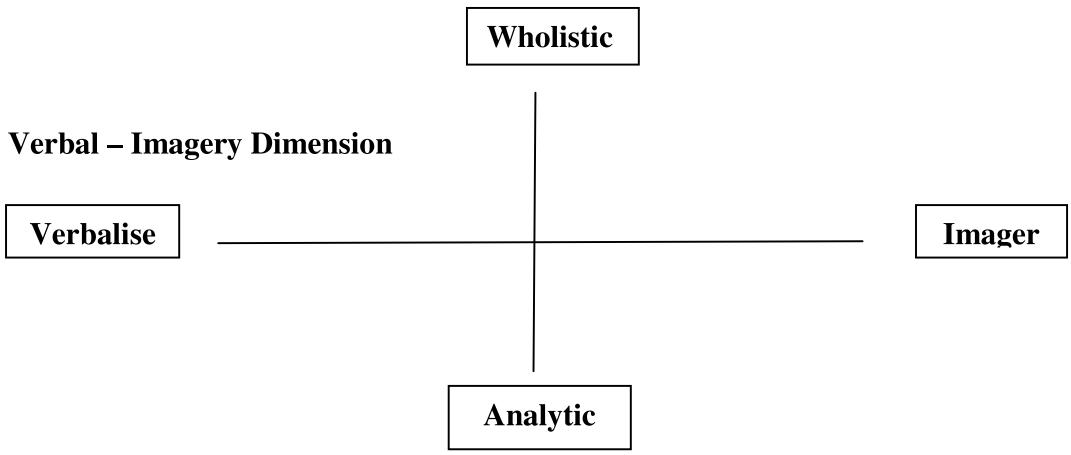
Individual Differences Questionnaire (Paivio, 1971)

Verbaliser – Visualiser (Riding and Calvey, 1981)

Verbaliser – Visualiser (Riding and Buckle, 1990)

From the above two cognitive style families, Riding and Cheema (1991) proposed two fundamental bi-polar cognitive style dimensions, Wholistic – Analytic and Verbaliser – Imager, which are independent of each other. This is shown diagrammatically as follows:

Wholistic – Analytic Dimension



They describe an individual placed on the Wholistic – Analytic cognitive style dimension as one who

“ - tends to process information in wholes (Wholistic) or parts (Analytic)”

and an individual placed on the Verbaliser – Imager cognitive style dimension as one who

“ - is inclined to represent information during thinking verbally (Verbaliser) or in images (Imager)”

This classification and arrangement, i.e. independent bi-polar dimensions, of cognitive styles gives a combination of styles for a given individual in terms of their preference for processing information and mode of thinking, i.e.

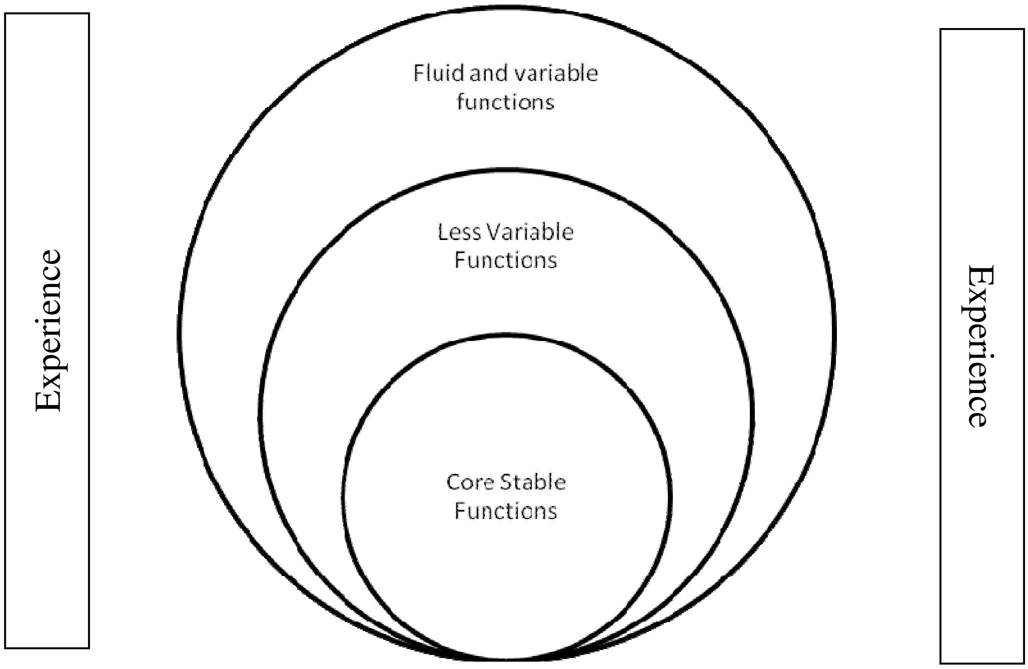
“- the position of an individual on one dimension of cognitive style does not affect their position on the other. For instance, a person may be an imager and a wholist, and another an imager and an analytic, or another may be a verbaliser and a wholist, while someone else may be a verbaliser and an analytic”
(Riding and Cheema, 1991)

Cognitive Styles Analysis (CSA) (Riding, 1991 and 2000)

To assess an individual’s position and level on each of the two cognitive style dimensions of Wholistic – Analytic and Verbaliser – Imager, Riding (1991, 2000) developed the Cognitive Styles Analysis (CSA) (this will be discussed in(Chapter 13/Study4).

Rayner (2000) suggests a style model which takes account of the degree of stability i.e. stable or less stable, of a number of 'style functions', within the individual learner. This model is illustrated as follows:-

Style Functions in the Individual Learner



Within the above model, Rayner regards 'style' or the idea of a 'style construct', as being applicable to a range of psychological attributes and not only cognitive, e.g. perception, but also personality, and motivation. Therefore, by considering a number of functions or attributes that relate to the process of learning, as well as their level of stability through a collection of learning experiences, over time, a more accurate and detailed (potentially) description of the process/mechanisms involved can be approached and identified with more certainty.

By 'Core Stable Functions', Rayner refers to cognitive style as a fundamental aspect of an individual's intellectual make up. This view is shared by Riding (1997) and referred to by Rayner as follows:

"He argued cognitive style has a physical basis and can and does control the way in which an individual responds to the events and ideas they experience. Importantly, he identified the "temporal stability" of style, suggesting that it is a constant aspect of a person's psychology that does appear to chance." Rayner (2000)

Therefore, cognitive style appears to be an internalised entity, associated with individual differences, which is stable and predictable. This forms the 'Core Stable Functions of

Rayner's (2000) model. However, it cannot be considered to exist in isolation, detached from learning experiences and the learning environment. This is where, between these two aspects of cognitive style, there is a link or several links between cognitive style and learning style. Learning style is, by tradition, and to a large degree, by definition, associated with learning experience and learning environment, and the level of adaptation made by the individual in terms of how the learning experience and environment is approached and managed. This is turn, strongly suggests that a learning style, as well as learning styles in general, is less stable and predictable than cognitive styles because of inevitable changing learning experiences and environments that are going to be met by the individual learner.

Rayner's (2000) model takes account of the above relationship and difference between cognitive style and learning style within the middle section by referring to it as 'Less Stable Functions'. Also, advocating that an individual's cognitive style, whatever it might be, is influential on their learning style, whatever it might be.

The outer layer of Rayner's (2000) model includes a range of functions which are characterised by their variability, hence part of this model being labelled 'Fluid and Variable Functions'. Such functions include learning, motivation and behaviour within a particular or changing, over time, learning environment, as well as learning processes or strategies (an extension of an individual's learning style) in response to a given learning environment. The major features of Rayner's (2000) model are connected in terms of cognitive style determining, to a considerable extent, learning style, which is itself influenced by learning situations and conditions; and both are influenced by the additional factors or functions of ability/intelligence, personality, self-esteem and motivation, together with learning experience. All of which combine to produce an individual's approach to learning and their '- general attainment or achievement in learning situations' (Rayner, 2000).

Rayner (2000) describes his model as follows:

"A person's learning style, in summary, is understood to be an 'umbrella construct', defining several aspects of an individual's approach to learning. It is made up of a 'core', a cognitive style, which in turn influences a secondary set of processes including learning strategies, learning preferences, motivation and self-perception as a learner."

The question that Rayner's (2000) model poses is 'Which learning style is produced by which cognitive style?', although such a question is perhaps too simplistic within the field of cognitive/learning style research and application, when viewed against the range of psychological (cognitive and emotional), social and environmental factors.

The Two Styles (Schmeck, 1988)

Schmeck, 1988, argues that several bi-polar constructs of cognitive style are manifestations of a single bi-polar dimension of cognitive style, which he equates to 'global versus articulated (or differentiated)', Witkin et al, 1977. Within this single dimension of cognitive style, Schmeck places 'holistic versus serialist' (Pask, 1972); 'right versus left brained' (Torrance and Rockenstein, 1977); 'Field-dependent versus field-independent' (Witkin et al, 1962); and 'impulsive versus reflective' (Kogan, 1976). Schmeck defines individuals with an articulated or extreme analytic style as;

"-field independent and have focused attention, noticing and remembering details. They have an interest in operations and procedures, or the 'proper' ways of doing things and prefer step by step, sequential organisational schemes. Their thinking, like their attention, is more controlled and consciously directed than that of individuals with a global style. This control and focus of attention allows them to divorce feelings from objective 'facts'. They are gifted at critical and logical thinking. They are also gifted at critical and logical thinking. They are also gifted at seeing differences between apparently similar experiences, in contrast to the global thinker - ."

In contrast, Schmeck defines 'global' as:

"Individuals with a global style are field dependent with attention tending toward scanning, leading to the formulation of global impressions rather than more precisely articulated codes. Rather than linear and sequential, their organisational schemes involve more random or multiple accessibility of components, allowing numerous and varied associations between coded experiences. Their thinking is more intuitive than that of an analytic person, including entry of feelings into decisions. The emphasis on conscious control and directing of thoughts is less evident, and global individuals are likely to be more impulsive than analytic thinkers. Also, - they are more gifted at seeing similarities than differences (between apparently different experiences)."

The global – articulation (differentiated or analytic) styles, whose origins lie in the formulation of the styles construct of field dependence – field independence, and are integral to it, appear to encompass many other constructs of style. This poses the question, 'Are many of the constructs of style, either manifestations of a fundamental entity in human thinking and information processing, or details associated with a fundamental process that enables the complete process to be described?'

The complexity of the above question is illustrated by the differences of opinion between researches in the field of cognitive styles. Kirby (1972) refers to -

“simultaneous processing involves the coding of a set of information into unitary representation which is Gestaltic or quasi-spatial in nature, whereas successive processing involves the coding of information into a sequence or temporally dependent series’, adding ‘I would suggest that the global style and its strategies employ simultaneous processing, while the analytic style and its strategies employ successive processing. – The synthetic style consists of the integration and orchestration of these clusters of styles, strategies, and skills.”

Schmeck (1988) referring to the work of Pask (1972) states:

“- individuals who were in the process of trying to understand a ‘body of information’. – (were allowed) to request information and externalise their thinking. (Pask) found that “serialists” (presumably individuals with an analytic style) “showed intention to search for specific data”, while “holists” (presumably with a global style) “test a large predictable or relational hypothesis”, – Pask found that serialist learners actually examine less data overall than holists, searching step by step to confirm or disconfirm one specific hypothesis at a time. In general, holists scan large amounts of data searching for patterns and relations. Pask also reported that holists had a greater tolerance for uncertainty than did serialists with regards to the ‘correctness’ of their hypotheses.”

There is some agreement between Kirby and Pask with regard to their concept and application of cognitive style. Schmeck (1988) describes this consensus as follows:

‘Pask argues that the best cognitive style for “understanding” (on the part of the learner) isn’t really a style at all in the traditional sense but is more like the absence of rigid, style-like consistency. He labels this latter state a ‘versatile style’ (similar to Kirby’s “synthetic style”)’.

The above views in relation to cognitive styles of Schmeck, Kirby and Pask, support Riding’s (1991) formulation of the fundamental cognitive style dimension of Wholistic – Analytic.

If there is a distinction between cognitive style and learning style, it can arguably be found between the skills/abilities and cognitive attributes, the learner brings to the learning situation as well as their orientation to it, i.e. habitual approach. In this context a relationship can be formed between an analytical style and a ‘surface’ approach to learning, and global style and a ‘deep’ approach to learning.

Schmeck (1988) refers to these different approaches in the following manner:

“Marton states, “in order to establish a structure, that is relationships between components, these components have to be seen in relation to each other, they have to be seen as parts of the same whole. Biggs maintains, “the reproductive nature of a surface strategy – omits or avoids the interrelations that may exist between components of the same task.- ” ”

Also,

"In addition to perception of relations and patterns, a truly deep approach requires initial evaluation, a truly deep approach requires initial evaluation, a hallmark of the analytic cognitive style and what Torrance and Rockenstein call "creating – by – improving". The approach to learning taken by Pask's globetrotting (extremely global) individual is probably what Kirby calls "primitive deep", Entwistle describes as "disorganised" and Biggs (1984) describes as "idealist" – oriented towards meaningful learning but lacking appropriate organisation and generally performing very poorly in the school setting."

Therefore, it appears that while cognitive skills and abilities are influential in relation to an individual's cognitive style, the orientation or approach adopted by the individual to the learning situation/task is also influential on the level of learning outcome achieved by the individual. It is as though a particular cognitive style and learning style combine to produce, what could be called a learning style, encompassing a range of cognitive, psychological (motivation), experiential and environmental factors.

Approaches to Study Inventory (ASI) and The Approaches and Study Skills Inventory for Students (ASSIST)

Whatever cognitive style or learning style an individual may have assuming that there is a difference between cognitive style and learning style, i.e. cognitive referencing to and including innate attributes of the individual and learning style referring to and including the broad approach to learning as a consequence of a combination of cognitive, experiential and environmental factors, there remains the question of individual study skills and organisational learning methodology adopted by the individual. This aspect of learning behaviour and achievement has been extensively researched by Entwistle et al (1998), which led to the development of the Approaches to Study Inventory (ASI) (Entwistle and Ramsden, 1983). The Approaches to Study Inventory (ASI) includes major factors of a 'deep approach', 'surface approach' and 'strategic approach' to study. These factors were established from investigations by Marton and Saljo (1976 and 1997) into the studying approaches and techniques adopted by higher education students. As the names of these factors associated with studying suggest, a 'deep approach' which includes reading for meaning, understanding and conceptual analysis; a 'surface approach' which includes a concentration on individual words or facts and little personal engagement on the part of the student, and a 'strategic approach' which includes a focus on the achievement of:

"- the highest possible grades by using organised study methods and effective time management (Entwistle and Ramsden, 1983)"
(Sternberg and Zhang, 2001)

Other inventories have added additional factors in the form of motivation, elements of meta-cognition and self-regulation (Pintrich and Garcia, 1994; Vermount 1998) within the domains of 'deep and strategic approaches'.

A development of the ASI has produced The Approaches and Study Skills Inventory for Students (ASSIST); (Tait, Entwistle, and McCune, 1998), includes additional factors to give a more detailed description of studying (general approaches and techniques) as well as reactions to teaching. Also, the 'strategic approach' was broadened to include meta-cognition, self-regulation and the monitoring of effectiveness; and the 'surface approach' having the inclusion of a scale to assess ineffective studying in relation to a 'lack of purpose'.

'The original version of the ASI explicitly included Pask's (1976) two styles of learning (i.e. holist and serialist). In ASSIST, however, these have been subsumed within the definition of the deep approach, which is taken to require both ways of thinking – relating ideas (holist) and using evidence (serialist) – or a versatile style in learning. The factor analysis confirms that these two processes link closely with both the intention to seek meaning and interest in ideas (an attitudinal correlate of intrinsic motivation). Linkages between approach and motive are also clean-cut within the strategic approach, where achievement motivation (Atkinson and Feather, 1966) is strongly associated with both organised studying and time management. Similarly, the "surface apathetic" factor brings together syllables boundness and lack of understanding with both lack of purpose and fear of failure."

Also,

"- the deep approach is linked with a conception of learning as "transforming" and with a preference for teaching that encourages and challenges understanding (Entwistle and Tait, 1990). A parallel finding indicates that students adopting a surface apathetic approach prefer teaching that transmits information and directs learning towards assessment requirements. Other research has indicated that students who show a deep strategic approach are better able to discern and use aspects of a learning environment that will support their way of studying (Meyer, 1991; Meyer, Parsons and Dunn, 1990)."
(Sternberg and Zhang, 2001)

The following Figure shows in diagrammatic form the 'Conceptual map of components of effective study' within the ASSIST inventory.

Deep, strategic approaches to studying,
without any pathological elements

Deep, strategic

Surface, apathetic

Deep

Strategic

Surface

Relating ideas using evidence

Awareness of understanding

Organising studying

Monitoring effectiveness

Routine memorising

Ineffective studying

Interest in course content

Determination to do well

Lack of purpose and confidence

Conceptual map of components of effective studying (Sternberg and Zhang, 2001)

The identification of an individual's cognitive and/or learning style can give a false sense of security in that it can provide a full explanation or description of how learning takes place. Although, knowledge of an individual's cognitive and/or learning style is important, because it, at least, makes a significant contribution towards a detailed description of the learning (and teaching) process, it arguably does not give the total possible description or explanation. The work of Entwistle et al, adds an additional category of factors to 'the goal' of a full account of the learning (and teaching) process, by providing a strategy of intervention and investigation to examine the on-going continuous learning (and teaching) process, once, cognitive and/or learning style has identified as an approach and initiation of learning. Also, the approach adopted by Entwistle, takes into account motivational issues on a long term basis and links these with teaching approach or style.

The 3P model of teaching and learning (Biggs, 1993a)

The '3P', i.e. Presage, Process and Product, model of teaching and learning, takes account, in more detail of the factors that influence learning outcomes from a learning and teaching context. The following Figure illustrates the major and minor components of the '3P' model.

Presage | **Process** | **Product**

A: STUDENT FACTORS
Abilities, styles, prior knowledge, motivation, orientation to learning

B: TEACHING CONTEXT
Curriculum, teaching, assessment, climate, instructional procedures

C: LEARNING ACTIVITIES
Appropriate/deep
Inappropriate/surface

D: LEARNING OUTCOMES
Quantitative:
Facts, skills
Qualitative:
Structure, transfer
affective:
Motivational

'Presage' refers to components or factors that are within the individual and the context in which teaching is to take place, but before teaching takes place; 'Process' includes activities that form part of the learning that takes place; and 'Product', that which is learnt or achieved as a consequence of the teaching/learning experience.

All of the components or factors affect each other at any given time, hence there are movements in each direction, i.e. from right to left and vice versa.

As indicated in the diagram, the 'Presage' components or factors are of two types:

"1. Student based: the relevant prior knowledge the student has about the topic, interest in the topic, student ability, commitment to university (this could also apply to other stages of education, i.e. primary, secondary and further/ training within the British education system. Also, within the context of the model, distinction can be made between – "hard" (not easily changed by teaching) – (and) – "soft" (relatively docile) student presage factors – (i.e.) Hard: abilities or intelligence, cognitive styles, learning styles, probably thinking styles, but the extent of their docility is unclear – Soft: motivation, orientations to learning.

2. Teaching and context based: aims and curriculum objectives, teaching and learning activities, assessment tasks and context, the expertise of the teacher, the "climate" or ethos of the classroom and of the institution itself – (school, college or university, within the British education system)."
(Sternberg and Zhang, 2001)

Although a consideration/inclusion of teaching and learning outcomes are important and relevant in any model which attempts to explain the continuous process of and interaction of learning, teaching and learning outcomes, the 3P Model can arguably be criticised because it does not address sufficiently the 'student factors' and 'learning activities'.

The ‘student factor’ includes ‘styles’, which are referred to as one of or, perhaps, a combination of cognitive, learning or thinking respectively, does not allow sufficient detail to be considered to give a detailed account of any learning and teaching process, at whatever stage and level of difficulty within an educational/training context. Whereas the notion of ‘deep’ and ‘surface’ approach and engagement with a given learning task are useful, in many respects a cognitive/learning style in their own right (Entwistle et al, 1998). Also, the use of the designation of appropriate and inappropriate ‘learning activities’, whether by themselves or in conjunction with ‘deep’ and ‘surface’ respectively, gives additional categories to be considered with the ‘learning activities’ of the model. However, the essence of the major cognitive styles, i.e. field independence – field dependence (Witkin et al, 1962); impulsivity – reflectivity (Kogan, 1965); holist – serialist (Pask, 1972); leveller – sharpener (Holzman – Klein, 1954) and divergent – convergent (Hudson, 1966), provides a platform from which an explanation of the (or a) learning process within a given context takes place. This is not to say that cognitive styles, particularly those stated above, are the sole consideration to ensure that learning takes place, but by their very characteristic(s) (and definition(s)), they are integral to a given individual and link with a range of other factors, e.g. motivation, within the learning process. In fact it can be argued that a consideration/inclusion of an individual’s cognitive style within the learning process, improves motivation and learning behaviour (Riding and Rayner, 1998), i.e. engagement with a learning task and maintaining contact with it until a successful outcome has been achieved.

Learning styles can be viewed as models offering a wider perspective on the learning process, by taking into account addition factors, e.g. learning environment, to factors of a cognitive nature. Since the 3P Model refers to a number of additional factors under the categories of ‘Teaching Context’ and ‘Learning Outcomes’, it loses the opportunity to expand and relate further details, that could well be contained in a finely detailed structure/explanation of the learning process and/or learning – teaching interaction.

However, an important feature of the 3P Model is the ‘Learning Outcomes’ section which is sub-divided into Quantitative, i.e. factors and skills acquired; Qualitative, i.e. structure – this can be thought of in terms of the formulation of a schema, and transfer affective – is structured and the facts and skills required, able to be applied to similar and/or different learning situations and tasks; and motivational – does the student feel secure with his or her newly acquired knowledge and skills and therefore, confident to engage with new learning tasks.

A Threefold Model of Intellectual Styles (Zhang and Sternberg, 2001; 2005)

The ‘Threefold Model of Intellectual Styles’ is an attempt to classify cognitive styles and learning styles into a unified model, with an emphasis on the intellectual aspects involved, hence the name of the model, and an attempt to redefine the field of cognitive/learning styles.

One of the starting points for this model has its origins in a model proposed by Grigorenko and Sternberg (1995), which attempts to integrate the three traditions of cognition-centred, personality-centred and activity-centred, within the field of individual differences, into a unified model of styles, i.e. cognitive, learning and personality (different from personality traits). Also, the Grigorenko and Sternberg proposal incorporates Sternberg’s theory of Mental Self-Government (1988, 1997). This theory advocates the idea that the thinking of any individual is subjected to variation, dependent on a particular context or situation which can be influenced by social factors, which implies that every individual has to manage or govern his or her activities. Therefore, the theory has a number of components, to attempt to define and take into account the wide diversity of different types of thinking applicable to a wide variety of situations. These include: Functions – legislative, executive or judicial; Forms – monarchic, hierarchical, oligarchic or anarchic; Levels – local or global; Scopes – internal or external; and Learnings – liberal or conservative.

A description of these terms/sub-terms is as follows:

Functions –

Legislative Style – “enjoys being engaged in tasks that require creative strategies – seeing or doing things in a new way

Executive Style – more concerned with implementation of tasks with set guidelines – getting things done in a way that is clearly specified (for the individual)

Judicial Style – focuses attention on evaluating others and the products of their activities” (Zhang and Sternberg, 2001)

Forms –

Monarchic Style – “enjoys engaging in tasks that allow complete focus on one thing at a time

Hierarchical Style – prefers to distribute attention across several tasks that are prioritised

Oligarchic Style – likes to work towards multiple objectives during the same period of time.

Anarchic Style – enjoys working on tasks that require no system at all”
(Zhang and Sternberg, 2001)

Levels –

Local Style – “enjoys being engaged in tasks that require one to work with details

Global Style – will pay more attention to the overall picture regarding an issue”
(Zhang and Sternberg, 2001)

Scopes –

Internal Style – “enjoys being engaged in tasks that allow (the) individual to work independently

External Style – likes to be engaged in tasks that provide opportunities for developing interpersonal relationships”
(Zhang and Sternberg, 2001)

Learnings –

Liberal Style – “enjoys being engaged in tasks that involve novelty and ambiguity

Conservative Style – tends to adhere to existing rules and procedures in performing tasks”
(Zhang and Sternberg, 2001)

An example (for an hypothetical individual) of Mental Self-Government could be as follows; the display of creativity (legislative function), focusing on several tasks at the same time (hierarchical – form), attention paid to the overall task and its outcome (global – level); a preference to work individually on a task (internal scope); and delighted to be involved in tasks which include novelty (liberal-learnings).

Although Sternberg has attempted to produce a comprehensive model of designated thinking styles that an individual might adopt in relation to a particular task, the model is only, to a large extent, redefining or taking into account, characteristics, either fully or in part, of some established cognitive and/or learning styles. Therefore, terms and descriptions advocated could equally be described by referring to particular cognitive/learning styles in a sequence, i.e. one applicable for the beginning of a task followed by one or more additional styles to complete and apply the product of whatever thinking had taken place. Hence, the hypothetical example given could be described as follows:

- The display of creativity – divergent thinking
- Focusing on several tasks at the same time – surface strategy/scanning/impulsive/global/holistic and wholistic approach

- Attention paid to the overall task and its outcome – deep strategy/focus/reflective/articulated approach
- A preference to work individually on a task – field independent/articulated
- Delighted to be involved in tasks which include novelty – divergent/innovative/analytic thinking

In spite of these possibilities of interpretation, the model does, through its designated terms, give the opportunity to broaden and take account of the many aspects of the act of 'thinking' in relation to a particular task, which are difficult to quantify. Also, many cognitive and/or learning styles can be restrictive, both in their explanation of a possible type of thinking and applicable to many different situations. Arguably, the exception to this is the cognitive style of field dependence – field independence and its development into the theory of psychological differentiation (Within et al, 1962).

However, the primary building blocks of the Threefold Model of Intellectual Styles are based on three criteria. The first of these is a selection of those styles which are considered to be the most influential in the literature by practitioners in the field; secondly, those styles, whose construct and definition are operationally based and supported by empirical evidence; and thirdly, those styles which have been empirically compared with at least one other style.

Zhang and Sternberg (2001) cite the following styles as meeting the above three criteria:

"
1. Sternberg's thinking styles (1985)
2. Biggs (1928) learning approaches
3. Holland's (1973) career personality types
4. Torrance's (1988) modes of thinking
5. Myers and McCaulley's (1988) personality types based on Jung's (1923) work
6. Gregorc's (1979) maid styles
7. Kirton's (1961, 1976) adoption-innovation decision-making and problem-solving styles
8. Kagan and colleagues' (1964) reflective-impulsive styles
9. Guilford's (1950) divergent-convergent thinking
10. Witkin's (1962) field dependence/independence"

Therefore, a review of these nine models of 'style' in the context of the above three criteria and against the framework of the theory of self-government, suggests, as far as Zhang and Sternberg are concerned, that styles are 1) not value free, 2) can be malleable and therefore, developed, and 3) each one of the nine models of 'style' reviewed is significantly related to at least one of them.

In addition to the above findings, Zhang and Sternberg (2001) state:

"Furthermore, there are three characteristics of the manner in which these styles are related to one another. First, those styles carrying "positive values" (e.g. field independent, reflective, legislative, artistic, perceiving, deep-) are positively correlated with one another and are related to human attributes that are commonly perceived as positive. Second, styles that carry "negative values" (e.g. field dependent, impulsive, executive, conventional, judging, surface-) are positively related t one another and are associated with human attributes that are usually perceived as negative. Finally, in the style models that address more than just bipolar intellectual styles, some styles (e.g. internal, introverted, thinking, feeling, achieving-) do not indicate consistent relationship patterns with style constructs that have only bipolar styles."

These findings in turn address the three controversial style issues of style malleability (i.e. to what extent do the activity-centred style theories, cognition-centred style theories, influence and therefore, enhance intellectual and personality development); style value (i.e. a style should be neutral neither "good" or "bad" (Sternberg, 1997), but some styles tend to be more valued in some contexts than others, particularly those styles within the cognition-centred tradition, because they are considered by some researchers to be closely associated with ability, e.g. field dependence and impulsivity (low ability); and style overlap (i.e. in spite of styles having differences, many share similarities both within and between the three style traditions of activity-centred, cognitive-centred and personality-centred).

The field outcome of Zhang's and Sternberg's attempt to produce a unified model of styles, relates to a reclassification of styles into three types based on:

"- individual differences in people's preferences from each of the underlying concepts (i.e. structured is free of structure, cognitive simplicity is cognitive complexity is nonconformity, authority is autonomy, and group is individual) – correspond to three types of thinking styles" (Zhang and Sternberg, 2001)

Type I intellectual styles describe preferences related to the continuance of low degrees of structure, cognitive complexity, nonconformity and authority.

Also,

"- the deep learning approach, the artistic career personality type, the holistic mode of thinking, the intuitive and perceiving personality types, the concrete random mind style, the innovative decision-making style, the reflective conceptual tempo, divergent thinking, and the field independent perceptual style, as sellers the – thinking styles of legislative, judicial, global, hierarchical and liberal"
(Zhang and Sternberg, 2001)

Type II intellectual styles describe preferences related to the continuum of, structure, cognitive simplicity, conformity, and authority, Also,

"-the surface-learning approach, the conventional career personality type, the analytic mode of thinking, the sensing and judging personality types, the concrete sequential mind style, the adaption decision – making style, the compulsive conceptual tempo, convergent thinking, the field dependent perceptual style, as well as the – thinking styles of executive, local, monarchic, and conservative."
(Zhang and Sternberg, 2001)

Type III intellectual styles describe preferences related to the continuum of Type I and Type II intellectual styles but are dependent "- on the stylistic demands of a specific task and on an individual's level of interest in the task"

(Zhang and Sternberg, 2001)

Therefore,

"- the achieving learning approach, the realistic, investigative, social and enterprising career personality types, the integrative mode of thinking, the thinking, feeling, introversion, and extraversion personality types, the abstract sequential mind styles, and the – thinking styles of oligarchic, anarchic, internal and external."
(Zhang and Sternberg, 2001)

Also, group is individual preference is contained in Type III intellectual styles, since this category of intellectual styles is "- dominated by styles that suggest sociological preferences, including the social and enterprising career personality types, the introverted and extraverted personality types, and the internal and external thinking styles."

(Zhang and Sternberg, 2001)

Therefore, the Threefold Model of Intellectual Styles (Zhang and Sternberg, 2001, 2005) includes many, if not all or at least the majority, cognitive and learning styles, as well as learning strategies within and across the three traditions of activity, cognitive and personality-centred approaches that attempt to provide a classification and explanation of the process of learning. However, many of the relationships between "styles", of whatever nature, can be shown and described by using existing style constructs, as the example given as part of the discussion of Sternberg's Theory of Mental Self Government (1987, 1997) illustrates (this theory is an integral part of the Threefold Model of Intellectual styles).

Whatever the future of the Threefold Model of Intellectual Styles, the authors make the following statement in defence of their use of the word 'types'.

"- whereas many theorists view people or 'types', we do not, we view styles as flexible and modifiable as a function of the interaction of person, task and situations. Hence when we

represent people as ‘types’, we do so to preserve the meanings of the researchers, not because we believe that people are susceptible to simplistic pigeon-holing.”
(Zhang and Sternberg, 2001)

4.10 Hierarchical/Matrix Model of Cognitive Styles/Cognitive Processes

Kozhevnikov (2011) advocates that research into cognitive/learning styles in relation to their characteristics and applications, requires to be compared to developments in cognitive psychology, neuro-psychology and neuro-science, if a comprehensive unifying model of cognitive styles/learning styles and associated psychological attributes is to be achieved. Such an approach to research and applications of cognitive/learning styles, strengthens the possibility of the concept of individual differences, as manifested within the individual and between individuals in a group situation, becoming more accurately defined and understood. Also, she reviews the history and development of cognitive/learning styles into four periods, which include in their formulation, information processing, environmental and cultural factors, all of which influence the definition and understanding of individual differences against the particular research emphasis from one period to the next.

The first period (1940s to early 1950s) is associated with the development of the concept of cognitive style and a realisation of individual differences in information processing. This was achieved by experimental studies which revealed the existence of individual differences in terms of the perception of information and level of performance on a variety of cognitive styles. (Hanfmann, 1941; Witkin and Ash, 1948; Klein, 1951)

“Klein (1951) termed them (individual differences) as “perceptual attitudes” and defined them (individual differences) as patterns of adaptation to the external world that regulates an individual’s cognitive function. Klein considered both poles of the levelling/sharpening dimension as equally valid ways for individuals to achieve a satisfactory equilibrium between their inner needs and outer requirements.” (Kozhevnikov, 2011)

The second period (mid 1950s to mid 1970s) is concerned primarily with the study of field dependence – field independence (Witkin et al, 1954). Through a large scale experimental study, the different characteristics between the field dependent and field independent individual, in terms of their perceptual ability, were established, i.e. field dependents exhibit high dependency on the surrounding field and field independents exhibit low dependency on the surrounding field. Further discoveries from this study included, the level of perceptual ability was influenced by the structure of the field, and the level of ability/intelligence, as well as personality characteristics of the individual, was also influential as to where an individual might be placed on the field dependence – field independence continuum.

Witkin et al (1954) referred to the individual differences in perception from this study 'as different modes of adjustment to the world', regarding both field dependence and field independence as having different abilities that are adaptive to particular situations.

The above conclusions form the basis for the idea of bi-polarity, i.e. opposite extremes of a continuum but each extreme having an equal value in relation to the type of ability displayed the individual.

The idea of bi-polarity led to the development of –
"A large number of other dimensions were proposed, such as field articulation (element articulation versus form articulation) (Messick and Fritzky, 1963); impulsivity/reflection (Kogan, 1958, 1966), breadths of categorization (Pettigrew, 1958), (and) conceptual differentiation (Gardner, 1953)."
(Kozhevnikov, 2011)

From the beginning of the formulation of cognitive style and the subsequent development of the idea of individual differences as being either fixed(stationery) or mobile(flexible) (or possibly both within the same individual depending on the problem to be solved together its particular context) has been recognised(Witkin et al, 1971;Duncker, 1945).

Fixity and Mobility can be considered to be an additional dimension to the bi-polar continuum of a number of cognitive styles, e.g. field dependence – field independence; impulsivity – reflectivity; and constricted – flexible cognitive control (Niaz, 1987; Ripoll, 2001; Kholodnaya, 2002). In the case of field dependence – field independence fixity – mobility can be shown diagrammatically as follows:-

(adapted from Kozhevnikov, 2011)

Therefore, the extension of the bi-polar of a given cognitive style to have a dimension of fixity-mobility can be considered to form a meta-style. Kozhevnikov (2011) describes a meta-style in this context as:-

"mobility-fixity may be better viewed as a metastyle representing the level flexibility with which an individual applies a particular style in a particular situation …. That is, metastyle represents the developmental level of an individual's metacognitive mechanisms - the ability to consciously control and situationally adopt their own problem solving strategies to the situation."

With regards to an attempt at a unification of cognitive and/or learning styles/strategies, several models have been cited in this chapter, e.g. visualiser – verbaliser fundamental cognitive style dimension (Riding and Cheema, 1991); and different aspects or dimensions of cognitive/learning style considered to be variations of an over-arching analytical – intuitive dimension (Hayes and Allinson, 1994).

A further approach to the objective of some sort of classification for cognitive and learning styles in terms of how they may relate to a number of cognitive and psychological attributes would be to form a hierarchical model or models.

Miller (1987 and 1991) has attempted to achieve such an objective with his model, as cited in this chapter, which incorporates the cognitive attributes of perception, memory and thought as a starting point. These cognitive attributes are then subdivided into a number of sub-cognitive attributes, which are then related to a particular bi-polar cognitive style.

Nosal (1990) produced a hierarchical model of cognitive styles that incorporated a matrix with one axis labelled 'executive functions' and the other axis labelled 'levels of information processing'. Therefore, this model allows the cross referencing of particular characteristics, in terms of the executive functions and levels information processing, from one dimension to another.

The dimensions from this model consist of the following:-

"1) Field structuring (context dependent vs context independent), describes a tendency to shift attention to perceiving events as separate versus inseparable from their context.
2) Field scanning (rule driven vs intuitive), describes a tendency for directed, driven by rules versus driven salient stimuli, information scanning.
3) Control allocation (internal vs external locus of processing), describes ways of locating criteria for processing at the internal versus external center.

4) Equivalence range (compartmentalization vs integration), represents a tendency to process and output information globally versus sequentially." (Kozhevnikov, 2011)

The above dimensions are placed on one axis of the matrix, and Perception, Concept Formation, Modelling and Programme, placed on the other axis.

These cross-dimensions are similar to the meta-components suggested by Sternberg (1985) in his 'Componential Theory of Intelligence', i.e. selection, representation, organisation and adopted strategy for the processing of information via the combination of lower order components.

Therefore, the four types of major cross-dimensions, 1, 2, 3 and 4 above, identified by Nosal, which can be considered to form four qualitatively different bi-polar cognitive style modules, appear to reflect four different types of executive processes that regulate an individual's perception, thoughts and actions. Such a model allows any given existing cognitive style to be seen in relation to one of the four major executive functions/cross-dimensions, operating at a certain level in terms of information processing.
However, although Nosal's model may display a greater degree of unification of the cognitive processes that are associated with cognitive and learning styles and a range of cognitive and psychological attributes, it does not provide an overarching theory that includes theories from cognitive psychology and cognitive neuro-science.

What is required to provide a connection between the repertoire of cognitive/learning styles and cognitive psychology/cognitive neuro-science is evidence to demonstrate that differences in performance (problem solving and academic achievement) and learning behaviour can be represented by specific patterns of neural activity.

Gevins and Smith (2000) in a study of verbal vs non-verbal cognitive styles using Electroencephalography (EEG), showed that verbalizers made greater use of the left parietal region, and visualisers tended to make greater use of the right parietal region. Also, Motes et al (2008) using Functional Magnetic Resonance Imaging (f MRI) looked for brain functioning differences between object and spatial imagers, i.e. two aspects of the visualiser style. As the name suggests the object imager can construct pictorial, detailed images of individual objects and spatial imagers can create images that represent spatial (positional) relations among objects as well as imaging spatial transformations. The outcome of this study showed greater activation in temple areas for spatial imagers while object imagers showed greater activation in the bi-lateral parietal junction. These findings support the idea of a relationship between individual differences in visual cognitive style and differential use of regions in the dorsal and ventral visual processing locations of the brain.

A further consideration for the formulation of a unification or unifying model of cognitive/learning styles is to take account of cultural factors/differences on a national and international level. This would, in turn, relate to models of cognitive psychology and neuro-science because the differences in approach to problem solving, thinking and learning, adopted by different nationalities, towards different circumstances, is likely to produce a difference in patterns of neural activity. Such a situation is also likely to occur within a given society between different socio-economic groups.

Cultural sensitive patterns of information processing have been identified at cognitive, neural and perceptual levels, suggesting that socio-cultural experience may affect neural pathways, formulate perception and higher order cognitive performance. (Han and Northoff, 2008)

" – cultural differences have been identified at all levels of information processing (from perceptual to higher order cognitive reasoning), and can generally be described as tendencies of East Asian people versus Western people to:-

- Engage in context – dependent cognitive processes while Westerners, who tend to think about the environment analytically, engage in context – independent cognitive processes (Goh et al.,2007)
- Have tendencies to perceive and think about the environment more holistically and globally, in contrast to Westerners, who engage in more sequential processing (Goh et al.,2007)
- Exhibit more external locus of control in contrast to Westerners who have -stronger internal locus (of control) (Nisbett et al., 2001; Glass and Singer, 1997)
- Seek intuitive instantaneous understanding through direct perception, while Westerners favour more logic and abstract principles (Nakamura, 1985)"

(Kozhevnikov, 2011)

4.11 Conclusion

It can seem from the reference to and discussion of a variety of leading cognitive styles and learning styles, as well as the concept of a learning strategy, that there is overlap in terms of the identification of a particular cognitive attribute or skill. Although there are some similarities between various cognitive and learning styles, there are also differences. This overall situation is further complicated by the fact that cognitive attributes and/or skills cannot be addressed in isolation, either from the perspective of the learner or the educational environment in which learning is taking place without considering a range of additional psychological attributes, e.g. personality traits and factors, self-esteem issues and locus of control, as well and at the same time.

There is also the question of match or mis-match between the learners cognitive or learning styles and that of the education (at whatever level), without ignoring the learning strategy(ies) of each, which can further complicate the act/experience of learning and teaching.

The large variety of style names, within each category of cognitive and learning styles, each with their own theoretical background, definitions (whole style and/or its major components) and applications, e.g. different stages of the educational process, i.e. primary, secondary, further and higher, or in commerce/industry, strongly suggest an urgent need for an integration or unification to clarify what it is they are actually describing. Such an integration or unification also needs to take account of psychological (cognitive and non-cognitive e.g. personality), and environmental factors, as well as suitability for particular applications, in relation to the different stages of the educational process and their associated experiences. Field dependence – field independence is arguably a promising candidate to provide a focus for a unified model of cognitive/learning styles, because of its strong associations with other psychological attributes, e.g. personality theory (Witkin and Eysenck) and ability (Thurstone).

The formulation of a unified model of cognitive and learning styles would also take into account the assessment of each style and perhaps category of style, i.e. cognitive or learning, in terms of their procedure and resulting construct validity and reliability over time, i.e. number of samples and age of sample members.

Also, cognitive psychology/cognitive neuro-science models – comprehensive unified model – prediction what style/approach given learner (teacher)/learning situation.

Chapter 5

Research Methodology and Design

5.1 Introduction

The formulation and development of any psychometric instruments requires a number of stages to try out the ideas generated to measure whatever it is that the instrument is intended to measure (Haimson and Elfenbein, 1976). For this reason, it was necessary for the Embedded Shapes Test (EST) to be used in two pilot studies before it was ready to use, and then after further modifications, in Experimental Study One. Because the Sense Word (SWT) was less complex than the Embedded Shapes Test (EST), it was only necessary to use it in one pilot study, followed with modifications to it, before it was used in Study One. The Non-Sense Word Test (NSWT) was formulated in terms of its presentation and administration on that of the version of the Sense Word Test (SWT) used in Experimental Study One, making it unnecessary to use the Non Sense Word Test (NSWT) in a pilot study.

Additional sources of data in relation to the measurement of particular skills relevant to the research were obtained from the application of published instruments, i.e. Gestalt Picture Completion Test (GPCT) (Street, 1935); British Ability Scales (BAS1)/ Short Form IQ (Elliot et al, 1986); Cognitive Styles Analysis (CSA) (Riding, 1991,2000); and unpublished instruments, i.e. Chronological Order Integrated Test (COIT) (Riding, [et al],1995); performance/ attainment scores from school subjects; and grades from General Certificate of Education (GCSE) subjects.

Table 5.1 illustrates the above progressions, types and sources of data obtained in relation to the two pilot studies and the four experimental studies.

Table 5.1 Progressions, Types and Sources of Data used in the Pilot and Experimental Studies

	EST	SWT	NSWT	COIT	GPCT	BAS I Scales/ IQ	CSA	School Subjects	GCSE Subjects
Pilot Study 1	V0								
Pilot Study 2	V1	V0							
Experimental Study 1	V2	V1	Vo						
Experimental Study 2	V2	V1	V0						
Experimental Study 3	V2	V1	Vo						
Experimental Study 4	V2	V1	V0						

Key to the above table

V0 = Original Version   V1 = First Modified Version   V2 = Second Modified Version

5.2 Research Rationale

The research paradigm uses a psychometric approach to obtain quantitative data and information which can be analysed to explore relationships between a range of cognitive variables included in the research.

Since the aims of the thesis include the development of an alternative instrument to measure field dependence – field independence from a spatial/geometrical perspective and the development of instruments to measure field dependence – field independence from a verbal (words and text) perspective, quantitative data is required to enable the development of such instruments to take place with some confidence, i.e. answers to the tasks of the instruments are either right or wrong to an established criteria, which has consequences, either positive or negative in relation to issues of validity and reliability (Cronbach, 1961).

In addition to the above aims, the investigation of the relationships between measure of field dependence – field independence of whatever modality, with measurements of other cognitive variables, e.g. Gestalt Picture Completion Test (GPCT), British Ability Scales (BAS I) Short Form IQ, and Cognitive Styles Analysis (CSA), can be explored because both ‘groups’ use a psychometric methodology to obtain data/information. By using a similar approach, the performance/attainment scores from school subjects and performance/attainment levels from General Certificate of Secondary Education (GCSE) subjects can be compared.

The above point is an important one because the comparison between school or GCSE subject performance/attainment, and what can be isolated measures of cognitive abilities, whether they are done by research instruments under development or published instruments, can give a less than compatible outcome between the different modes of measurement of cognitive/educational performance.

For this reason school subject performance/attainment scores and GCSE performance/attainment levels where included in the thesis so that evidence for the existence of field dependence – field independence manifesting itself in school performance/attainment could be investigated.

However, the use of psychometric to acquire quantitative data should not be considered as providing absolute, fixed measures of whatever it is that is being measured, but in terms of a ‘snapshot’ of a performance/attainment of an individual at a particular point in time. This philosophical stance is also applicable to the dangers of ‘labelling’, i.e. judging an individual solely in terms of scores obtained on psychometric measures of whatever type.

Both of the above statements are particularly relevant to cognitive styles, many of which are constructed on a bi-polar basis with a continuum between each pole. Field dependence – field independence is no exception to this. Instead individual’s need to be judged in terms of having a propensity towards one pole relative to the other pole especially in terms field dependence – field independence because of the perceptual nature of it and the possibility that it may be context specific, e.g. a simple shape of figure hidden in a complex shape or figure, in contrast to a hidden object in a room, required to perform a particular task as distinct from other objects in the room (Witkin, 1971; and Duncker, 1945, respectively).

The samples of students for both the pilot and experimental studies were selected on the basis of the following criteria:-

i) They needed to be within the age range applicable to Year 8. This would mean that most if not all of the students were likely to have reached the Piagetian Formal Operational Stage of cognitive development (Piaget, 1970). This was deemed necessary to ensure that the students would have an appropriate level of cognitive skills maturity, to approach the field dependence – field independence tasks, i.e. provide to each of the tasks a considered answer, thus, rendering an accurate measure of field dependence – field independence.

ii) Each of the samples of students was of mixed ability. This would allow the notion that more able students are field independent and less able students are field dependant to be investigated across the four experimental studies, particularly in Experimental Study Four, which includes measures of verbal and non-verbal reasoning, speed of information processing, and intelligence (British Ability Scales (BASI) /Short Form IQ, Elliot [et al], 1986).

Also, through the application of the British Ability Scales (BASI) for verbal and non-verbal reasoning, and the measurement of the field dependence – field independence using different modalities, in Experimental Study Four, comparisons can be made between non-verbal reasoning and the Embedded Shapes Test (EST); and verbal reasoning and the Sense Word Test (SWT) and the Non Sense Word Test (NSWT).

iii) As far as possible the number of males and females would be approximately equal in each sample.
Such proportions would allow the outcomes from each of the four experimental studies in particular to be more meaningfully generalised and comparisons, if differences occurred, to be made between males and females, especially in relation to degree of field dependence – field independence.

5.3 Research Methodology

Samples used in the Thesis.

As can be seen from Table 5.2 below, a total of six different samples were used for the Pilot and Experimental Studies.

Table 5.2 Samples used for the Pilot and Experimental Studies

	School Year	Sample Size	Number of Males per sample	Number of Females per sample	Ability
Pilot Study 1	Y8	27	16	11	Mixed
Pilot Study 2	Y8	22	11	11	Mixed
Experimental Study 1	Y8	62	32	30	Mixed
Experimental Study 2	Y8	93	49	44	Mixed
Experimental Study 3	Y8	224	122	102	Mixed
Experimental Study 4	Y8	128	72	56	Mixed

The above samples are represented by five High Schools, located within two Counties, one City and one Unitary Education Authorities.

Although a minimum number of students for each pilot study, i.e. thirty, was requested on the part of the high school involved, it was not possible to achieve this due to absenteeism on the day of administration of the research instruments. This situation presented no difficulties with the experimental studies, where a minimum number of 60 students was requested from each of the high schools involved, because three of the high schools allowed the research assessments to be administered to more than two classes, one class approximates to thirty students, over several days.

Variability of the number of males and females in each class and within each sample as a whole, was due to each high school's organisational arrangements.

Also, the request for the samples for both the pilot and experimental studies to consist of Year 8 students was met by the high schools.

5.4 Materials Used in the Thesis

Each of the research and published instruments used in the thesis will be fully explained in different chapters of the thesis, as an explanation of their development is given or as they are used in the pilot and/or experimental studies.

These materials are as follows:-
Embedded Shapes Test (EST); Sense Word Test (SWT), Non Sense Word Test (NSWT); Chronological Order Integration Test (COIT); Gestalt Picture Completion Test (GPCT); British Ability Scales (BASI)/Short Form Intelligence Quotient; Cognitive Styles Analysis (CSA); School Subjects Performance/Attainment Scores; General Certificate of Education (GCSE)

The following Table 5.3 shows School Subjects and General Certificate of Secondary Education (GCSE) Subjects that were used in each of the Experimental Studies within the Thesis.

Table 5.3 School and GCSE Subjects used in the Experimental Studies

	Experimental Study 1	Experimental Study 2	Experimental Study 3	Experimental Study 4
School Subjects				
English (Language/ Literature)			*	*
Mathematics			*	*
General Science	*		*	*
History			*	*
Geography			*	*
Design /Technology (Product)		*	*	
Design /Technology(Food)			*	
Religious Education			*	
Art			*	
Music			*	
French	*	*	*	

German			*	
PE			*	
GCSE Subjects				
English Language			*	
Mathematics			*	
General Science			*	
History			*	
Geography			*	
French			*	

The High Schools, both different, used for Experimental Studies One and Two were only able to supply performance/attainment scores for the two school subjects as indicated.

Procedure Adopted within each Pilot and Experimental Study in the Thesis.

As with the materials used in the thesis, a description of the procedure adapted will be given in each of the pilot and experimental studies. This description will explain differences from one Pilot Study One to Pilot Study Two, and Experimental Study 1 thorough to Experimental Study Four, which have taken place as a consequence of applying the research instruments, together with the addition of published instruments, school and GCSE subject performance/attainment scores and grades, respectively.

5.5 Research Design

i) Pilot Studies One and Two

Each of these studies were undertaken to assess the construct validity (Cronbach, 1970), level of difficulty, the organisation and presentation of the tasks and general and general administration of the Embedded Shapes Test (EST). Descriptive statistics e.g. frequency histogram, information was used to rearrange the sequence of the tasks within each section and from section to section in terms of level of difficulty from Pilot Study One to Pilot Study Two.

Also in Pilot Study Two, the Sense Words Test (SWT) was used to assess the same issues as those stated above for the Embedded Shapes Test (EST).

From Pilot Studies One and Two, further modifications were made to both the Embedded Shapes Test (EST) and the Sense Words Test (SWT) and the modified versions of these two tests were used in Experimental Study One.

The Non Sense Word Test (NSWT) was first administered in Experimental Study One. This was because the general format of it was decided from the outcomes of the administration of the Sense Word Test (SWT) in Pilot Study Two, since the modality used to measure field dependence – field independence was the same and the construction of the two tests were similar. The full details of Pilot Studies One and Two are contained in Chapter Eight.

ii) Experimental Studies One, Two, Three and Four

In each of the above experimental studies Analysis of Variance and Correlation Statistics were used to analyse the data produced by each Experimental Study. The level of complexity from Experimental Study Two to Experimental Study Three and from Experimental Study Three to Experimental Study Four in terms of the number of independent variables (factors) and dependent variables generated from the additional 'tests' used, increased. The complexity of the Analysis of Variance procedures also increased between and within the Experimental Studies of Two, Three and Four, for the same reason.

Also, the designated independent variables (factors) from one experimental study to another, were divided into a number of levels, particularly for the principle independent variable (factor) of the Embedded Shapes Test (EST) which was included in each of the four experimental studies. The use of a number of levels for independent variables was done to explore the full range of scores produced by each of them but primarily through the use of the EST in relation to the accuracy of the measurement of field dependency – field independency, i.e. locating individuals towards each end of the field dependence – field independence continuum as well as those individuals within a middle range of it. By using this technique, all of the other scores from the variety of different cognitive abilities measured, across the four experimental studies, could be compared to different degrees of field dependence – field independence.

Therefore, other test scores can be mapped onto the full range of field dependent – field independent scores, wherever they occur on the field dependence – field independence continuum. This enables a greater degree of accuracy of comparison between any of the other tests' range of scores and those of the range of scores for field dependency – field independency.

iii) Further Details of the Statistics Used

Analysis of Variance with repeated measures was applied to the factorial designs of each of the four experimental studies. This allowed the scores of each dependent and independent variables to be analysed at the different levels assigned to them (Winer, 1971; Ferguson and Takane, 1989; Coolican, 1994).

The outcomes from the above analysis for each experimental study gave evidence as to whether or not there were any main effects, interaction effects (shown graphically for each experimental study), or levels of significance (F ratios) between the different factors and levels measured, especially in relation to the measurement of field dependence – field independence via a spatial / geometrical or verbal (words and text) modality.

Although school subject performance/attainment was acquired for the majority of students in each sample to each experimental study, not all students followed the same school courses in all subjects. As a consequence of this the sample numbers in some school subjects became statistically invalid and therefore were not included in the analysis of variance within particular experimental studies.

A similar situation occurred with the General Certificate of Secondary Education (GCSE) subjects in Experimental Study Three.

Correlations (Coolican, 1994) were also calculated between each variable within each of the four experimental studies. This gave the opportunity for the exploration of possible relationships (not cause and effect) between pairs of variables on a one and two tailed level of significance.

In addition to the above a Cronbach Alpha (Cronbach, 1970; Field, 2009) was calculated to determine the reliability of the Embedded Shapes Test (EST) since it formed the principal component of the thesis.

The full experimental details i.e. materials (tests) used, procedure, outcomes, analysis and conclusions, are given in each of the chapters of the thesis that give the overall and detailed account of the pilot and experimental studies. Also, research experience gained from the first experimental study was incorporated into the next experimental study and so on up to the last experimental study, and where modifications were made, from one experimental study to another, these were documented in the respective chapters.

Chapter 14 of the thesis compares the outcomes and conclusions, from each of the four experimental studies. The information gained from this activity forms the basis of a discussion and exploration of possible future developments and research into the measurement of field dependence – field independence in Chapter 15.

5.6 Ethical Considerations

The collection of the research data for the thesis was done in accordance with the British Psychological Society's Code of Good Practice for Psychological Testing (2010), Code of Human Research Ethics, (2009) and Code of Ethics and Conduct (2009).

Consent for the 'testing' to take place in each of the schools that participated in the research was obtained from the Head teacher, with a Deputy Head teacher or Senior Teacher involved in the organisation (time-tabling) with the researcher of the arrangements of when and where the testing could take place.

With regards to the 'testing' of children or young people, the British Psychological Society Code of Human Research Ethics (2009) makes the following statements:-

"In relation to the gaining of consent from children and young people in school or other institutional settings, where the research procedures are judged by a senior member of staff or other appropriate professional within the institution to fall within the range of usual curriculum or other institutional activities, and where a risk assessment has identified no significant risks, consent from the participants and he granting of approval and access from a senior member of school staff legally responsible for such approval can be considered sufficient."

Any research endeavour that includes the 'testing' of children or young people requires consideration to be taken with regards to possible risks, bearing in mind the welfare of the children or young person at all times. In relation to research in general and the current research, four possible areas of risk could apply. These are:-

i) "Research involving vulnerable groups (such as children age 16 or under; those lacking capacity; or individuals in a dependent or unequal relationship)
ii) Research involving access to potentially sensitive data through third parties (such as employee (or school) data)

iii) Research that could induce psychological stress, anxiety or humiliation or cause more than minimal pain (e.g. repetitive or prolonged testing)

iv) Research that may lead to 'labelling' either by the researcher (e.g. categorisation) or by the participant (e.g. 'I am stupid', 'I am not normal')".

(British Psychological Society Code of Human Research Ethics, 2009)

All of the above statements were addressed throughout the research in a dialogue between the researcher and senior member of staff at each school, and between the researcher and the participants of each sample from each school.

In terms of the participants, they were informed of what we were going to do, how we were going to do it, why we were doing it, and what it might mean for them as individuals. Technical vocabulary was omitted, e.g. instead of the use of the term field dependence – field independence, in relation to an explanation of a simple shape being located in a complex shape, the phrase 'seeing the wood for the trees' was used. Also, the sorts of 'tests', which were always referred to as different activities, on the part of the researcher, that we were doing did not necessary have a right or wrong answer, and that the whole purpose of what we were doing was to look at ways in which they, the participants, approached learning in different school subjects.

Participants in each sample, from each school, were given the choice as to whether they or not they wished to participate in the 'testing'/activities or not, by the researcher. This was also agreed between researcher and Head teacher/Senior Member of Staff at each school.

Further steps to ensure the welfare of the participants included:-

i) "Give due consideration to factors such as gender, ethnicity, age, disability and special needs, educational backgrounds and level of ability in using and interpreting the results of tests.

ii) Provide the test taken or other authorised persons with any agreed feedback about the results in a form which makes clear the implications of the results, is clear and as a style appropriate to their level of understanding.

iii) Ensure test results are stored securely, are not accessible to unauthorised or unqualified persons and are not used for any purposes other that those agreed with the test taken (or school)"

(British Psychological Society Code of Good Practice for Psychological Testing, 2010)

The essence of the above statements was referred to by the researcher in discussions with the Head teacher or Senior Member of Staff at each school, and with the participant from each school, in a simplified manner.

The above statements include two very important aspects of psychological testing, although not exclusively to psychological testing. One aspect is the value of ‘feedback’ to the participants and the organisation to which they belong. Everyone, child, young person or adult, like to know how they performed. Such information together with an explanation, enables ‘closure’ to be placed on the ‘testing’ experience for the individual. For the organisation, it enables the research outcomes to be placed in an appropriate context relative to it. The other aspect is that of confidentiality and security of the research outcomes. For both participate and organisation, having ‘peace of mind’ that the research outcomes are not going to go beyond the classroom or the school, respectively. Also, if published, the research findings cannot be linked to any individual or organisation.

5.7 Conclusion

The approach and designs adapted for the research is an attempt to provide sufficient information and data for the research questions to be adequately answered and the overall aims of the research to be met. Also, by including associated areas of psychological/cognitive topics and assessments, e.g. Gestalt Completion Test (GCT); British Ability Scales (BASI) Short Form IQ; and Cognitive Styles Analysis (CSA), to that of field dependence - field independence, within the overall research, a clearer and perhaps an extended understanding of field dependence - field independence can be obtained, with the addition of investigating how field dependence - field independence may be operating within the subjects of the school curriculum.

Chapter 6

Developments in the Measurement of Field Dependence – Field Independence

6.1. Introduction

This chapter gives an account of the development of new methods of measuring field dependence – field independence. One method involves a geometrical/spatial modality (a new form of an embedded figures test), and the other utilises a verbal modality (embedded words and letters tests).

The development of the above two methods of measuring field dependency – field independency address the following research questions:-

1. *Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?*

and

2. *Is it possible to measure field dependence – field independence using a verbal modality?*

6.2. Measurements of Field Dependence – Field Independence by the use of Embedded Figures/Shapes Tests

The purpose of any embedded figures/shapes test, whether administered on an individual or group basis, is to measure the construct of field dependence - independence. Like any other 'test', embedded figures/shapes tests require standard 'testing conditions' in an attempt to control the overall administration of the test to ensure that the responses of each testee are their own and to minimise extraneous variables.

However, with embedded figures/shapes tests, especially when administered on a group basis, a variety of other factors have to be controlled carefully to enable each testee to respond to their maximum ability and to provide a uniformity of approach for all testees.

6.2.1. General Factors

Traditionally, with any form of embedded figures/shapes test e.g. Group Embedded Figures Test (GEFT) (Witkin et al, 1971), there are a number of general factors that are involved. These include:-

i) The questions relate to the characteristics of a particular cognitive style, i.e. field dependence – field independence or a psychological attribute e.g. analytic ability, that the embedded figures/shapes test is attempting to measure.

ii) An understanding of the concept of locating an embedded simple figure/shape within a complex figure/shape.

There is a difference between understanding 'what to do' and being 'able to do' or 'unable to do' it, i.e. a propensity to be placed in the field dependent (unable to do) or field independent (able to do) region of the field dependence – field independence bi-polar continuum.

iii) The type and range of the figures/shapes to be used, and the relationship(s) between the pairs of simple and complex figures/shapes to be used.

iv) The time required to complete the test, i.e. how many questions does it contain? and does it have a number of sections and why?

v)The presentation of the test in terms of how the questions are to be presented to the testees, and the method by which they are required to respond.

vi) Administration of the test including, seating arrangements, supply of appropriate pencils and erasers, instructions related to different sections within the test, and timing considerations.

vii) The intended recipients of the test encompassing age range, ability range and/or aptitude/occupational assessment.

viii) Is such a test to be administered on an individual or group basis?

On a group basis it is very important that testees are not able to readily see/copy the responses of other testees. This is particularly relevant with embedded figures/shapes questions, because at a glance, a testee may be able to see the correct solution to a question from another testee.

Each of the above eight inter–related factors do not provide sufficient detail for a robust formulation, construction and application of any embedded figures/shapes test. Therefore, an expansion of the above eight inter–related factors is required to produce a number of specific categories, each containing a number of specific factors.

6.2.2. Specific Categories of Factors

The following specific categories consist of a number of specific factors that are likely to be necessary to take into account to direct the formulation and construction, and describe the application of any embedded figures/shapes test.

6.2.2.1. Presentation of the Figures/Shapes – complex and simple

i) Familiarity of the figures/shapes used, complex and simple, to everyday experience.

ii) Type of figures/shapes, complex and simple, in terms of whether or not they are three or two dimensional, and whether each complex/simple pair of figures/shapes (within each question) consists of three or two dimensions or a combination of the two.

iii) Degree of the distraction each complex figure/shape. e.g. number and type of lines; amount of shading/colour, i.e. the level or number of 'Gestalten' elements.

iv) Dimensions of both complex and simple figures/shapes, i.e. how big or small they are in their presented format.

v) Size of the simple figure/shape (embedded) in relation to size of the complex figure/shape, i.e. does the size and shape of the given simple figure/shape match or not match exactly the size and shape of the simple figure/shape embedded in the complex figure/shape?

vi) Orientation of the simple figure/shape within the complex figure/shape i.e. one or more possible orientations of the simple figure/shape occurring more than once within the complex figure/shape.

6.2.2.2. Presentation of the Questions (each question is a combination of a complex and simple figure/shape)

i) Proximity of the simple figure/shape to the complex figure/shape, i.e. the arrangement of the two figures/shapes on the page, or on different pages.

ii) The number of figure/shape pairs (complex and simple) on any one page, and therefore, the degree of distraction from one question (complex and simple figure/shape) to another, and the amount of surrounding space, large or small, on any one page.

iii) The use of sections within the overall test, e.g. worked examples section, practice section, section or sections of a different level of difficulty.

iv) The number of questions presented, i.e. overall or within each sections, if sections used.

v) Time considerations, timed or untimed, overall or within each section used, apart from perhaps a ‘practice section’.

vi) Degree of representativeness of the questions in the ‘practice section’ (if used) compared to the questions in the other section or sections of the test.

vii) Quality of the printing of the figures/shapes (complex and simple), in relation to accuracy of proportions and clarity of lines.

viii) Test booklet size, or single page size, in relation to the handling characteristics of it, e.g. turning the pages of a ‘test booklet’, working on the figures/shapes presented under time conditions.

6.2.2.3. General Administration

i) Is the ‘test’ designed to be administered on an individual or group basis or either?

ii) Instructions given, verbal and/or written format, for the overall completion of the test.

iii) Completion of the questions, i.e. necessary to have an appropriate pencil and eraser, in relation to clarity and accuracy of answers given, i.e. lines drawn by the testee(s).

iv) General seating arrangements

v) Number of testees at any one time when the ‘test’ is administered on a group basis.

vi) Method of communication between testees and administrator once the 'test' has started.

6.2.2.4. Scoring

i) Only points given for a full/accurate (following closely the outline of the embedded figure/shape) 'answer'; or points given if the subject is able to give a strong indication that he/she has located the simple (embedded) figure/shape in the complex figure/shape.
ii) Score obtained determines a position on the field dependence – field independence bi-polar continuum.
iii) Possible use of normative designation from score obtained for field dependence – field independence (Witkin Et Al., 1971).

6.2.2.5. Client Group

i) A specific range, e.g. primary or secondary school age, or a wider age range, e.g. young or older adults.
ii) Anyone considered to have average ability, i.e. within the average range for a Standardised Score, or below and beyond average ability
iii) Persons with designated Special Educational Needs (SEN) may experience difficulties with the concept of field dependence – field independence type questions of whatever modality.
iv) A possible measure of particular aptitudes for certain occupational placements.

6.3. Group Embedded Figures Test (GEFT)

6.3.1. Origins of the Group Embedded Figures Test (GEFT)

The Group Embedded Figures Test (GEFT) was developed from the Embedded Figures Test (EFT) (Witkin Et Al., 1971). The EFT is administered on an individual basis, for the measurement of field dependence – field independence, and consists of a number of modified Gottschaldt (1926) figures. These figures have a simple figure incorporated in a complex figure, the simple figure being obscured by a number of lines drawn within the boundary of the complex figure. Witkin Et Al., 1962 and 1971, felt that the Gottschaldt material had limitations in terms of the number of difficult and different figures it was possible to generate by the use of lines as described above. Therefore, he developed, using colours, a means of obscuring or embedding to a greater extent, the simple figure within the complex figure.

From this approach, applied to extensive studies (Witkin et al., 1962 and 1971), twenty-four complex figures and eight simple figures were selected, each of the simple figures being contained or embedded in several of the complex figures. Witkin appears to have used two main criteria in selecting the complex figures i) to produce a series of figures arranged in increasing difficulty, i.e. the ease/difficulty of detecting the simple figure within the complex figure; and ii) to have a variety of simple figures so that no one simple figure would be encountered many times in the range of the complex figures used, in an attempt to reduced practice effects.

As the name suggests, the GEFT enables the measurement of field dependence – field independence to be done on a larger scale, i.e. a group of testees instead of a single testee to reduce the overall time for the administration of a large sample.

With both the EFT and the GEFT, the simple figure(s), referred to as ‘embedded forms’, be located in the complex figure(s), are shown on the back page of the ‘test’ booklet.
For a full account of the ‘test’ development of the Embedded Figures Test (EFT) and the Group Embedded Figures Test (GEFT), see Witkin et al. (1971).

6.3.2. General Description of the Group Embedded Figures Test (GEFT).

The GEFT consists of i) an exploration of the task to be done/practice section with two worked examples, and ii) three other sections. These three sections have seven, nine, and nine complex figures or embedded figure items/questions respectively. The simple figure(s) or ‘embedded form(s)’, are required to be located within a given complex figure(s), and some of the simple figure(s) or ‘embedded form(s)’are applicable to more than one complex figure(s).

The number of correctly, i.e. shape and accuracy, located simple figures or ‘embedded forms’ from each of the three sections are summated to give an overall total which is used for a designation of field dependence – field independence (similar to that used for the EFT).

Of the eighteen complex figures used in the GEFT, seventeen were taken from the EFT. A colour component was not used in the GEFT but instead, light blue shading was used with some of the complex figures in parts of them.

Many of the figures, complex and simple, used in the GEFT are two dimensional, and many of the complex figures used have the additional ‘embedding’ characteristic of light blue shading, the intensity of which is approximately the same for all of the complex figures that have it.

Explanation/Practice Section

The first item in the explanation/practice section consists of a three dimensional complex figure having a two dimensional simple figure (embedded form) embedded in it; and the second item, a two dimensional complex figure having a two dimensional simple figure (embedded form) embedded in it. There is no use of ‘light blue shading’ with either of the two complex figures used in this section, and there are no obvious similarities between the two complex figures and the two simple figures or ‘embedded forms’ used.

First Section

This section consists of seven two dimensional complex figures, all of which have no ‘light blue shading’. The simple figures or ‘embedded forms’ are also two dimensional except one, which is therefore, three dimensional, and no one simple figure or ’embedded form’ is used more than once, i.e. applicable to more than one complex figure, in this section. Seven out of a total of eight simple figures or ‘embedded forms’ are used once in this section.

Second Section

The nine complex figures that constitute this section are two dimensional, and all have an amount of ‘light blue shading’. Their corresponding simple figures or ‘embedded forms’ consist of two or three dimensions, some of them being applicable to more than one complex figure. Of the total possible number of simple figures, which is eight, seven are used in this section, with two being used twice, i.e. the same simple figure or ‘embedded form’ embedded in two different complex figures.

Third Section

Of the nine complex figures used in this section, seven are two dimensional and two are three dimensional. All but one of the nine complex figures have ‘light blue shading’. Six of the eight possible simple figures are used, two of them twice.

With the Explanation/Practice section, the embedded simple figure to be located in the complex figure, is situated near to the complex figure with each of the two worked examples, and the solution ‘drawn’.

However, with all of the complex figures (items/questions) in each of the three sections, all of the simple figures or ‘embedded forms’ to be located in the complex figures are situated at the back of the ‘test booklet’. Consequently, the ‘testee’ has to memorise the simple figure/embedded form before attempting to locate it in the complex figure and then draw around it. Although the ‘testee’ can look at the simple figure/‘embedded form’ as often as they wish, a memory factor continues to be present and the greater the number of times a ‘testee’ finds it necessary to look at the simple figure/‘embedded form’ at the back of the ‘test booklet’ in attempting to memorise it, less time becomes available to consider all of the questions in the ‘test’ as a whole, as the ‘testee’ is required to do.

Throughout the GEFT, all of the simple figures/embedded forms have the same size and proportions as their corresponding simple figures/‘embedded forms’ in the complex figures.

A copy of the Group Embedded Figures Test (GEFT) ‘test booklet’ is in the Appendix.

6.3.3. Administration of the Group Embedded Figures Test (GEFT)

After the completion of personal details at the front of the test booklet, testees are requested by the ‘administrator’ to read through the ‘Directions’ which include the two worked examples. When all the subjects have completed this and before moving on to the next or first section, the ‘administrator’ reads through the main points (contained in the ‘Directions’) that the ‘testees’ have to follow, and gives them the opportunity to ask any questions.

Once the ‘administrator’ is sure that all of the ‘testees’ understand what they have to do, and how to do it, the three sections can be attempted, one by one under the management of the ‘administrator’.

Each of the sections is timed. Two minutes are allowed for the first section, which is essentially a practice section to consolidate the understanding of the task involved as well as giving practice in the motor coordination skills necessary to draw around the simple figure/embedded form, embedded in the complex figure of each question presented. The second and third sections each have five minutes allowed for their completion.
With each section the ‘administrator’ starts and ends the time allowed for the completion of them.

‘Testees’ are also given instructions about what to do if they need a new pencil during a timed section, and told not to go on to another section if they finish a section before the allowed time has elapsed.

Since the medium used to answer the questions in each section is pencil, the need for accuracy when drawing or tracing around the embedded figure or form is emphasised, and ‘testees’ are allowed/requested to use a pencil eraser if they feel they have made a mistake. Obviously, if mistakes are made and the testee chooses to erase them, this takes away time for other questions in the section.

Throughout the administration of the GEFT, it is advised (Witkin et al., 1971) that other people should be in the room to help oversee that the ‘testees’ keep their focus on their own work.

At end of the last timed section, the testees are requested to close their ‘test booklet’.
For full administration details of the GEFT, see Witkin et al, 1971).

6.3.4. How does the Group Embedded Figures Test (GEFT) relate to the General Factors and Specific Categories of Factors (considered appropriate for any Embedded figures/shapes test)?

The use of simple figures (embedded forms) more than once, in spite of them being embedded in a different complex figure, allows a possible 'practice effect' to take place to a certain extent, i.e. increasing familiarity with the simple figure (embedded form) increases the ability of the testee to manipulate and re-orientate it mentally; and the use of complex and simple figures (embedded forms) throughout the test have no overall geometrical sequence. However, this arguably could provide both an advantage and disadvantage in terms of the accuracy of determining the position of an individual on the field dependence – field independence bi-polar continuum. An advantage in that it could provide a more accurate measure of field dependence – field independence, i.e. the testee is not helped in any way because of the abrupt changes from one set of complex/simple figures (embedded forms) to another; and disadvantage in that it could enable a greater number of questions to be completed successfully, i.e. the testee is helped from one set of complex/simple figures (embedded forms) to another because of gradual changes that a geometrical sequence would provide. Also, a few three dimensional complex and simple figures (embedded forms) appear to have been included on a random basis. Since an embedded figures/shapes test should be able to measure the degree of field dependence – field independence for a wide range of individuals, the above factors may not enable such an objective to be achieved, i.e. sudden changes from two to three dimensions with either or both complex and simple (embedded forms) figures could cause confusion on the part of some testees.

While this may give, in itself, a further degree of difficulty as an integral component of the test as a whole, it could be argued that without a geometrical sequence, the ability of the test to measure the field dependence – field independence construct is diminished because it presents too difficult a task to the testee by not leading him/her into the mode of thought necessary for the successful completion of each of the questions within any embedded figure/shapes test. However, this would be the case with any category of problem, i.e. using a particular technique to determine a solution. In a similar way, by having a geometrical sequence the testee is led and/or encouraged to think in relation to the characteristics of the embedded tasks through the experience of the familiarity of figures having both similarities and differences; and, arguably differentiating 'general ability' from 'perceptual ability' which is an integral aspect of the measurement of field dependence – field independence (Witkin et al., 1962 and 1971)

Also, the inclusion of three dimensional figures, complex and simple, inserted in each of the three sections (but not included in the initial worked examples section) in an unsequenced and varied way, only serves to support the above argument by adding to the difficulty of the GEFT by, again, the introduction of a possible element of confusion. This does not mean that three dimensional figures should not be used in the GEFT, whether in pairs or combinations, i.e. a three dimensional complex and simple figure (embedded form), or a three dimensional complex figure and a two dimensional simple figure (embedded form) or vice versa. However, a more accurate measure of field dependence – field independence, could well be achieved if they were introduced within separate sections or in a sequence, evenly distributed throughout the GEFT, i.e. worked examples as well as the other sections.

A particular criticism of the GEFT is that the simple figures (embedded forms, as they are referred to in the test booklet) are not located by the side of the complex figure in which they are embedded, but at the back of the test booklet. Consequently, the testee has to remember the shape of the simple figure (embedded form) while attempting to locate it, or disembed it, from the complex figure.

Although most of the complex figures, in each section, are arranged as two per page, this is perhaps both an advantage and disadvantage. An advantage in terms of less distracting influences on the page as a whole, i.e. when focusing on one of the complex figures to locate the embedded simple figure or form; and a disadvantage in terms of having to consider and remember, albeit separately, two simple figures or forms, in close proximity, because they are not printed near to any one particular complex figure in which each one is embedded. Therefore, the testee's eyes may not be focussed onto the intended complex and associated simple figure or embedded form, but instead might well wander onto the other complex figure on the same page.

However, in spite of having to remember the simple figure or form to be located in the complex figure, the testee is arguably helped in the completion of the GEFT by knowing (told in the introductory part to the GEFT) that within the GEFT, the simple figure as presented at the back of the test booklet, is the same size, proportion and orientation as its counterpart embedded in the complex figure.

While it is perhaps reasonable to have the size and proportion fixed for the two figures, i.e. the simple figure in isolation and its embedded counterpart within the complex figure, if only to control factors which are likely to relate to the degree of difficulty of the task of disembedding simple figures or forms from complex figures, and the overall complexity of the GEFT, there is a distinct advantage and possible reduction in the degree of difficulty of the task, disembedding simple figures or forms from complex figures, if the simple figure has the same orientation as its embedded counterpart in the complex figure. However, this in turn, possibly, makes the task of having to remember the simple figure or form when attempting to locate its embedded counterpart in the complex figure, a little easier because the testee is not having to mentally and continuously re-orientate the simple figure or form to locate it within the complex figure.

With regard to the intended client group for the GEFT, although wide, i.e. from the latter part of the primary school age range to adult the above aspects of the GEFT may prevent younger testees from obtaining an accurate field dependent – field independent measure.

6.4. New Form of a Group Embedded Figures Test – the Embedded Shapes Test (EST)

6.4.1. Origins of the Embedded Shapes Test (EST)

The development and production of the Embedded Shapes Test (EST) is an attempt to produce a method of measuring field dependency – field independency which is more accurate than the Group Embedded Figures Test (GEFT) in designating an individual on the field dependent – filed independent bi-polar continuum. This relates directly to the first research question of this thesis, i.e. Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?

Also, the structure and sequential arrangement of the items/questions contained in the EST provide the beginnings of a diagnostic element as to why some individuals are designated field dependent and others field independent.

Although the new form of a Group Embedded Figures Test, i.e. Embedded Shapes Test (EST), described in this section has similarities to the Group Embedded Figures Test (GEFT)(Witkin et al, 1971) in relation to its presentation and administration, there are major differences which, it is considered, address the criticisms directed at the GEFT in the last section.

The starting point for the exploration and selection of suitable shapes for the EST was to consider a range of existing and original complex and simple shapes consisting of two and three dimensions arranged in a verity of combinations, i.e. a two dimensional complex shape with a two dimensional simple shape, a three dimensional complex shape with a three dimensional simple shape, and a mixture of two and three dimensions for both complex and simple shapes.

To give the possibility for a logical sequence of development to take place, a series of circles and lines was selected. The description of the complex shapes and resulting sequence is as follows:-

a) Three circles were arranged so that their circumferences touched each other.
b) Three circles were arranged so that the circumferences of each circle passed through the centre of two other circles. This gave an overlapping configuration of the three circles.
c) Four circles were arranged so that their circumference touched each other.
d) Four circles were arranged so that the circumference of each circle passed through the centre of two other circles. This gave an overlapping configuration of the four circles.

Each of the circles used in the three and four circle configurations are of equal diameter.

With both the three and four circle arrangements, where the circumference of each of the circles touched, straight lines were drawn to join each centre of each circle.

The above arrangement produced an equilateral triangle shape within the three circle (non-overlapping) configuration, and a parallelogram consisting of four right angled triangles (same size) shape within the four circle (non-overlapping) configuration.

As a consequence of these arrangements (non-overlapping and overlapping) and numbers of circles, with or without straight lines, but especially with straight lines, four basic complex shapes were produced that had common elements within their structure.

Also, the geometrical characteristics of the basic unit chosen, i.e. a circle, combinations of it, i.e. non-overlapping and overlapping, and additions to it, i.e. straight lines, enabled the generation of a wide variety of 'internal' shapes which were to become the 'simple' shapes in the Embedded Shapes Test. This situation would not have been possible with some of the 'complex' shapes, of varying configurations, that were explored initially.

Each of the four basic complex figures were then rotated clockwise and anti-clockwise in increments of either ninety, sixty, thirty or forty-five degrees to give a different visual effect, at a glance a different complex shape, in an attempt to reducing possible practice effects.

A further method employed to increase the degree of embeddedness, was to arrange the simple shape, to be located in a given complex shape, with a different orientation to its counterpart in the complex shape, whatever the orientation of the complex shape.

By using the above four basic complex shapes and orientations it became possible to arrange all of the complex shapes throughout the overall EST in a logical sequence, i.e. rotations through a designated number of degrees either in a clockwise or anti-clockwise direction.

This was done as follows:-

Test Items/Questions

1) three circles complex shape—circles touching (centres joined with straight lines)

2) three circles complex shape—circles touching (centres joined with straight lines) (rotated through ninety degrees in a clockwise direction)
3) three circles complex shape—circles touching (centres joined with straight lines) (rotated through a further ninety degrees in a clockwise direction)
4) three circles complex shape—circles touching (centres joined with straight lines) (again, rotated through a further ninety degrees in a clockwise direction)
5) three circles complex shapes—circles touching (centres joined with straight lines) (same orientation as for (4) above)
6) three circles complex shapes—circles touching (centres joined with straight lines) (rotation through ninety degrees in a clockwise direction)
7) three circles complex shapes—circles touching (centres joined with straight lines) (rotation through a further ninety degrees in a clockwise direction)
8) three circles complex shapes—circles touching (centres joined with straight lines) (again, rotated through a further ninety degrees in a clockwise direction)

These rotations of the complex shapes having three circles touching, and their centres joined with straight lines, gives the situation of 1 = 8; 2 = 7; 3 = 6; and 4 = 5, which were the numbers used to designate each complex shape in the EST.

Although only one complex shape was used for the first eight items, the four orientations used, first in one direction (each subsequent orientation following the preceding one in a defined way) and then in the reversed order (following the same criteria, as described above, from one orientation to the next) created a continually changing contextual field, particularly in relation to the simple shape or embedded shape that was to be disembedded from the complex shape.

A different simple shape was used for each of the test items/questions 1 to 8, with 5 to 8 being placed on a different page within the EST.

Item/Question – Continuation

9) four circles complex shape—circles touching (centres joined with straight lines as much as possible)

10) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (rotated through thirty degrees in a clockwise direction)
11) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (rotated a further thirty degrees in a clockwise direction)
12) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (rotated through sixty degrees in a clockwise direction)
13) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (same orientation as for (12) above)
14) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (rotation through sixty degrees in an anti-clockwise direction)
15) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (rotation through thirty degrees in an anti-clockwise direction)
16) four circles complex shape—circles touching (centres joined with straight lines as much as possible) (rotation through a further thirty degrees in an anti-clockwise direction)

As with the previous eight complex shapes, the following set of rotations of the complex shapes having four circles touching, and their centres joined with straight lines, gives a similar situation in terms of 9 = 16; 10 = 15; 11 = 14; 12 = 13; which were the continuing numbers used to designate each complex shape in the EST. Again, from one complex shape for the following eight items/questions in the EST, the four orientations used enabled a further variety of alternate contextual situations to be presented.

A different simple shape was used with each of the test items/questions 9 to 16, with 13 to 16 being placed on a different page within the EST.

Test Item/Question - Continuation

17) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles)

18) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (rotated through ninety degrees in a clockwise direction)
19) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (rotated through a further ninety degrees in a clockwise direction)
20) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (rotated through a further ninety degrees in a clockwise direction)
21) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (same orientation as for (20) above)
22) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (rotated through ninety degrees in a clockwise direction)
23) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (rotated through a further forty-five degrees) in a clockwise direction.
24) three circles complex shape—overlapping (circumference of each circle passing through the centres of the two other circles) (rotated through a further forty-five degrees) in a clockwise direction.

Again, as with the previous two different complex shapes and their associated sets of orientations, the arrangements of this third complex shape, having three overlapping circles, with the circumference of each circle passing through the centres of the two other circles, was 17 = 24; 18 = 23; 19 = 22; and 20 = 21; which correspond to the numbers within the EST.

Also, as with the previous sets of orientations from the principal complex shapes, additional contextual situations were able to be created, by using the same criteria, i.e. rotations; and a different simple shape was used with each of the test items/questions 17 to 24, with 21 to 24 being placed on a different page within the EST.

Test Item/Question- Continuation

25) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles).
26) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (rotated through forty-five degrees in a clockwise direction)
27) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (rotated through a further forty-five degrees in a clockwise direction)
28) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (rotation through forty-five degrees in a clockwise direction)
29) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (same orientation as for (28) above)
30) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (rotation through forty-five degrees in an anti-clockwise direction)
31) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (rotation through a further forty-five degrees in an anti-clockwise direction)
32) four circles complex shape—overlapping (circumference of each circle passes through the centres of the other three circles) (rotation through a further forty-five degrees in an anti-clockwise direction)

Here, again, as with the previous three different complex shapes and their associated sets of orientations, the arrangement of the fourth complex shape, having four overlapping circles, with the circumference of each circle passing through the centres of the three other circles was 25 = 32; 26 = 31; 27 = 30; 28 = 29; which corresponds to numbers within the EST.

Again, as with the other sets of orientations, additional contextual situations were able to be created from the principal complex shape, using a similar criteria in terms of rotations and allocating a different simple shape to a complex shape, to each of the items/questions 25 to 32, with 29-32 being placed on a different page within the EST.

Therefore, in reviewing the types of complex shapes used and the variety of orientations, in the EST, the following observations can be made:-
From the four complex shapes, with straight lines in two of them, and the use of a variety of orientations for each complex shape, arguably, a greater number of complex shapes was obtained, which increased the variety of contextual fields.

The orientations generated from any one of the four 'basic' complex shapes, could be described as an 'associated orientation set' of a particular complex shape.
Each of the complex shapes generated had four different orientations, each one being used twice but not consecutively within each quarter of the test items/questions, i.e. 1 to 32 of the EST, where each one of the four 'basic' complex shapes was used in turn.
From the four 'basic' complex shapes, a variety of simple shapes were obtained from each of them. This enabled a different simple shape to be allocated to each test item/question, i.e.1 to 32, of the EST.

In addition to the above considerations, several geometrical units or basic geometrical shapes were investigated, using a variety of combinations and rules for the generation of a series of complex shapes (and simple shapes), before the ones that were used in the Embedded Shapes Test were selected.

6.4.2. General Description of the full Embedded Shapes Test (EST)

The Embedded Shapes Test (EST) consists of three sections, Worked Examples (A), Practice Examples (B) and Response(C) respectively.

The Worked Examples Section is preceded by a set of instructions, explaining to the testees how they are to respond to the test items/questions presented in the EST.

Worked Examples Section (A)

This section consisted of four complex shapes and their corresponding simple shapes. The complex shapes were arranged in a column on the left hand side of an A5 sized piece of paper, and each simple shape was placed by the side of its corresponding complex shape.

The orientation of the simple shape by the side of the complex shape was different from its located, or embedded, orientation within the complex shape.

There was space between the complex shape and simple shape (they were arranged side by side) to allow the two different shapes to be viewed separately or together; and a space between each set of shapes, i.e. complex and simple, forming the one test item/question to minimise a possible 'influencing factor' from one set of shapes to the next.

The type of complex shapes used in this section included,

a) three touching circles (centres joined with straight lines), and

b) three overlapping circles, arranged alternatively, and with a different overall orientation, starting with a three overlapping circle shape.

Each of the simple shapes was different and they encompassed a range of size and shape types.

The simple shape was located within the complex shape by a 'bold' outline, to indicate to the testees its exact location within the complex shape, and to illustrate how the simple shape is located in the complex shape.

With each of the complex shapes and their corresponding simple shapes, used in this section, it was possible to locate the simple shapes in three different orientations. This factor was not mentioned in the written instructions but referred to verbally by the administrator as the Worked Examples Section was explained to the testees. There was no time limit set for the explanation of this section.

Many of the points referred to in the description of the Worked Examples Section (A) with regard to size of the pages of the test booklet; the number of test items/questions per page; their arrangement on the page; the arrangement/orientation of simple shapes to complex shapes; and the size and shape type of the simple shapes, are common to the other two sections, i.e. Practice Examples (B) and Response (C), of the EST.

Practice Examples Section (B)

The complex shapes used in this section were exactly the same as those used in the previous, Worked Examples Section (A), in terms of their composition and orientation. The simple shapes, however, were different.

In this section the testees were required to locate the simple shape in the complex shape by drawing around the simple shape within the complex shape.

With three of the simple shapes used in this section it was possible for them to be located in one of three different orientations within their corresponding complex shapes.

In this, the initial version of the EST, four minutes were allowed for the completion of the Practice Examples Section (B).

Response Section (C)

This section consisted of thirty-two complex shapes, with an allocated simple shape, all of which were different both within the section and in relation to those simple shapes used in the previous two sections, i.e. Worked Examples (A) and Practice Examples (B).

The overall section can be considered to have four sub-sections in terms of the particular complex shapes used (non-overlapping/overlapping circles with or without straight lines) and the sequence of their orientations.

Such an arrangement gives the following:-

Complex shape—three circles with their circumferences touching and centres joined with straight lines, having four orientations arranged in the sequence one to four (forwards), five to eight (backwards), so that 1 corresponds to 8, 2 – 7, 3 – 6 and 4 – 5, as described in Section 6.4.1. of this chapter.

b) Complex shape—four circles with their circumferences touching and centres joined with straight lines.

For both a) and b) type complex shapes, straight lines were used to join the centres of the circles involved, to increase the complexity of the complex shape and to increase the range of simple shapes contained in them.

c) Complex figure—three overlapping circles, i.e. the circumference of each circle passing through the centre of the other two circles.

d) Complex figure—four overlapping circles, i.e. the circumference of each circle passing through the centre of three of the other circles.

The b), c) and d) complex shapes each followed a similar arrangement of orientations and corresponding item/question numbers within each of their respective sub-sections and within the Response Section (C) as a whole of the EST.

For full details of the initial version of the EST see Section 6.4.1. of this chapter.

In the initial version of the EST, there was no set time for the completion of the Response Section (C), i.e. the testees were allowed to attempt/complete all of the items/questions in their own time.

6.4.3. Administration of the Embedded Shapes Test (EST)

Following the completion of personal details at the front of the EST ‘test booklet’, the testees were requested by the administrator to read through the directions that followed. The instructions explained the purpose of the task and how the test items/questions were to be completed.

Once the above instructions had been read by each testee, the administrator read through the instructions aloud with the subject following the reading and the testees given the opportunity to ask any questions to clarify their understanding of what they were being asked to do.

After this the administrator referred the testees' attention to the Worked Examples Section (A), and the testees were allowed to study the worked examples. Then the administrator 'worked through' the worked examples with the testees to ensure that they understood what to do and how to do it. Reference was also made by the administrator to the following points:-

- Drawing round the simple shape within the complex shape needed to be accurate, i.e. following the boundary closely, and completely for a point to be gained.
- The orientation or position of the simple shape within the complex shape could be any one of several, providing that it was accurately located, to gain a point.
- The orientation or position of the simple shape within the complex shape need not be the same as the orientation of the presented simple shape. The Worked Examples Section (A) illustrated this aspect.
- If a mistake was thought to have been made, it could be 'rubbed out' and the test item/question re-attempted, since pencil and not ink/biro was to be used with both the Practice (B) and Response (C) Sections.

In relation to last point all testees were supplied with an HB pencil and a pencil eraser at the start of the overall administration of the EST.

When the above points had been talked through by the administrator, and assurances given by the testees that they understood what to do and how to do it, the testees were allowed to 'turn' to the title page of the Practice Examples Section (B). The above title page stated that there were four minutes allowed to complete this section.

The administrator, having ensured that the testees were aware of the time limit and knew what to do if they finished before the allowed time had elapsed, i.e. put their pencils down and wait, and not to start the Response Section (C), the testees were allowed to work through this section.

When the time had elapsed for this section, the administrator asked any testees still working to stop and asked if anyone was confused about what they had just done. Depending on the response from the testees, a further explanation (re-explanation) was given by referring to the points already made and reviewing the Worked Examples Section (A) if necessary.

After this the testees were allowed to turn to the title page of the Response Section (C). The above title page stated that there was no set time for the completion of all of the test items/questions in this section.

As the testees finished the above section, they were asked to record the time they had taken at the front of the 'test booklet' in the space provided.

6.4.4. How does the Embedded Shapes Test (EST) relate to the General Factors and Specific Categories of Factors (considered appropriate for any embedded figures/shapes test)?

Since the simple shapes, in the EST, are situated by the side of the complex shapes, a memory factor does not apply, i.e. the testee does not have to remember the shape of the simple shape from another part of the test booklet before attempting to locate it within the complex shape.

Also, each simple shape is only used once, allocated to a particular complex shape. This greatly reduces (or eliminates) the possibility of a practice effect taking place in relation to the gaining of familiarity with a particular simple shape as would be the case if it was required to be located within more than one complex shape.

However, since all of the four principal complex shapes i.e. three circles non-overlapping and overlapping, and four circles non-overlapping and overlapping, used in the EST, initial version, follow a sequential arrangement in terms of their type, complexity and orientation, the testee is, in a sense, guided through the task of disembedding a variety of simple shapes but at the same time presented with an essentially different disembedding context. Also, although each orientation of each of the four principal complex shapes used had a different simple shape allocated to it, the fact that there were only four different principal complex shapes, enabled both a familiarity to be established and at the same time, the integrity of attempting to measure field dependence – field independence to be maintained.

All of the simple and principal complex shapes used in the EST were two dimensional and plain, i.e. they had no shading of any colour. Thus, by using a small variety of shapes, i.e. multiples of a basic geometrical shape (a circle), with or without lines joining their centres, to produce enhanced principal complex shapes, and by arranging them in a predetermined sequence, the above arguments can be conserved.

Although the arrangement of the complex shapes with their associated simple shapes, in the EST, was four to a page, within each of the three sections, because each complex shape had only one simple shape allocated to it, the potential distracting influences from the other shapes on the page is likely to be reduced and possibly eliminated. The reason for this is due to the nature and process of disembedding a simple shape from a complex shape with any embedded figures/shapes test because the testee has to focus on one disembedding test item/question at a time, i.e. the testee has only to consider one simple shape in relation to one complex shape.

A better arrangement, perhaps one approaching an ideal in terms of measuring field dependence – field independence, would be to arrange one complex shape with its simple shape, having a different orientation to the embedded orientation, on each page of the test booklet. However, apart from having to turn over a page after each test item/question, that which might be gained by way of focused attention in terms of the above, might be lost by way of interruption to the establishment of spontaneity to the task of locating the embedded shape, i.e. a stopping and starting of the thinking processes involved from one test item/question to the next instead of a group of test items/questions, as well as turning over many pages, a little more time would be taken away from the potential completion of each test item/question in the EST.

Each of the simple shapes used in the EST, had the same size and proportions to their counterparts embedded in the complex shapes. The orientation however, was different, the simple shape having a number of possible positions within the complex shape depending upon the characteristics of the complex shape, i.e. some complex shapes allowed the simple shape to be located in them once, twice, three of four times.

The above arrangement ensures that the testee has to extend his or her thinking by considering a greater number of possible locations or positions of the simple shape within the complex shape, in searching for the embedded simple shape. Such an arrangement also 'offsets' perhaps the 'familiarity' effect (practice effect) of having the same or similar principal complex shape, in spite of different orientations of it, repeated four times on one page in the Response Section (C). However, the overall result of using different orientations, both for the simple and complex shapes is a more systematic and potentially accurate way of attempting to measure field dependence – field independence.

Like the Group Embedded Figures Test (GEFT) 'test booklet', the Embedded Shapes Test (EST) 'test booklet' is substantial in terms of strength and its ability to withstand the physical processes necessary for its use and subsequent completion, and its overall size (A5) enables it to be handled with ease. In addition, the printing of the shapes, complex and simple, is accurate and of good quality. This also, applies to the instructions at the front of the 'test booklet' and, in the case of the EST, on each title page to each of its three sections.

For a copy of the Embedded Shapes Test (EST), initial version, 'test booklet' see Appendices.

6.5. Measurement of Field Dependence - Field Independence by the use of Words and Letters Tests

Since the concept of field dependence – field independence is based on the notion of the ability of an individual to disentangle or disembed a simple figure/shape from a complex figure/shape, or a small amount of information from a larger amount of information, then it should be possible to use some sort of alternative method to that of geometrical figure/shapes to measure whether an individual is functioning in a field dependent or field independent mode.

This notion is related to the second research question of the thesis, i.e.

> *Is it possible to measure field dependence – field independence using a verbal modality?*

The initial alternative method chosen for the above purpose was to use words, and in an additional development, groups of letters. With both of these approaches the format of simple and complex components was used, the simple component being contained or embedded in the complex component in a similar way to that used with geometrical figures or shapes as a different way of measuring field dependence – field independence.

Although, it could be argued that the use of words or groups of letters to measure field dependence – field independence is essentially the same as when using geometrical figures or shapes, especially when a similar format, as already described, is used, because words and letters produce overall shapes, it was felt by the researcher that such an approach would begin, at least, to 'tap' into the measurement of field dependence – field independence from a verbal perspective. However, a sensitivity to research methodology needs to be borne in mind because the perception of words and letters has a visual and also a semantic component.

Furthermore, this new approach, might provide a comprehensive measurement of an individual's field dependence – field independence designation, when correlated with similar measurements from the use of an embedded figures or shapes test, and perhaps provide a more meaningful measure of field dependence – field independence when comparing such a measure to performance in different school subjects or types of study in relation to the acquisition of certain types of knowledge or training. Therefore, one might reasonably expect a geometrical approach to the measurement of field dependence – field independence to match well to those areas of knowledge requiring a well-developed sense of spatial ability; and a verbal approach using words or groups of letters, to the measurement of field dependence – field independence, to match well to those areas of knowledge requiring a well-developed sense of verbal ability. Such an aspiration is directly related to the third research question of this thesis, i.e.

> *Is it possible to show a relationship between the measurement of field dependence – field independence, ability, and attainment in school subjects?*

However, each of the above different methods of measuring field dependence – field independence may well only measure field dependence – field independence in an isolated sense, and not have any affinity to particular school subject types or areas of knowledge. Studies designed to investigate the above possibilities will be discussed in detail in Chapters 10, 11, 12 and 13 of the thesis.

6.6. Sense Words Test (SWT) (real words forming the basis for a way of measuring field dependence – field independence)

6.6.1. Origins of the Sense Words Test (SWT)

To form the basis of this field dependent – field independent measure a variety of word types in terms of their general characteristics were selected at random. Although the words selected varied in length, the one aspect that they all had in common was that each of them contained at least one smaller word. These smaller words were used as the equivalent to the simple figure or shape in an embedded figures or shapes test, and the bigger words from which they came, were used as the equivalent of the complex figure or shape, the two parts forming one item or question within the SWT.

6.6.2. General Description of the Sense Words Test (SWT)

The Sense Word Test (SWT) consists of fifty different ‘complex’ words (complex in the sense of words that have four or more letters, most of the words used in this context had between six and nine letters) arranged in two columns of twenty-five.

After each ‘complex’ word is placed the ‘simple’ word (each one is different for each of the fifty ‘complex’ words). These words consisted of three or four letters in the majority of cases, and each one was contained in its corresponding ‘complex’ word.

The SWT consists of a single piece of A4 paper, at the top of which are allocated places for identification information of each testee. Underneath the identification information is an explanation of what to do and how to do it. This is followed by a worked example, which indicates how the testee is to locate the ‘simple’ word within the ‘complex’ word, i.e. by drawing a ring, in pencil, around the ‘simple’ word within the ‘complex’ word.

6.6.3. Administration of the Sense Words Test (SWT)

Once the testees had completed the personal information at the request of the administrator, the administrator then asked the testees to read through the instructions and the worked example. The administrator emphasised the need for accuracy when drawing a circle around the small word within the larger word. Also, that erasing of circles was permitted but if this was done, valuable time would be used with regards to the completion of the SWT.
When the administrator was assured that all of the testees understood what to do and how to do it, the testees were told that they had two minutes to complete as many of the test items/questions as they could.

Pencils (HB) and erasers were supplied and replacement pencils in the events of breakages were made available.

6.6.4. How does the Sense Word Test (SWT) Relate to the General Factors and Specific Categories of Factors (considered appropriate for any embedded type of test)?

While the author of the SWT endeavoured to take into account all of the 'factors' described in Section 2 of this chapter, with the SWT, the medium used, i.e. words, make the accommodation of all of the factors more difficult to achieve than when geometrical figures or shapes are used for the purpose of attempting to measure field dependence – field independence.

However, a major consideration relates to a familiarity with words than geometrical shapes on the part of most of the testees. Also, the type of words used, being common high-frequency words, are likely to be known by the testees, more so than a set of geometrical shapes used in an embedded figures/shapes test, which are likely to be very different from plain, basic and therefore common, geometrical shapes, even if such shapes are combined in a simple manner, to produce a more complex shape.

Because most of the words that are used in the SWT have a phonetic, and in many cases, a syllabic characteristic, familiarity and the ability to manipulate words due to reading practice, is increased. Therefore, the level of difficulty of disembedding words as opposed to geometrical shapes is likely to be found to be an easier task for most testees.

The particular presentation arrangement of the words, large (complex) and small (simple), used with the SWT, i.e. all of the test items/questions presented on a single page, is not likely to produce an 'overwhelming factor', i.e. so many test items/questions in such a small space leading to interference or confusion on the part of the testees when moving from one test item/question to another, and therefore likely to produce an increase in a propensity for field dependency. Such a presentation arrangement could assist the testees to complete more of the tasks in the time permitted because they can quickly move from one item/question to another and do not have to turn over pages.

6.7. Non-Sense Words Test (NSWT) (collections of letters forming the basis of a way of measuring field dependence - field independence)

6.7.1. Origins of the Non-Sense Words Test (NSWT)

A further way of measuring field dependence – field independence, using a methodology that arguably, falls between a geometrical/spatial and verbal approach was formulated. The reason for this was to explore a possible linkage between the field dependence – field independence continuum as measured by the Embedded Shapes Test (EST) and the Sense Words Test (SWT).

As a starting point to the formulation of such a measure of field dependence – field independence, fifty randomly selected words were used (this set of fifty words being different from the set of fifty words used for the SWT). The 'starting' words used in the Non-Sense Words Test (NSWT) were similar to those used in the SWT in terms of general characteristics, i.e. phonetic and syllabic, and length.

To transform the above set of real words into the new words for the NSWT, the vowels were removed from each word. The result of this operation produced a series of letters, all consonants, from each of the former words, hence the name of this test—Non-Sense Words Test (NSWT).

See Appendix I for the list of words from which the NSWT1 test items/questions were derived.

Each series of letters was now treated as the equivalent of a complex figure or shape, as in embedded figures/shapes tests, and a smaller group of consecutive letters selected from each of the larger series of letters to form the equivalent of the simple figure or shape, again, as in embedded figures/shapes tests.

6.7.2. General description of the Non-Sense Word Test (NSWT)

As with the SWT, the NSWT consists of fifty 'complex' words (not really words but collections of letters, ranging from between four to seven letters in most cases) and arranged in two columns of twenty-five.

Before, each 'complex' word or set of letters was placed the 'simple' word or set of letters, which consisted of two, three or four letters. Each smaller set of letters is contained or embedded within their corresponding larger set of letters.

The reason the NSWT has the 'simple' part placed before the 'complex' part of each item/question, will be explained in Chapter 9 - Pilot Study 1 and 2.

The NSWT consists of a single piece of A4 paper, at the top of which are allocated places for identification information of each testee. Underneath the identification information is an explanation of what to do and how to do it. This is followed by a worked example which shows how the testee is to locate the 'simple' part within the 'complex' part of each item/question, i.e. by drawing a ring, in pencil, around the small collection of letters within the larger collection of letters.

6.7.3. Administration of the Non-Sense Word Test (NSWT)

The administration of this test is almost identical to that of the SWT except for the actual items/questions, i.e. after ensuring that the testees have understood the instructions and worked example, the administrator refers to the circling of the small group of letters within the large group of letters instead of the small word within the large word as in the SWT.

When the administrator was assured that all of the testees understood what to do and how to do it, the testees were told that they had one minute to complete as many of the test items/questions as they could.

The need for accuracy when drawing a circle around the small group of letters within the larger group of letters was emphasised by the administrator. It is arguably more difficult to draw a circle around a small group of letters within a larger group of letters than it is to draw a circle around a small word contained in a larger word, sufficiently accurately to gain a successful outcome. This is because real small words can be more easily recognised than a small group of letters or a non-sense word as in the case of the NSWT.

6.7.4. How does the Non-Sense Word Test (NSWT) relate to the General Factors and Specific Categories of Factors (considered appropriate for any embedded type of test)?

As with the SWT, attempts were made to take account of all of the 'factors' described in Sections 6.2.1 and 6.2.2 of this chapter.

Since the NSWT has neither figures/shapes nor words but collections of letters which have individual letter shapes as well as an overall shape, the disembedding task requires, perhaps, a combination of a 'geometrical shape' identification, i.e. the outline shape of both the small and large collection of letters, and letter identification, i.e. the small and large collection of letters are associated with words, skills to achieve a field independent outcome.

Again, as with the words in the SWT, because of familiarity with common words and letters, in spite of the vowels of the words used having been removed, the task of disembedding a small collection of letters from a larger collection of letters is, perhaps, easier than disembedding simple geometrical figures or shapes, from complex geometrical figures or shapes. Arguably, this is more difficult than disembedding small words from larger words. In terms of the presentation arrangement of the small and large collections of letters used in the NSWT, a similar format was used to that of the SWT (apart from the small/simple part placed in front of the large/complex part), i.e. the NSWT is presented on a single page (A4), two columns each of twenty-five items/questions, a place for identification information, and an explanation and worked example. The testees are required to respond to the NSWT, in a similar way to the SWT, and the arrangement of the items/questions is unlikely to produce an 'overwhelming factor', but instead provide a possible aid to the number of tasks that can be completed in the time permitted, because of the proximity of one item/question to another and no turning of pages.

6.8. Conclusion

The advent of the EST and the potential for further development, e.g. the use of three dimensional complex and simple shapes, will enable research into the field dependent – field independent bi-polar continuum to be extended. Also, if this continuum and the two cognitive styles that are contained within it, i.e. field dependent and field independent, prove to be a fundamental entity within the process of learning, then it may well provide the basis for a diagnostic instrument to take account of the learner's approach to learning (perception of a given task) as well as personality traits of the learner.

In addition to the above possibilities, by attempting to measure the concept of field dependence – field independence using a verbal modality, further details with regards to a comprehensive understanding of field dependence – field independence may be obtained, e.g. 'Is field dependence – field independence context or school/university subject specific?'

Chapter 7

Comparison between the Group Embedded Figures Test (GEFT), Embedded Shapes Test (EST), Sense Word Test (SWT), and Non-Sense Word Test (NSWT).

7.1. Introduction

In this chapter comparisons between Group Embedded Figures Test (GEFT), Embedded Shapes Test (EST), Sense Word Test and Non-Sense Word Test (NSWT) will be discussed. The GEFT has been included in the discussions by way of a starting point or baseline and not as a ‘gold standard’, since it has similarities to the EST, but the EST is an attempt to improve upon the GEFT in relation to the measurement of field dependence – field independence.

With regards to the SWT and the NSWT there are additional points to consider since they use primarily a verbal modality (words and letters) as opposed to a geometrical/spatial modality (shapes). However, this distinction becomes less obvious with the NSWT because groups of letters are used which are neither words nor shapes in the conventional sense. Therefore, arguably, the NSWT has a degree of affinity to the EST in that they both share a number of similar characteristics.

7.2. Comparison between the Group Embedded Figures Test (GEFT) and the Embedded Shapes Test (EST)

The major differences between the Group Embedded Figures Test (GEFT) and the Embedded Shapes Test (EST) are a) the general arrangement of the sections and their purpose, b) the number of tasks in each section, and c) the characteristics and arrangements of both the complex and simple figures/shapes. Whereas the worked examples, of which there are two, form part of the instructions and explanation of how the items/questions are to be approached and executed in the GEFT, the worked examples in the EST form a self-contained section. Also, there are four worked examples in the EST.

Both of the worked examples in the GEFT ‘double’ as practice items as well, i.e. the testees are first asked to locate the embedded simple figure (or form) within the complex figure, after reading the instructions telling them what to attempt to do, before looking at the correct, given, solution, on the next page of the ‘test booklet’. However, the first section in the GEFT, consisting of seven embedded figures items/questions, is really a practice section in that the testee's score from it is not included in the overall score used for the measurement of field dependence – field independence. Also, the directions for the administration of the GEFT require the administrator to check that the testees have understood what to do and how to do it. In the EST the testees are required to work through four practice embedded shapes, items/questions, in a self-contained section before moving on (as a group) to the main section, Response, of the EST, after the administrator has ensured that the testees have understood what to do and how to do it.

The embedded items/questions that are used for the measurement of field dependence – field independence in the GEFT are arranged in two sections each one consisting of nine items/ questions. This is in sharp contrast to the corresponding part, Response Section, of the EST, which consisted of thirty-two embedded shapes items/questions in a self-contained section. The differences between the GEFT and the EST in relation to the characteristics and arrangements of their complex and simple figures or shapes, respectively, are illustrated as follows in Table 7.1.

Table 7.1. Differences between the Complex and Simple Figures/Shapes of the GEFT and EST

Group Embedded Figures Test(GEFT)	Embedded Shapes Test(EST) (Initial Version)
a) Random selection of complex figures	a) All complex shapes are generated from a series of circles/lines, and arranged in a sequence, that follows set rules, i.e. rotation through designated angles.
b) Two and three dimensional complex and simple figures	b) Two dimensional complex and simple shapes
c) Embedded simple figures having the same orientation as the presented simple figure (or form)	c) Embedded simple shapes can have the same or a different orientation to the presented simple shape.
d) The simple figures are not presented next to the complex figures.	d) The simple shapes are presented next to the complex shapes
e) Some of the complex figures have colour in the form of blue shading.	e) All of the complex shapes have no colour or shading.
f) Some of the complex figures have additional lines that are placed randomly.	f) All straight lines that are included in the complex shapes follow a set of basic rules used to generate the total complex shape.

By generating and arranging the complex shapes used in the EST the way they were, i.e. increasing numbers of unit circles and lines whose resulting complex shapes were arranged by following a series of generated rotational rules, there were no very abrupt changes from one complex shape to another, or one group of complex shapes to another.

The above developmental methodology, as it was applied to the generation of the EST, enabled a variety of complex shapes, and a wide variety of simple shapes to be obtained. This situation is considered to be an improvement on the way in which the figures, complex and simple, were obtained/generated by Witkin et al. (1971) for both the Embedded Figures Test (EFT) and the Group Embedded Figures Test (GEFT). Also, the way in which the shapes, complex and simple, were generated for the Embedded Shapes Test (EST), enabled some representative complex shapes, from the Response Section, to be used in the Worked Examples and Practice Sections of the EST. This, arguably, enabled the testees to have a clearer understanding of the overall task they had to do before engaging with the embedded shapes items/questions in the Practice and then the Response Sections of the EST. See Table 7.2. for details.

A further difference between the GEFT and the EST is the number of test items/questions in each section and the time allocated for the completion of the various sections. This is indicated in Table 7.2 as follows:-

Table 7.2. Differences between the Number of Test Items/Questions per Section and the Time for the Completion of each Section of the GEFT and the EST

GEFT		EST	
Section 1	Seven Test Items/ Questions; Two minutes	Section A	Worked Examples: Four Test Items/ Questions No Set time
Section 2	Nine Test Items/ Questions; Five minutes	Section B	Practice: Four Test Items/ Questions Four minutes
Section 3	Nine Test Items/ Questions; Five minutes	Section C	Response: Thirty-two Test Items/ Questions Testee’s Own Time

With both the GEFT and the EST, the printed and verbal instructions and general 'test' procedure, e.g. section arrangement and the supply of pencils and pencil erasers, of the two 'tests' were similar. Also, the test administrator ensured at each stage or section, especially with the initial ones, that each testee understood what they were being asked to do as well as how to do it, and that support, e.g. the replacing of a pencil, was available throughout the 'test'.

The responses of the testees to all of the test items/questions presented in both the GEFT and the EST were completed on one side of each page, following the lay-out of the test items/questions within each section of both tests. The reason for this was to remove additional distracting elements from one page to the next as would have been the case if the test items/questions were presented on each side of a given page, because the impression resulting from the drawing of the embedded figure or shape would have shown through to the preceding test items/questions, thus making them more difficult.

7.3. Comparison between the Group Embedded Figures Test (GEFT) and the Embedded Shapes Test (EST) in terms of the General Factors and Specific Categories of Factors

There are many aspects of the 'general and specific categories of factors', as cited in chapter 6, that relate to both the Group Embedded Figures Test (GEFT) and the Embedded Shapes Test (EST). Several of these different types of factors are discussed in this Chapter, Section 3, with regards to the GEFT and the EST. However, the major difference between the GEFT and the EST is associated with their construction. With the EST, the employment of a systematic methodology to generate the complex and simple shapes, which is also applied to the arrangement and order of the complex shapes throughout the overall 'test'. This does not appear to have been the case with the formulation of the GEFT.

Consequently, the EST provides, potentially, a more detailed method and therefore, a more accurate way, of measuring field dependency – field independency, with the additional possibility of further development to enable additional improvements to be made in the measurement of field dependency – field independency. Such possibilities could lead to a more detailed investigation of the field dependent – field independent bi-polar continuum, as well as the designation of individuals on it.

7.4. General Comparison between the Embedded Shapes Test (EST), the Sense-Words Test (SWT) and Non-Sense Words Test (NSWT)

Both the Sense Words Test (SWT) and the Non-Sense Words Test (NSWT) are in an earlier stage of development when compared to the Embedded Shapes Test (EST). Although the EST employs sets of original complex shapes with corresponding simple shapes, its methodological approach in relation to the measurement of field dependence – field independence follows a tradition established by Witkin et al., 1972. Also, whereas the EST is an attempt to refine the measurement of field dependence – field independence, the SWT and the NSWT is an attempt to extend and explore other possible ways of measuring field dependence – field independence.

In contrast to the development of the EST, the development of the SWT and NSWT is not so detailed to date. For example, little consideration was given to the overall phonetic characteristics of the 'sense words' used in the SWT or in relation to the 'starting words' (readable words) in the NSWT, although this is arguably less important, because of the nature of the final product used, i.e. a small group of letters embedded in a larger group of letters. However, some consideration was given to the syllabic characteristics of the words used in both the SWT and NSWT. Consequently, it may have been possible that words could have been chosen initially, through additional investigations, that would have produced more difficult 'embedded' test items/questions. However, the main purpose of this section is to compare the EST with the SWT, and the NSWT, as effective ways of measuring field dependence – field independence through different modalities i.e. geometrical/spatial and verbal.

As referred to already, phonetic considerations are not as applicable to the 'non-sense' words as they are to the 'sense words', since the end result of the so-called 'non-sense' words are collections of letters, for both the complex and simple component of each test item/question, and not words. Therefore, in attempting to locate the small collection of letters within the large collection of letters it is likely that the testees are encouraged to use more of a spatial skill or approach than a verbal skill or approach to each test item/question. However, since collections of letters are used as the way of measuring field dependence – field independence, a verbal skill/awareness factor is likely to be used as well as a spatial one, i.e. perceiving the collections of letters in spatial terms due to their shape, before considering their names and sounds.

Also, by comparing the outcomes from each of these three ways of measuring field dependence – field independence, i.e. EST, SWT and NSWT, and their relationship to other cognitive and educational variables, included in the four studies of this thesis, new insights into the nature and measurement of field dependence – field independence, may be obtained.

7.5. Comparison between the Embedded Shapes Test (EST) and the Sense Words Test (SWT)

The obvious difference between the Embedded Shapes Test (EST) and the Sense Words Test (SWT) is in the nature of the task the testees are required to do, i.e. separating or disembedding words from words and letters from letters, although both types of task are considered by the researcher to relate to the measurement of field dependence – field independence, and therefore, have a similarity.

Apart from the difference between the two tasks in terms of predominantly verbal skill and a spatial skill, for the SWT and the NSWT respectively, necessary in locating the word or shape, there is also a difference in indicating the located word or shape in comparison to the EST. With the EST, this is done by drawing around, accurately, the located shape, and with the SWT, drawing a circle, again accurately, around the located word. Arguably, it is a more difficult task to draw around a smaller word contained in a larger word accurately, i.e. so as not to unintentionally include other letters or half letters, than it is to draw around a simple geometrical shape within a complex geometrical shape, once located in each case. Also, a more difficult task with the SWT than with the EST because once the simple shape has been mentally located, the testee has the boundary of the simple shape as a guide to draw around, whereas, with the SWT, there is no such guide when drawing around the smaller collection of letters.

In terms of presentation, i.e. the arrangements of the test items/questions in the 'test booklet'/'test page' of the EST and the SWT respectively, there are additional differences, which relate to surrounding influences to each test item/question, i.e. other test items/questions, and the time allowed for the completion of all the test items/questions. With regard to the time allowed for the EST and the SWT, this was initially left open or estimated in relation to the nature of the test items/questions, i.e. what had to be done to answer each test item/question, how the answer was to be recorded, and how many test items/questions were to be completed, in a particular section of the EST or for the 'entire test' of the SWT. Consequently, four minutes were allowed to complete the Practice Section (B) of the EST, the Response Section (C) of the EST had no set time, and two minutes were allocated to the SWT for the entire completion of it.

For the execution of the test items/questions of the EST and the SWT, a well-developed level of fine motor skills is required to locate accurately the embedded shape or word, respectively. Arguably, this skill is more important in the execution of the SWT because of the nature of each test item/question, as already described in this section, the number of test items/questions to be completed in the allocated time, and the arrangement as well as the proximity of the test items/questions within the SWT. Also, with the SWT there is the skill of reading, which is considered by the researcher to be an important influencing factor in relation to the efficiency with which a testee can work through each of the test items/questions within the SWT. However, this is not to suggest that there is no field dependence – field independence factor in operation within the SWT.

Although all of the above factors are influenced to varying degrees within both the EST and the SWT, in relation to the outcome achieved by each testee, the over-riding attribute, under examination, is the ability to disembed shapes or words. Obviously the easier a testee finds this; the less time is going to be taken to complete each test item/question, which in turn allows more of the allocated time to attempt other test items/questions. Therefore, if the correct responses have been given to the majority of the test items/questions presented, a placement on the field dependence – field independence continuum towards the field independence end of it will be achieved. Continuum in this context is referring to a range of scores, between the extremes of high field dependence and high field independence, as dictated by the lowest and the highest score, on both the EST and SWT.

7.6. Comparison between the Embedded Shapes Test (EST) and the Non-Sense Words Test (NSWT)

As already described in previous sections of this chapter, each test item/question in the NSWT consists of a collection of letters that is equivalent to a complex geometrical shape, and a smaller collection of letters that is equivalent to a simple geometrical shape, of an embedded figures/shapes test.

Since the derived collection of letters, large and small, have no verbal meaning in the usual sense, i.e. both sets of letters represent non-words, they arguably, have a similarity to the geometrical shapes, complex and simple, as used in the EST, or any embedded figures/shapes test, because the shape of individual letters or the overall shape of a group of letters has to be considered when attempting to locate the smaller set of letters within the larger set of letters. Level of reading attainment could prove to be an influencing factor in this context, i.e. a low level of reading ability may encourage a testee to focus more on the shape of individual and/or groups of letters in an attempt to disembed the small group of letters from the large group of letters in the NSWT. Consequently, the level of ability to locate and disembed, the small group of letters within the larger group of letters of the NSWT has a greater similarity to the EST than the SWT. This is a reasonable assumption to make since the verbal and reading ability components found in the SWT do not apply, at least, in a direct way to the NSWT. However, some testees may choose to compare or read each letter one by one from one set of letters to another, i.e. large and small. This approach, if adopted, is likely to take more time from test item/question to test item/question and therefore, not give the testee sufficient time to attempt all of the test items/questions of the NSWT.

The factors discussed in the last Section 7.5 with regard to the SWT in terms of how the responses to each test item/question are recorded and the fine motor skills involved related to the accuracy and efficiency of completion of all of the test items/questions, are considered to be the same in the NSWT.

As with the SWT, although attempts were made to include all of the 'factors' as described in Section 7.6 of this chapter, the medium used, i.e. groups of letters, make the embedded test items/questions presented in the NSWT a little dis-orientating since they present something which falls between geometrical shapes and real words.

In general terms, the above consideration, could be related to the degree of familiarity and experience an individual testee has to either geometrical shapes or real words, in terms of how he/she would respond to such embedded test items/questions. Also, reading proficiency could be an influencing factor in relation to the outcomes of the NSWT for all of the testees.

This would relate to phonetic and syllabic considerations, which would only apply if a testee, due to very well developed reading/literacy skills, was able to re-constitute the given complex or simple 'non-sense' word (collection of letters) by putting back the missing vowels. However, even with very well developed reading/literacy skills, it would be unlikely for anyone to have sufficient time to do such a thing during the execution of the NSWT. Therefore, one could argue that both the complex and simple non-sense words (collections of letters) used have a greater affinity to geometrical shapes than words.
Also, the principal geometrical shapes used in the Initial Version (Vi) of the EST, were not common shapes in the majority of cases and therefore not likely to be in the geometrical experience of the individuals constituting the sample used.

Therefore, all three of the embedded 'tests', EST, SWT, and NSWT, each have a different or mixed modality of presentation, i.e. EST spatial, SWT verbal, and NSWT spatial/verbal, as well as presenting different types of task, in unfamiliar ways, to the testees. All of which enable the first and second research questions of the thesis to be addressed in a direct manner.

The presentation of the NSWT, Initial Version (Vi), was not the same as the Initial Version (Vi) of the SWT, in terms of the arrangement of the complex/simple test items/questions (collections of letters in each case), but was the same with regards to the general arrangement of all of the test items/questions on a single sheet, and the time allowed for completion.

Therefore, the comments made about the additional aspects of the presentation of the SWT Initial Version (Vi) in Section 7.7 of this chapter, also apply to the presentation of the NSWT Initial Version (Vi).

7.7. Comparison between the Sense Words Test (SWT) and the Non-Sense Words Test (NSWT)

Although the arrangement of the test items/questions and their associated complex and simple components were the same, in the final versions of both the Sense Words Test (SWT), and the Non-Sense Words Test (NSWT), as used in Studies 1,2,3 and 4; Chapters 10, 11, 12 and 13, respectively, of this thesis, there were differences in the Initial Versions of each ‘test’. Such differences were related to the arrangement of the complex word or collection of letters to the simple word or collection of letters, and the time allowed for the completion of each ‘test’.

In the Initial Version (Vi), of the SWT, the complex word was placed before the simple word with each test item/question. This arrangement was reversed in the subsequent version of the SWT, i.e. Second Version (Vii). The time allocated for the completion of the SWT was also different for its Initial Version when, compared with the Second Version (Vii), in terms of the time which was reduced from two minutes to one minute.

The NSWT, which has one version, the Initial Version (Vi) uses the same arrangement for the complex or larger collection of letters and the simple or smaller collection of letters, components of each test item/question, as does the second version of the SWT (Vii), and the time allocated for the completion of the NSWT is also the same.

Also, as already discussed in previous sections (7.5 and 7.6) of this chapter, there are several factors influential to both the SWT and the NSWT in relation to the outcomes likely to be achieved by the testees participating in each of these tests, in relation to a measure of field dependence – field independence.

7.8. Comparison between the Embedded Shapes Test (EST) and the Sense Words Test (SWT) and Non-Sense Words Test (NSWT) in terms of the General Factors and Specific Categories of Factors

Since many of the 'general and specific categories of factors' cited in Chapter 6, have evolved through the formulation and application of embedded figures or shapes types of test, they therefore, have a degree of affinity with them. When words or collections of letters are used instead of figures or shapes in embedded tests, some of these factors may not apply to the same extent, although it is likely that they will because of the characteristics in disembedding one entity from another, irrespective of what the entity might be.

Although there is a difference between the EST, SWT and NSWT, there is also a difference between the SWT and NSWT in terms of the entity to be disembedded, i.e. shapes from shapes, words from words, and letters from letters, respectively. However, it is because of the similarities in the disembedding activity that is shared by the EST, SWT and NSWT that many of the general and specific categories of factors are applicable to each of them.

7.9. Conclusion

As with embedded figures/shapes, all of which use a geometrical/spatial modality, the general factors and categories of specific factors applicable to the construction and application of such 'tests', are also relevant when the modality changes from that of geometrical/spatial to verbal and verbal/spatial. This is because the methodologies involved are measuring field dependence – field independence using essentially the same fundamental approach, i.e. the detection of something hidden in a given context.

Chapter 8

Additional Developments

8.1. Introduction

In this chapter the fundamental concept of field dependence – field independence is used as a pivotal component in a model that i) explores and extends the use of it via a verbal modality using text instead of words or collections of letters; ii) extends and gives a juxtaposition to it; and links it to a range of cognitive and psychological attributes.

8.2. Chronological Order Integration Test (COIT)

The Chronological Order Integration Test was formulated by Riding et al (1990) to explore the possibility of field dependence – field independence characteristics, being displayed by individuals in their manipulation and application of information through a written (text)/ verbal medium.

This 'test' consists of two different accounts of the life and work of a famous person. Each account contains different dates and facts about the person, and the combination of the two accounts gives a more detailed description of the person's life and work. The two accounts 'mesh' chronologically. The two different accounts are read out to the 'testees' on separate occasions there being a period of one or two days in between, and after a further similar period of time, the 'testees' are requested to write down as much as they can remember from the two accounts, in whatever order they think is appropriate

Using the COIT to measure field dependence – field independence is done by counting the number of facts written down from the first passage (A), the second passage (B), and the number of times a switch (S) has taken place from passage (A) to passage (B). The greater the number of facts written down from passage (A) compared to (B) or vice versa, the less the number of possible switches(S) from passage (A) to passage (B).

Therefore, a number of stated facts from passage (A) and/or passage (B) where one set of facts follows another, with little or no chronological integration i.e. few or no switches (S) or alternations between the two passages, gives an indication of field dependency. Whereas, a number of stated facts from passage (A) and passage (B) which are arranged chronologically and therefore integrated, indicating that a number of switches (S) or alternations between the two passages have taken place, gives an indication of field independency.

Also, the greater the number of stated facts from passage (A)and/or passage(B) either separated or integrated can be equated to an individual's position on the field dependent – field independent bi-polar continuum, i.e. a designation of field dependency or field independency, respectively. Many stated facts from passage (A) followed by many stated facts from passage (B), that are not chronological integration, gives high field dependency; and many stated facts from passage (A) and passage (B), that are chronologically integrated, gives high field independency.

Each passage and both passages together, can be considered to be equivalent to a complex shape or figure in EST or GEFT terms, giving the account of the person's life and work, i.e. in each or both passages; and the individual facts within each account can represent or be equivalent to a simple shape or figure.

The above methodology/description can be illustrated diagrammatically as follows:-

Table 8.1. Sequence of Statements from Passages A and B in Relation to Field Dependence/Dependency and Field Independence/Independency.

Field Dependence/Dependency

A 1 3 5 B 2 4 6

Field Independence/Independency

1	2	3	4	5	6
A	B	A	B	A	B

Therefore, the level of field dependence – field independence (and therefore an individual's designation on the field dependence – field independence bi-polar continuum) is considered to be proportional to the number of facts and their chronological integration from the two passages, particularly the degree of chronological integration.

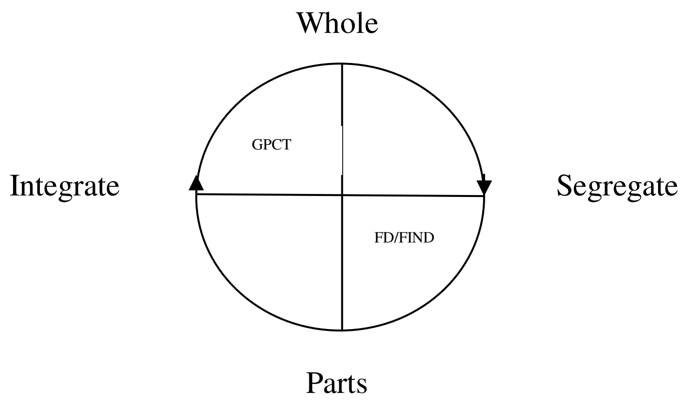
8.3. Perceptual Integrate and Segregate Model (Pearson, 2009)

In an attempt to explain the perceptual/cognitive processes involved in completing Street's Gestalt Completion Test (1935) (see Chapter 12, Study 3 for a description) and Witkin's Group Embedded Figures Test (1971)/Pearson's Embedded Shapes Test (2008) (unpublished), the Perceptual Integrate and Segregate Model was formulated. This is also related to the Wholistic – Analytic cognitive style dimension (Riding and Cheema, 1991), in terms of the process(es) considered to be involved, i.e. thinking in 'wholes' or 'parts.'

Within the Perceptual Integrate and Segregate Model, the two figures 8.1 and 8.2 represent two broad aspects of the overall model. The first part,(see Figure 8.1), depicts the ability of an individual to integrate or segregate pieces of information in relation to specific contexts of both a cognitive and social nature; and the second part, (see Figure 8.2), depicts the placement of an individual on a duple bi-polar dimension, half of which is cognitive and half of which is social.

Therefore, the above two aspects, show a process followed by an interaction and placement on both a cognitive and social dimension, each with a continuum. The perceptual integrate and segregate model incorporates several aspects of Gestalt Psychology together with those of field dependence – field independence to give a comprehensive description and designation of cognitive functioning/information processing applied to both cognitive and social contexts.

Figure 8.1. Diagrammatic representation of the principle components of the model - including the direction of movement within the overall process.



The objective of the Gestalt Picture Completion Test is to link or 'close' a series of parts of a picture, and in doing so, recognise the picture. The process involved here, is a synthesis or putting together of the information or parts given, to forms, followed by a recognition of the picture (really an object or person). However, more needs to be included with the information or parts given before the picture can be completed and then recognised. This additional information, or way of perceiving the information given, is described by the process of 'closure'.

The principle of 'closure' is derived from Gestalt Psychology and can be defined as:-

'- a tendency to perceive an incomplete figure as the complete figure of which it appears to be a part.' (Weintraub and Walker, 1966, p 13)

A further element in the explanation of the process involved in the completion of the tasks of the Gestalt Picture Completion Test, is that of 'figure - ground' or 'ground – figure', which again, is derived from Gestalt Psychology.

'Distinctions between figure and ground were stated explicitly by Edgar Rubin (1921; English translation, 1958), who listed seven differences between figure and ground:

1) When two fields have a common border, it is the figure which seems to have shape while the ground does not.
2) The ground seems to extend behind the figure.
3) The figure appears to be object-like (even though it may be an abstract shape) while the ground does not.
4) The colour of the figure seems more substantial and solid than the ground.
5) The ground tends to be perceived as farther away and the figure nearer the observer even though both are obviously at the same distance.
6) The figure is more dominant and impressive and tends to be remembered more easily.
7) The common border between figure and ground is called a contour and the contour appears to be a property of figures.' (Weintraub and Walker, 1966, p11)

An example that illustrates the above properties of figure-ground is the reversible figure(s) of a vase/side view of two human faces.

Therefore, in the Gestalt Picture Completion Test, the individual has to separate figure from ground, or ground from figure (the colour, black or white, of the figure/ground is reversed for some 'pictures'), while arguably, simultaneously achieving closure for the figure and therefore, recognising the figure.

Another way of viewing the above process in relation to the completion of the Gestalt Picture Completion Test is to regard the information given as being in need of integration, i.e. amalgamating or pulling together the parts to form a whole figure or object. This suggested alternative process can be linked to the holistic cognitive behaviour of the holistic – analytic style dimension (Riding, 1991), i.e. perceiving the whole instead of parts even though the parts are separated (in the Gestalt Picture Completion Test, tasks). However, the question of 'How many separate parts does there need to be before 'closure' or a 'whole' can be achieved or seen?' remains an open one.

Hidden (Gottschaldt, 1926) or embedded figures (in relation to field dependence – field independence) have their origins in Gestalt Psychology. A further basic law of perceptual organisation, as advocated by Gestalt Psychology, is the ‘law of Pragnanz’, which translates to ‘good configuration’ or ‘good figure’.

‘The idea is that the perceiver will organise his (or her) perception of the environment (or problem to be solved) so that the environment (problem) appears as simple and or orderly as possible – (this law) is assumed to be an innate characteristic of the perception and the brain process associated with the perceptual experience. –‘good’ figures are assumed to have the properties of simplicity, symmetry, balance, and ease of being remembered’
(Weintraub and Walker, 1966, p12)

Gottschaldt (1920) argued that a simple figure e.g. a hexagon, hidden or embedded in a more complex figure, i.e. a figure with several lines surrounding or crossing the hexagon, thus making it difficult to be perceived as a separate figure from the overall figure, is a consequence of a ‘good fit’ (the hexagon itself when perceived) and figure – ground (the hexagon is the (simple) figure forming ground (complex figure) and the lines surrounding the hexagon, and therefore followed the Gestalt laws of perceptual organisation. Also, that since a common figure like a hexagon could not be recognised when embedded in a more complex figure, familiarity with a hexagon in a variety of sizes and applications, would not help many individuals to locate it. Therefore, the ability to locate it would depend on innate skill and not practice. Although a hexagon may be familiar by itself, when it is hidden or embedded by several lines and different angles, it becomes less familiar or not familiar at all and therefore, more difficult to see.

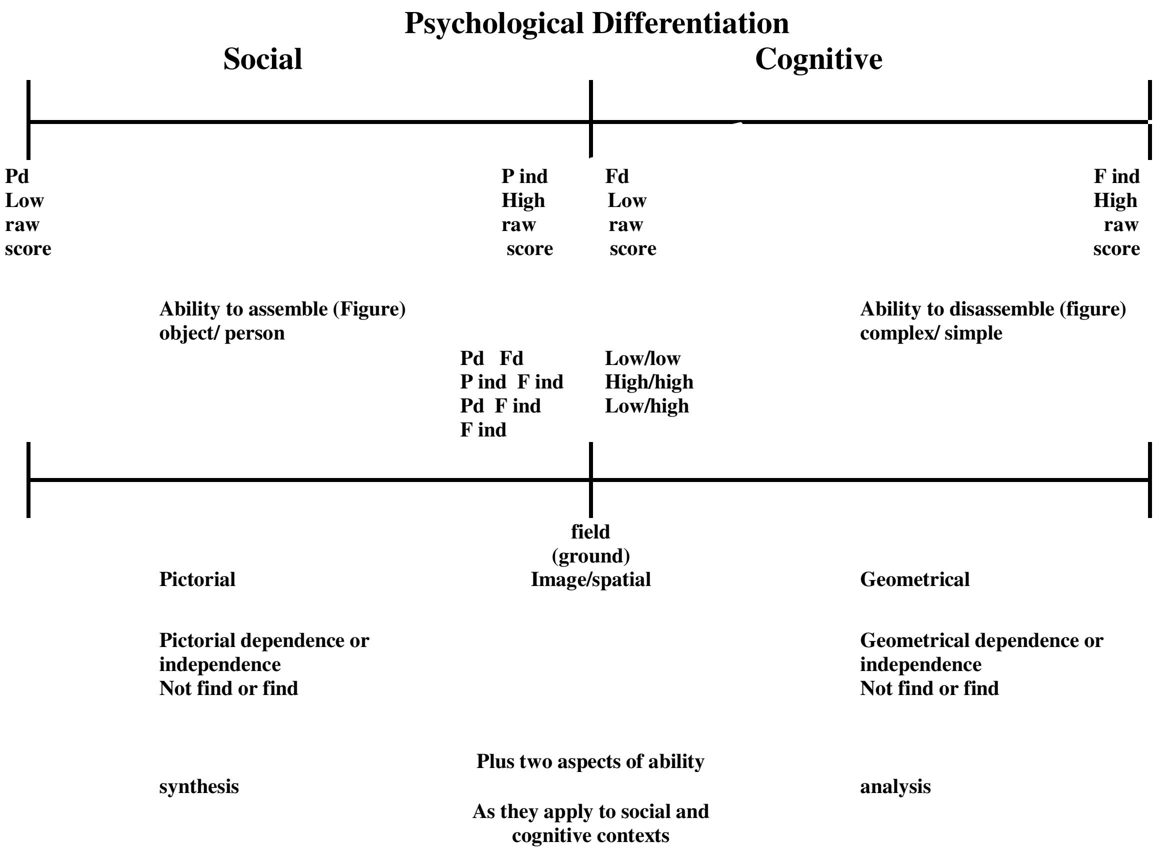
The above view supports Witkin et al (1962) view that the ability or otherwise to perceive simple figures hidden or embedded in complex figures is a reflection of perceptual ability and individual differences. This position is further strengthened by the correlations obtained by Witkin et al (1962) between the outcomes obtained from the Rod and Flame, and Chair and Room studies, when compared to outcomes from the Embedded Figures Test.

Therefore, the Perceptual Integrate and Segregate Model is advocating two basic forms of processing information, an integrate – synthesis approach/process and segregated – analytic approach/process. Not only does this formulation encompass a number of established cognitive styles in the literature, e.g. Holist – Serialist and Leveller – Sharpener and the cognitive style family associated with the fundamental cognitive style dimension of Wholist – Analytic (Riding, 1991), it also includes aspects of perceptual organisation. All of which, arguably, give some insight into the detailed explanation of the perceptual and cognitive mechanisms involved in the overall process of perceiving and comprehending information

(Also, it is only when a given piece of information has been understood, i.e. in its own right and in relation to other pieces of information that it can be encoded in both short and long term memory, applied, generalised as necessary to other situations, and provide links made with other sources of information).

This model also provides a continuum from a process of integration, synthesis and assembly or putting together of pieces of information, to a process of segregation, analysis and disassembly or taking apart of pieces of information. With regards to an individual's ability and its relationship to their position on the above continuum, and the relationship between the two extremes of the continuum (as well as social and cognitive aspects of field dependence – field independence in terms of 'psychological differentiation', is illustrated by Figure 8.2.

Figure 8.2 Extended Dimension/An extension of field dependence – field independence (duple bi-polar dimension)



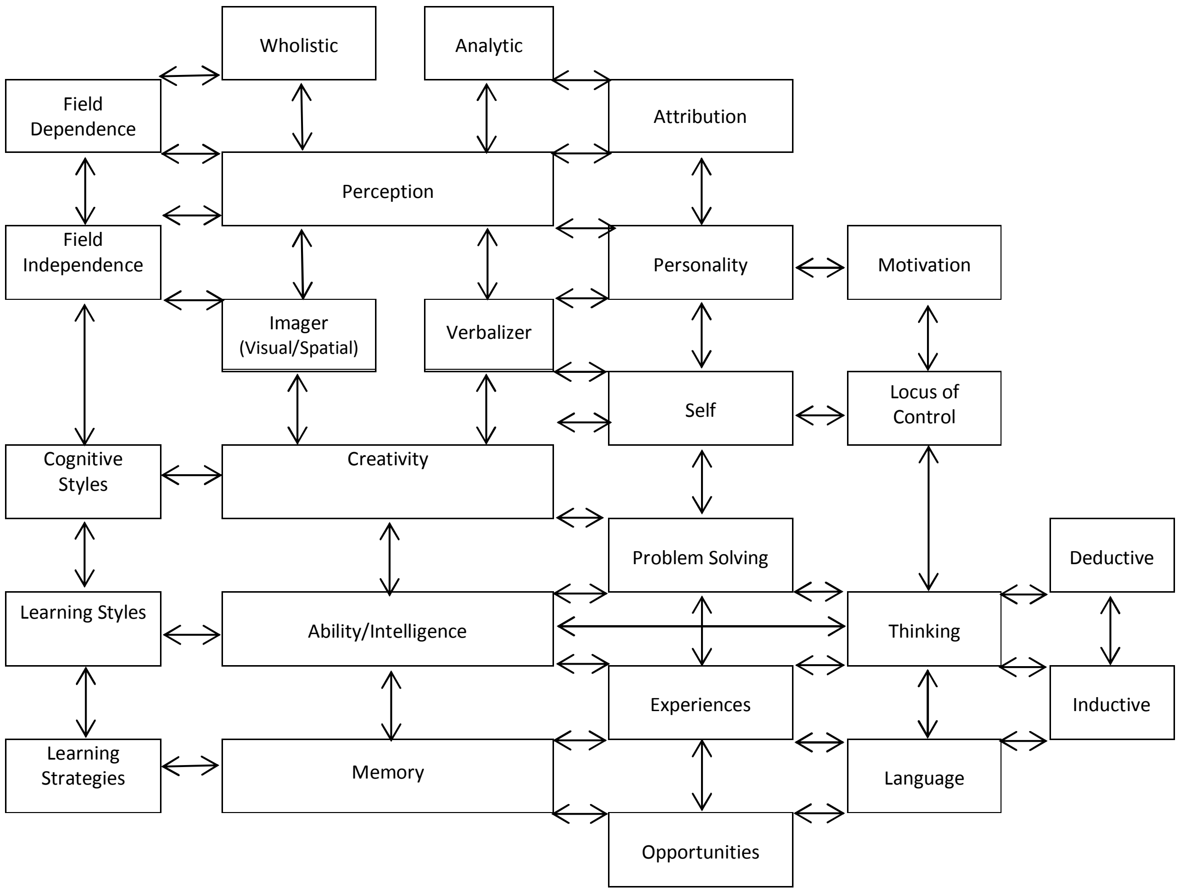
This suggests the processes and outcomes from the Gestalt Picture Completion Test in relation to the ability or skill to integrate discrete pieces of information into a unified whole; and from the Embedded Figures Test or Group Embedded Figures Test (or the Embedded Shapes Test) in relation to the ability or skill to segregate or separate a discrete piece of information from a configuration, are both complimentary and independent, i.e. complimentary in the beginning of the processes involved, and independent in the final outcome.

Therefore, this model allows whatever propensity an individual may have for either end of its continuum but it also allows an individual to move from one end to the other depending on the problem/task, i.e. the problem/task dictates unlike other (duple) bi-polar constructs, whether the nature of the problem/task relates or does not relate to a particular end of the construct.

8.4 Comprehensive model of the interaction of factors applicable to the learning situation (Pearson, 2005)

This model places field dependence – field independence at the starting point of the cognitive process, once initiated by a cognitive control, that is applicable to any learning/problem solving situation, whether of a social (interaction between individuals) or academic (abstract thinking) nature. This is shown diagrammatically as follows in Figure 8.3.

Figure 8.3 Interaction of factors applicable to the learning situation



All of the components (boxes) in the above model are linked by interactions in either direction, i.e. horizontally and vertically, forming a network.
The arrangement of the components of Figure 8.3 is an attempt to indicate the different psychological attributes, cognitive and non-cognitive, inherent in any human thinking and/or decision making process. Each component (or box) represents a single psychological attribute, cognitive or non-cognitive, or a collection of psychological attributes, either cognitive or non-cognitive, or models, e.g. personality. Therefore, this model is an attempt to produce a unified model of human psychology, in terms of a range of components, some of which incorporate models in their own right, e.g. CSA, and clusters of factors (See Figure 8.4), and the possible interactions between them.

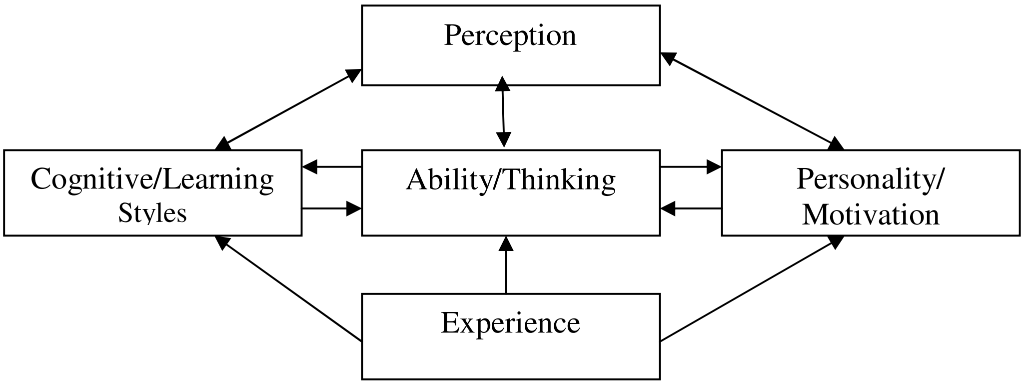
However, the absolute starting point for any comprehensive model of learning/problem solving is a consideration of the psychological and neurological state of the brain of the individual involved in the learning/problem solving process. Such considerations include static and dynamic aspects. Static in terms of the initial conditions of the brain, i.e. physical in terms of its overall size and weight, proportion (size) of the different structures to each other, the efficiency of chemical transmission from one synapse to another, and the encoding of information; and dynamic in terms of the development and organisation of neuron clusters and neuron networks, in association with the reorganisation of neuron networks, as more learning experiences take place and a greater knowledge (information) base is established (long term memory).

Because this model encompasses a number of cognitive, personality and within-person issues, i.e. self-concept and locus of control, the major components of certain learning styles, e.g. Kolb; and Honey and Mumford can be mapped onto the model, i.e. Accommodator, Diverger, Converger, Assimilator/Activist, Reflector, Pragmatist, Theorist, respectively. Not all of the components will be used in every learning/problem solving situation by every individual. Therefore, the model does not show a series of lines joining each component. However, the model does advocate that the starting point will be with cognitive control (given that physiological and neurological factors are 'normal') followed by a field dependence or field independence orientation, to whatever characteristics a learning situation or problem solving activity might have.

Also, some factors would contain a number of sub-factors, e.g. cognitive and learning styles; personality; and thinking combinations.

With regards to the Wholistic – Analytic and Imager – Verbalizer cognitive style dimensions, these indicate a particular approach (whole or parts) and modality (Imager (visual/spatial) or Verbalizer), respectively, as well as position and level on each of the two independent continua, i.e. W-A and I-V, in relation to one of nine combinations (Cognitive Styles Analysis (CSA), Riding, 1991, 2000), in terms of a W – A and I – V score, for an individual.
Also, the model (Figure 8.3) can be viewed in terms of several clusters, each relating to a broad aspect of cognitive behaviour, as Figure 8.4 illustrates.

Figure 8.4 Interaction of clusters of factors relating to cognitive behaviour.



It can be seen from Figure 8.4 that the major components of perception, cognitive/ learning styles, ability/thinking, and personality/motivation are interrelated; with experience interacting in one direction only but directly with cognitive/learning styles, ability/thinking and personality/motivation; and indirectly with perception, i.e. through ability/thinking primarily.

An example of a pathway through the model, Figure 8.3, linking a number of components of the model, could be as shown in Figure 8.4 starting with field dependence – field independence (as the cognitive style focus), moving on to perception, ability/thinking and experience, and ending with personality/motivation.

The above considerations pose a number of fundamental questions in terms of i) Is a style of learning innate or can it become modified with learning and educational experience? and ii) Is a style of learning a combination of innate, experiential and environmental factors? Whatever the answers to these questions might be, it is very likely that psychological and neurological factors would have to be taken into account to provide adequate answers.

In addition, the above two questions could be directed to intelligence, however it may be measured, whether in terms of fluid (analytical) intelligence, although there is evidence of an increase in fluid intelligence as a consequence of learning/educational experience.

8.5. Conclusion

The use of the Chronological Order Integration Test (COIT) to investigate the measure of field dependence – field independence within a verbal modality through text could possibly provide insights into the sequencing of information, memory and comprehension skills, in addition to providing a further measurement of field dependence – field independence in relation to a different context.

Perceptual Integrate and Segregate Model is an attempt to formulate and investigate what appears to be the opposite of the basic concept of field dependence – field independence, which could potentially enable a greater understanding of the mechanisms inherent in field dependence – field independence in terms of why many individuals are designated to one or other of the poles of its continuum.

'The comprehensive model of the interaction of factors applicable to the learning situation' (Pearson, 2005), places field dependence – field independence, linked to a Wholistic and/or Analytic approach, and a Verbal and/or Imager (Spatial) modality (Riding, 1991 and 2000), at its centre, because it gives a perceptual (field dependence – field independence)/ (Wholistic and/or Analytic) approach as well as a modality (Verbal and/or Imager (Spatial)), as the starting point of any learning process, irrespective of ability/intelligence. These elements of the model form bonds with other cognitive and psychological attributes of the learner as well as learning experience, to suggest a unified and comprehensive model of the learning process in any context.

Chapter 9

Pilot Studies One and Two

9.1 Pilot Study One

9.1.1. Introduction

Pilot Study One was concerned with the use of the Embedded Shapes Test in its initial form, Version One (EST1), to measure field dependence – field independence in relation to Research Question 1:-

> *Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?*

The purpose of Pilot Study One, therefore, was to investigate how a relatively small sample of testees would respond to the Embedded Shapes Test, Version One (EST1), in relation to the test items/questions presented and the general administration of the 'test'.

9.1.2. Method

i) Sample

The sample consisted of twenty-seven Year Eight students, males and females, from an Inner City Comprehensive School.
Selection of the students for the sample was governed by timetabling convenience of the school, and consisted of a mixed ability group.

ii) Materials

Embedded Shapes Test, Version One (EST1), consisting of a Worked Examples Section (A), Practice Section (B), and Response Section (C), all in one booklet of A5 size. The worked examples and the test items/questions in the respective sections were four, four, and thirty-two.
Each testee was supplied with an HB pencil and a pencil eraser.

iii) Procedure

The sample was divided into two sub-samples of thirteen and fourteen, each sub-sample being 'tested' separately, one after the other.
Each sub-sample had approximately the same number of males and females.
There was no attempt to separate males from females.

With each sub-sample the seating positions of the testees were arranged in a normal sized classroom in such a manner so as to maximise the space between each testee.

Each testee was given an HB pencil and a pencil eraser before the test booklets were given out.

After the test booklets were given out, by the administrator, the testees were asked to complete the personal details on the front of the test booklet.

Next, the administrator asked the testees to read through the instructions at the beginning of the test booklet and to look at the Worked Examples Section (A).

Also, the testees were requested not to look at any part of the test booklet beyond the Worked Examples Section (A) until told to do so.

Once all of the testees had read through the instructions and looked at the Worked Examples Section (A), the administrator read through the instructions aloud to the testees, and 'worked through' each of the Worked Examples, Section (A), with the testees to ensure that all of them understood what they were being asked to do.

The administrator drew the attention of the testees to the point made in the instructions referring to there being no need to use instruments to draw around the simple shapes.

The administrator then emphasised the need for accuracy when drawing around the simple shape within the complex shape, that it was possible to erase an attempt that was considered to be incorrect, and that in the event of a pencil breaking, a new pencil could be obtained from the administrator on request.

The attention of the testees was also drawn to the fact that with the Embedded Shapes Test, like any other 'test', it was important to observe standard test/ examination procedures.

The next stage was to allow the testees to work through the Practice Section (B).

Before this commenced, the time allocated for the completion of the Practice Section (B) was referred to by the administrator and the suggestion made to the testees that they need not be overly concerned about the time.

The testees were then told to turn to the Practice Section (B), and to read the brief instructions which included the time allocated on its title page.

The time and number of tasks contained in the Practice Section (B) was referred to by the administrator.

Once this was done the testees were told that if they had finished the practice test items/questions before the allocated time had been reached, they were not to start the next section but to wait for further instructions.

The Practice Section (B) was then started, timed and stopped once the time allocated for it had elapsed.

Before, moving on to the final section, Response Section (C), the administrator ensured, by asking everyone and checking some test booklets, that all of the testees in the sub-sample, had followed the instructions correctly. If anyone had not followed the instructions correctly, the administrator repeated the procedures to the individual concerned. Once this had been done, the testees were instructed to turn to the title page of the Response Section (C) and to read the instructions. It was emphasised to the testees that there was no time limit for this section. Also, the administrator told the testees that there were thirty-two test items/questions in the Response Section (C), which was not mentioned in the instructions, and requested the testees to attempt as many as they could.

In addition to the above instructions and information related to the Response Section (C), the testees were asked to record the time (minutes and seconds) that they had taken to complete the Response Section (C), on the front of their test booklet in the space provided.

The time was measured either by the testees themselves or by the administrator. In the case of the administrator, this was done by an individual testee telling the administrator when they had finished the Response Section (C) and the administrator then computing how much time the candidate had taken, since the administrator knew the time at which work on the Response Section (C) had started by the sub-sample(s).

Each testee was requested to remain in their place after they had completed as many test items/questions as they could in the Response Section (C), within the time allocated, until their test booklets had been collected by the administrator.

As each testee completed the Response Section (C) the administrator collected the test booklet, checking that the personal information and the time taken to complete the Response Section (C) had been entered on the title page of the test booklet.

9.1.3. Results and Analysis

9.1.3. i) Results

All of the testees appeared to have understood what they were being asked to do with regard to the completion of the test items/questions, in both Practice (B) and Response (C) Sections, presented in the Embedded Shapes Test, Version One (EST1).

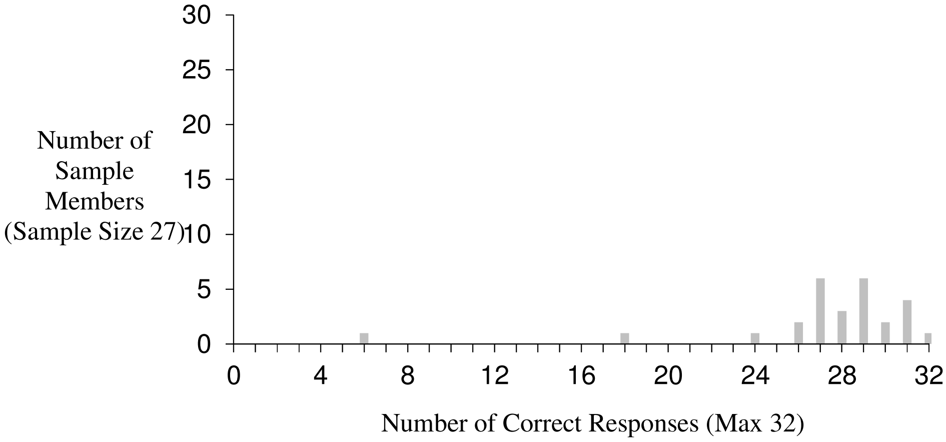
The majority of the testees in the overall sample were able to obtain a correct solution to all four test items/questions in the Practice Section (B), and most of the test items/questions in the Response Section (C) of the EST1. However, these results appear to have been influenced by the amount of time allowed for the completion of each section. This was particularly so with the Response Section (C), in spite of it having a wider range of test items/questions in terms of complexity and difficulty, with the majority of the testees scoring between 24 and 31 (see Figure 9.1). The time required to complete the Response Section (C) ranged from twelve minutes forty seconds to twenty-five minutes thirty seconds, for the overall sample within this Pilot Study (One).

There was some variation in age within the overall sample, which amounted to several months, but all of the subjects were in the same 'Year' at school. The ages of the overall sample ranged from twelve years three months to thirteen years five months.
In terms of a difference in the range of raw scores between the male and female testees of the overall sample, only minor differences were obtained.

9.1.3. ii) Analysis

No statistical procedures were performed on the data obtained from the administration of the EST1, within Pilot Study One, except for it to be arranged as a frequency distribution of the number of correct responses from the Response Section (C) for each testee within the overall sample. This is shown in Figure 9.1.

Figure 9.1 Frequency Distribution of Correct Responses from Response Section (C) (raw scores) from Embedded Shapes Test (EST1) - Pilot 1



9.1.4. Discussion and Conclusion

9.1.4. i) Discussion

The provision of having written instructions applicable to EST1 in general and to each of its three sections, and the administrator addressing the instructions collectively with the testees as the EST1 was being 'worked through', section by section, appears to have been successful in enabling the majority of the testees to understand what they had to do and how they had to do it.

With most testees the general quality and accuracy of the drawing around the simple shape within the complex shape was good, i.e. following the outline of the simple shape by drawing on top of it or next to it either inside or outside of the shape.

In spite of this, a few testees tended not to draw on or close to the simple shape within the complex shape, but to draw or imitate the simple shape some way from it, i.e. several millimetres on the outside of the boundary of the simple shape. If this style of completing the embedded shapes tasks was not done accurately, i.e. following the contour of the simple shape, it was difficult to be sure if the testee had genuinely located or disembedded the simple shape within the complex shape, and consequently whether or not to award a point for those test items/questions completed in this manner. However, when it was clear that an embedded test item/question had been successfully completed in spite of this way of responding, a point was awarded to the testee.

The overall size of the test booklet and its general arrangement, i.e. the personal information, instructions, and test items/questions and their related sections (Worked Examples (A), Practice (B) and Response (C)) appeared to present no major difficulties for the testees.
As can be seen from Figure 9.1, many testees achieved a high number of correct solutions in Response Section (C) (This was also the case in Practice Section (B) but the correct solutions from Practice Section (B) are not included in Figure 9.1). Therefore, the ability of the EST1 to differentiate between a field dependent or a field independent designation in its present form is, in all probability, not very high.

To overcome this situation the EST1 needs to be modified in some way. This could be done in a variety of ways which might include i) different complex and simple shapes, ii) an increase in the level of difficulty of the test items/questions (i.e. the complex and simple shapes used), iii) more test items/questions to be done in a set time or iv) impose a time limit for the completion of Response Section (C).

Since the form and sequence of the complex shapes had been established using a number of criteria (as described in Chapter 6), the simplest modification to use would be that of a time limit for Response Section (C) and possibly a reduced time limit for the Practice Section (B).

After consideration of the experiences gained so far in using the EST1, the researcher decided at this stage in the development of the EST1 to maintain the present time limit for the Practice Section (B) but to impose a time limit for the completion of the Response Section (C).
The reasons why the time limit was unchanged for the Practice Section (B) was i) it enabled the testees to have enough time to carefully think through what they were doing and how they were asked to do it, since they were attempting embedded test items/questions for the first time (i.e. after the Worked Examples Section (A)), and ii) there are very few test items/questions in the Practice Section (B) compared with the Response Section (C) (even if the outcomes were to be included with those of the Response Section (C) in the measurement of a field dependence or a field independence designation for each testee, which they were not).

9.1.4. ii) Conclusion

The present format of the EST1 appears to have an acceptable level of construct validity with regards to the measurement of field dependence – field independence.
With regards to a time limit for the completion of the Response Section (C), twelve minutes will be allocated. The origin of which was a time approximated to the lowest time taken in relation to the maximum number of correct responses i.e., thirty-one out of thirty-two, achieved by one of the testees in the overall sample for this Pilot Study (One).
The average time for the completion of the Response Section (C) by the overall sample was approximately nineteen minutes.
The inclusion of a time limit for the completion of the Response Section (C), should produce an increase in difficulty for the completion of it, i.e. the number of correct responses obtained within the time limit, and thus, give an increase in accuracy of either a field dependent or field independent designation for each of the testees.
Therefore, the EST1 will be unchanged, except for a twelve-minute time limit for the completion of the Response Section (C), when it is used in Pilot Study Two. However, this change will produce a new version of EST1, i.e. Embedded Shapes Test, Version Two (EST2).
The sample for Pilot Study Two will be similar, i.e. age, ability and number of testees, to that used in Pilot Study One.

9.2. Pilot Two

9.2.1. Introduction

Pilot Study Two is concerned with the application of Embedded Shapes Test, Version Two (EST2), resulting from a modification of a time limit being placed on the Response Section (C), which was absent from Embedded Shapes Test, Version One (EST1), for the measurement of field dependence – field independence.

This relates to research question 1:-

> *Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?*

Also, the Sense Words Test, Version One (SWT1), the initial version of this test, was used in parallel with EST2 in terms of exploring the measurement of field dependence – field independence using a different approach/modality, i.e. the use of words instead of shapes.
This relates to Research Question 2:-

Is it possible to measure field dependence – field independence using a verbal modality?

Therefore, the purpose of Pilot Study Two, like the previous Pilot Study One, was to investigate how a further relatively small sample of testees would respond to the modified Embedded Shapes Test (EST2), i.e. the Response Section having a time limit.
Also, a further purpose of Pilot Study Two was to investigate how a relatively small sample of testees would respond to the Sense Words Test, Version One (SWT1), in relation to the test items/questions presented and the general administration of the 'test'.

9.2.2. Method

i) Sample

The sample for Pilot Study Two, which was different to that of Pilot Study One, consisted of twenty-two Year Eight students, males and females, from an Inner City Comprehensive School, (the same school from which the sample for Pilot Study One were taken).
Selection of the students for the sample was governed (as with Pilot Study One) by timetabling convenience of the school, and consisted of a mixed ability group.

ii) Materials

a) Embedded Shapes Test, Version Two (timed) (EST2), consisted of a Worked Examples (A), Practice (B), and Response (C) Sections, all in one booklet of A5 size. The number of examples and test items/questions in the respective sections were four, four and thirty-two. The instructions at the beginning of the test booklet and the title page of the Response Section (C) were modified to state the time allowed for the completion of Response Section (C).
b) Sense Word Test, Version One (SWT1), consisted of a worked example and fifty test items/questions, presented on one page of A4 size.
Each testee was supplied with an HB pencil and a pencil eraser.

iii) Procedure

General Comments

The sample was divided into two sub-samples of eleven, each sub-sample being 'tested' separately, one after the other.
Each sub-sample had approximately the same number of males and females.
There was no attempt to separate males from females.

With each sub-sample the seating positions of the testees were arranged in a normal sized classroom in such a manner so as to maximise the space between each testee.

Although, there were two 'tests' used in Pilot Study Two, they were each given out and 'worked through' separately.

Each testee was given an HB pencil and a pencil eraser before the first 'test' was given out.

The attention of the testees was drawn to the fact that with the Embedded Shapes Test, Version Two (EST2) and the Sense Word Test, Version One (SWT1), like any other 'test', it was important to observe standard test/examination procedures.

a) Embedded Shapes Test, Version Two (timed) (EST2)

The detailed procedure used for the administration of the EST2 was the same as that for EST1 as described in Pilot Study One except for difference in the time allowed for the completion of the Response Section (C).

With regard to the above difference, when the Response Section (C) of the EST2 was reached in Pilot Study Two, the administrator informed the testees that they would be allowed twelve minutes to attempt all of the test items/questions in the section.

Therefore, the administrator started and stopped the time allowed for the Response Section (C), monitoring the time throughout.

Before starting the Response Section (C), the testees were told to remain quiet and stay in their places if they were to finish the Response Section (C) before the time allowed for it had elapsed.

When the allocated time for the Response Section (C) had elapsed, the test booklets from each of the testees (per sub-sample) were collected in by the administrator, who at this time checked that the personal information had been provided by each testee on the front of the test booklet.

b) Sense Words Test, Version One (SWT1)

After the collection of the EST2 test booklets, the administrator explained to the testees that they were now going to 'work through' another activity which had some similarities to the last one.

When this had been done, the SWT1 test paper was given out, placed 'face down', by the administrator, and the testees asked not to 'turn over' until told to do so.

Once all of the testees had been given the SWT1 test paper, they were told to turn them over, complete the personal information items, and then listen to the explanation of what they were going to do.

The administrator then explained to the testees what they were to do and how they were to do it, referring to the worked example.

When the administrator was assured that all of the testees understood what they were to do and how they were to do it, the testees were referred to the test items/questions that constituted the SWT1, and told that they were to be allowed two minutes to complete all, or as many as possible, of the fifty test items/questions.

Before starting the SWT1, the administrator emphasised to the testees the importance of drawing around the simple or embedded word accurately so as to give a clear indication that the simple word had been located in the complex word.

Also, the testees were told to remain quiet and stay in their places if they had finished all of the fifty test items/questions before the time allowed for their completion had elapsed.

The administrator started and stopped the time allowed for the SWT1, monitoring the time throughout.

When the time had elapsed the administrator told the testees that were still working to stop.

The SWT1 test sheets were then collected by the administrator, who checked that the personal information was complete for each testee.

9.2.3. Results and Analysis

9.2.3. i) Results

a) Embedded Shapes Test, Version Two (timed) (EST2)

The general response of the testees of the overall sample to the EST2 in this Pilot Study (Two) was similar to that in Pilot Study One with EST1, in terms of the general understanding and subsequent completion of the test items/questions presented.

However, the limited time period for the completion of the Response Section (C) was influential in relation to the range of outcomes achieved by the testees. This resulted in the production of a number of raw scores that were lower in general and spread out across most of the range of scores achieved, i.e. 7 to 27, (See Figure 9.2, Section 9.2.3. ii) Analysis) than those obtained for the same section of the EST1 by the testees of the overall sample used for Pilot Study One.

This is not surprising when one considers the narrow range of raw scores produced and the length of time taken to complete the Response Section (C) of the EST1, and the number of correct responses achieved, by the testees of Pilot Study One; and that the testees of the overall sample used for Pilot Study One were very similar in age, ability and educational background to the testees of the overall sample used for Pilot Study Two.
In terms of difference in raw scores between the male and female testees of the overall sample, only minor differences were obtained.
Therefore, sex differences in relation to the raw scores produced from EST2 by the sample of Pilot Study Two, when compared with Pilot Study One, are approximately the same.

b) Sense Words Test (Version One) (SWT1)

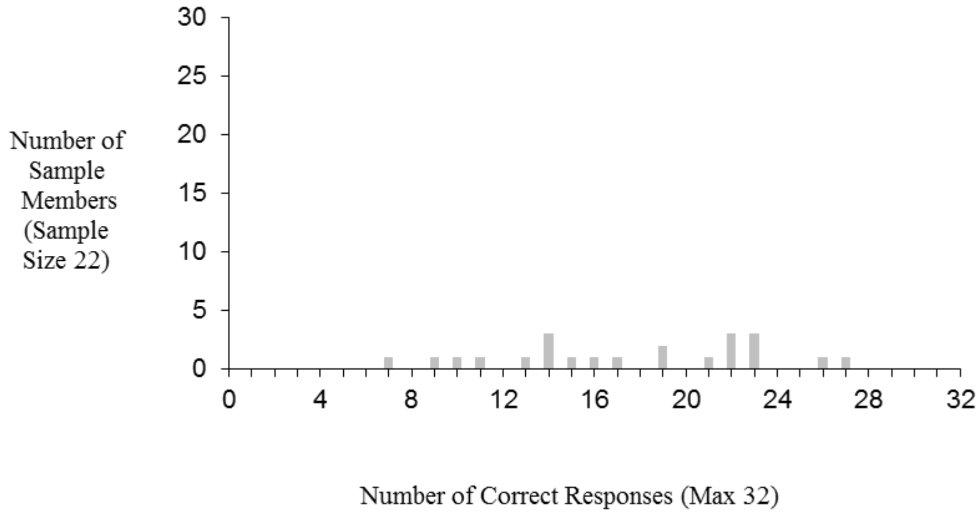
The majority of the testees appeared to have understood what they were being asked to do with regard to the completion of the test items/questions that formed the SWT1.
Many of the testees in the overall sample were able to attempt all or the majority of the test items/questions, obtaining a high number of correct responses.
The above results appear to have been influenced by the two factors of i) the time allowed for the overall completion of the test, and ii) the arrangement or positioning of the complex word to the simple word, i.e. the complex word was placed before the simple word. This suggests that there was too much time allowed, and by placing the complex word before the simple word, the locating or disembedding of the simple word within the complex word, appeared to have been made easier.
The range of the raw scores for the overall sample was from 9 to 50. There were some differences between the males and females of the overall sample for the SWT1 in terms of the raw scores, in that several of the female testees obtained a maximum score whereas none of the males achieved this.

9.2.3. ii) Analysis

a) Embedded Shapes Test, Version Two (EST2)

No statistical procedures were performed on the data obtained from the administration of the EST2, within Pilot Study Two, except for it to be arranged as a frequency distribution of the number of correct responses from the Response Section (C) for each testee within the overall sample. This is shown in Figure 9.2.

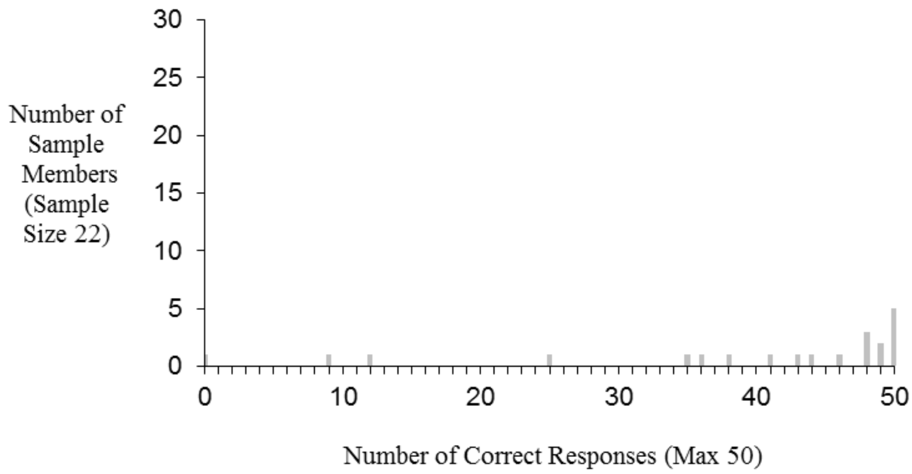
Figure 9.2 Frequency Distribution of Correct Responses from Response Section (C) (raw scores) from Embedded Shapes Test (EST2) - Pilot 2



b) Sense Word Test, Version One (SWT1)

As with EST2, within Pilot Study Two, no statistical procedures were performed on the data obtained for SWT1, except for it to be arranged as a frequency distribution of the number of correct responses achieved by each testee within the overall sample. (Shown in Figure 9.3)

Figure 9.3 Frequency Distribution of Correct responses from Sense Word Test (SWT1) - Pilot 2



Although the frequency distribution of the raw scores in Figure 9.3 is somewhat spread and skewed towards the maximum score possible, none of the scores can be considered to be ‘outliers’, because each score represents a field dependent – field independent designation. This situation also applies to Pilot 1(Figure 9.1, Section 9.1.3. ii) Analysis).

9.2.4. Discussion and Conclusion

9.2.4. i) Discussion

a)Embedded Shapes Test, Version Two (timed) (EST2)

The inclusion of a time limit for the Response Section (C) of the EST2 for Pilot Study Two, had an impact on the overall success rate of the testees in relation to the numbers of test items/questions attempted and in some cases the number of correct responses, i.e. correctly located or disembedded shapes.

The general quality and accuracy of the drawing around the simple shape within the complex shape did not appear to be substantially different from the quality and accuracy obtained by the testees of the overall sample used for Pilot Study One. Also, the number of testees who did not draw on or close to the simple shape but imitated its contours some several millimetres from it, within the complex shape, did not increase, in spite of the time factor. The numbers of testees using such a method were very small and approximately the same number for the two pilot studies, and the same scoring criteria, as described in this section of Pilot Study One, was used.

Since the inclusion of a time limit has made the location of a simple shape within a complex shape more difficult, (based on the raw score data from the two pilot studies), the reliability of the EST2 and the sensitivity of it is likely to have increased, enabling the measurement of field dependence – field independence to a finer degree in terms of allocating testees on the field dependence – field independence continuum. Therefore, the apparent importance of a time factor in attempting to formulate a way of measuring field dependence – field independence, suggests that it should be introduced to aid in the measurement of the immediate response of a testee to a given perceptual context, or field, in relation to a disembedding task, which in turn relates to the overall ability of the testee to do so, i.e. the extent to which a testee can or cannot disembed a given simple shape from a complex shape. In terms of the EST2, this would strongly suggest that not only Response Section (C) but also Practice Section (B), to give it more credibility within the overall test, would both require a time limit for their completion.

Since the Response Section (C) has thirty-two test items/questions and was allocated twelve minutes for its completion, and the Practice Section (B) has four test items/questions then by proportion, one and a half minutes would have to be allocated to it instead of four minutes. If this were to be done it would make the Practice Section (B) a more realistic activity for the testees in preparing them for the Response Section (C), which contains the majority of the test items/questions in the EST1 and EST2. Therefore, such an arrangement would enable an individual's position on the field dependence – field independence continuum to be located with a greater level of accuracy.

A further consideration for EST2 would be the order or sequence of presentation of the complex shapes. It appears from the results obtained from Pilot Study Two and the previous study, Pilot Study One that the testees from the two overall samples found the same embedded test items/questions difficult or easy to the same extent, i.e. the ratio of correct responses to attempted individual test items/questions was about the same. However, the testees of Pilot Study Two attempted a smaller number of test items/questions in the Response Section (C), compared with those of Pilot Study One, overall.

Therefore, since the frequency of correct responses to attempted tasks appear to be about the same for each overall sample in each of the pilot studies, this suggests that a rearrangement of the sequence of the complex shapes and their associated simple shapes within the Response Section (C), would aid the testee, in a sense, by guiding the testee through the various test items/questions from easy to more difficult. Also, the Practice Section (B) test items/questions could follow this approach, especially if the time allowed for its completion was in proportion to the time allowed for the completion of the Response Section (C).

The factors of time for completion, and sequence in terms of the difficulty of embedded test items/questions, appear to have been shown to have more importance in relation to the measurement of field dependence – field independence, than does the sequencing of embedded test items/questions on a purely geometrical sequence, i.e. following set rules. This implies that the general findings from Pilot Study Two and the previous Pilot Study One tend to diminish the arguments put forward in Chapter 6, which described the initial development of the Embedded Shapes Test, Version One (EST1) and the thinking behind it, in favour of a strict geometrical sequence of complex shapes. However, since the overall geometrical development of the complex shapes will be inherent in the overall set of complex shapes, irrespective of their particular order or sequence in an individual section or linked sections, the initial sequence does not appear to be an essential condition to be maintained. In other words, because the same types of complex shapes are to be found throughout the Embedded Shapes Test in general, the degree of familiarity the testee will acquire of them as he or she works through the test, will be of some aid to the testees in attempting to disembed a given simple shape from a complex shape, irrespective of the difficulty of a particular embedded test item/question.

Therefore, the sequence of the complex shapes and their associated simple shapes will be rearranged in Practice Section (B) and Response Section (C), together with a proportional time limit for each of these sections to produce a new version of the Embedded Shapes Test, i.e. Embedded Shapes Test Three (EST 3).

b) Sense Word Test, Version One (SWT1)

The general presentation of the SWT1 in terms of all of it being contained on one piece of paper, does not appear to have generated any additional difficulty for the testees, i.e. interference between test items/questions or having sufficient space to indicate responses. Although only one piece of paper was used for the SWT1, the test items/questions were arranged to minimise interference from each other and to give the testees sufficient space to indicate, by drawing a circle, their responses to each test item/question posed.
The reason for giving an example was to show the testees how the simple word was to be located and indicated within the complex word. Also, the number of examples given could easily have been more, e.g. a fairly short and then long complex word, but the present results suggested that this was not necessary.

As indicated in the last section, 9.2.3.i) – ii) Results/Analysis, two minutes appears to have given the testees too much time to consider the overall number of test items/questions presented. This situation was possibly assisted by the close proximity of each of the tasks in that it was possible to ‘scan’ several words simultaneously, as well as the arrangement of the complex word to the simple word, i.e. the complex word placed before the simple word, and therefore, it is scanned first. Also, perhaps, the degree of similarity and level of complexity of both or either of the complex and simple word, i.e. the overall shape of the words, enables a faster detection of the simple word within the complex word.

Most of the testees were able to draw a circle around the simple word contained in the complex word sufficiently well for it to indicate that they had successfully located, or disembedded, the simple word within the complex word. Where the circle line included part (usually a half plus) of another letter that was not contained in the simple word, the attempt at locating or disembedding the simple word in the complex word was not considered successful and therefore no point awarded. This aspect of the SWT1 is fraught with difficulties because the indication of the simple word within the complex word requires well developed fine motor skills and a sharp pencil, especially when attempting to complete many test items/questions within a short time period. However, to overcome this difficulty, a 'tolerance approach' was adopted which allowed the enclosing circle to encompass part of the letter on one or either side of the simple word, providing that no more than a half of one letter on one or either side of the simple word was included in the circle.

Apart from a consideration of the number of test items/questions to be completed in a given time, the number of test items/questions arranged on any one page, and the method of indicating the simple word within the complex word, there are two other factors which could be manipulated in an attempt to increase the sensitivity of the SWT1 to measure field dependence – field independence. These are i) the arrangement or positioning of the complex word in relation to the simple word, and ii) the complexity and/or familiarity of the complex word and the simple word.

The establishment of a list of complex and associated simple words from the investigation of details related to syllabification and phonic considerations, could be done in an attempt to make the test items/questions of the SWT1 more difficult, i.e. the task of locating, or disembedding, a simpler word in a more complex word. However, the general difficulty of the SWT1 can be increased by altering the time allowed for its completion and, possibly, the positioning of the complex word in relation to the simple word.

The reducing of the allocated time for the completion of the SWT1 is self-explanatory in terms of the increased difficulty, and probable effectiveness as a possible measure of field dependence – field independence. Other factors such as the re-positioning of the complex word in relation to the simple word, i.e. simple word before complex word and not the other way about, is less so. Such a modification is likely to make each individual test item/question more difficult because the complex word is not scanned before the simple word, whereas the original arrangement of the complex and simple word, possibly makes the task of locating, or disembedding, the simple word within the complex word easier.

9.2.4. ii) Conclusion

a) Embedded Shapes Test, Version Two (EST2)

The present format of the EST2 appears to have an increased level of construct validity with regards to the measurement of field dependence – field independence.
The inclusion of a time limit for the completion of the Response Section (C), produced an increase in difficulty for it, i.e. the number of correct responses obtained within the time limit, and thus, provides an increase in accuracy of either a field dependent or field independent designation for each of the testees. Consequently, a time limit (as expounded in the Discussion Section 9.2.4. i) a)),will be allocated to the Practice Section (B) in proportion to the number of test items/questions contained in it, and in comparison to Response Section (C).

A full description of the modifications resulting from the above conclusions will be given in Chapter 10, Study One.

b) Sense Word Test, Version One (SWT1)

The present format of the SWT1 appears to have an acceptable level of construct validity with regards to the measurement of field dependence – field independence, although the level of accuracy of the measurement of field dependence – field independence at this stage in the development of the SWT1, remains an open question. However, a modification in the allowed time for the completion of all of the test items/questions, in the SWT1, is likely to produce an increase in the reliability of it to measure field dependence – field independence, i.e. the number of correct responses in a limited time, using a verbal modality.

If the above modifications were made, i.e. a reduction in the time for the completion of the fifty test items/questions, together with a re-positioning of the complex word in relation to the simple word in each of the test items/questions to the SWT1, it is possible that an increase in the reliability and sensitivity of it to measure field dependence – field independence will be made. Therefore, the above modifications to the SWT1 would produce a new version, i.e. Sense Word Test, Version Two (SWT2).

A full description of the modifications resulting from the above conclusions will be given in Chapter 10, Study 1.

Chapter 10

Study One using the Embedded Shapes Test, Version Three (EST3), Sense Word Test, Version Two (SWT2), Non-Sense Word Test, Version One (NSWT1) and School Subjects

10.1 Introduction

The purpose of Study One is to investigate the use of both the Embedded Shapes Test (EST3) and the Sense Word Test (SWT2) in a further modified form, as a consequence of Pilot Study Two, and to introduce and investigate the use of the Non-Sense Word Test (NSWT1). This gives a traditional and/or alternative way of measuring field dependence – field independence, to include spatial and verbal modalities.

A further purpose of Study One is to investigate possible relationships between field dependence – field independence, as measured by the above 'tests', and school subject performance/attainment.

The school subjects used in Study One were a Modern Language (French) and Science (General). These subjects were considered appropriate because of the verbal component in the case of language, and the spatial component in the case of science, in relation to the Sense Word Test (SWT2) and Non-Sense Word Test (NSWT1), and the Embedded Shapes Test (EST3), respectively.

All of the above relate to the three research questions of the thesis as follows:-

1. *Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?*
2. *Is it possible to measure field dependence – field independence using a verbal modality?*
3. *Is it possible to show a relationship between the measurement of field dependence – field independence, ability, and attainment in school subjects?*

10.2 Method

i) Sample

The sample consisted of sixty-two Year Eight students, thirty-two males and thirty females, from an urban comprehensive school.
Selection of the students for the sample was governed (as with Pilot Studies One and Two) by timetabling convenience on the part of the school, and consisted of two mixed ability groups.

ii) Materials

a) Embedded Shapes Test, Version Three (EST3)

Version Three of the Embedded Shapes Test, like Version One and Version Two, consisted of a Worked Example (A), Practice (B) and Response (C) Section, all in one booklet of A5 size. Although the number of worked examples and test items/questions remained the same within each of the three sections, i.e. four, four and thirty two respectively, differences occurred with regards to the time allowed for particular sections and the sequence or order in which the test items/questions were presented in particular sections.

The details of these differences are as follows:

1. The time allowed for the completion of the Practice Section (B) is one and a half minutes, which is in proportion to the time of twelve minutes allowed for the Response Section (C), in relation the number of test items/questions in each section, i.e. four and thirty two respectively.
2. The sequence in which the test items were presented in both the Practice(B) and the Response (C) Sections were combined and given in order of difficulty, i.e. test item/question 'one through to test item/question item thirty six', while retaining the two discrete sections.

Derivation of the sequence of test items/questions within the Practice (B) and Response (C) Sections of the Embedded Shapes Test, Version Three (EST3).

The data on which the new sequence for the test items/questions in both the Practice (B) and Response (C) Sections was obtained from Pilot Study Two.

This was done by compiling a table giving the number of incorrect responses for each test item/question in both the Practice (B) and Response (C) Sections, from the overall sample of testees of Pilot Study Two. The magnitude of the number of incorrect responses for each test item/question was than arranged in numerical order, ascending, to give the new sequence for the test items/questions across the two sections.

The orientation and arrangement of the simple shape to the complex shape remained the same within each test item/question of each of the Practice(B) and Response (C) Sections.

The combining of the Practice (B) and Response (C) Sections in terms of the sequencing of the test items/questions was considered to be valid on the basis that it would allow a more meaningful Practice Section (B). This is in relation to the essential role of the Practice Section (B), as a provider of experience in attempting and completing embedded shapes tasks.

Although this new sequence of the embedded shapes in the Response Section (C) contravenes the initial geometrical rules used to generate the original sequence, it is more likely to allow the testees to be gradually led into and through the Response Section (C), especially with a time limit. Thus, the 'new' sequence may prove to be able to provide a more meaningful and precise measurement of field dependence – field independence, especially in the context of group administration.

It may prove necessary, in time, to modify the 'new' sequence, based on a bigger sample, since the new sequence is based on the relatively small sample of Pilot Study Two, and administered using different time limits for both the Practice (B) and Response (C) Sections. The test items/questions of the Worked Examples Section (A) in each of the three versions of the Embedded Shapes Test, was the same, i.e. the complex and simple shapes used, their orientation and arrangement to each other and the sequence of their presentation.

Instructions for the working and completion of EST3 was exactly the same as that for EST2 and EST1, except for the request for the testees to write down, at the front of the 'test booklet', on the title page, the time taken to complete the Response Section (C). This was not applicable to EST1 and EST2 because of the set time for the completion of the Response Section (C). Also, the instructions and title page incorporating personal information for EST3 were type written and not hand written as they were for EST1 and EST2.

The overall layout of EST1, EST2 and EST3 was the same in terms of the number of test items/questions on each page, and the number of pages in the test booklet. However, in EST3, the sequence of the complex and associated simple shapes in the Practice (B) and Response (C) Sections, and the numbering of the test items/questions in these sections, went from one to thirty-six, i.e. one to four in the Practice Section(B), and five to thirty-six in the Response Section (C).

Therefore, the differences between EST1, EST2 and EST3 are shown as follows in Table 10.1.

Table 10.1 Differences between EST1, EST2 and EST3

	Worked Examples Section (A)	Practice Section (B)	Response Section (C)
EST1	4 test items/questions no time limit	4 test items/questions (1 – 4) time limit – 4 mins	32 test items/ questions (1 – 32) no time limit
EST2	4 test items/questions no time limit	4 test items/questions (1 – 4) time limit – 4 mins	32 test items/ questions (1 – 32) time limit – 12 mins
EST3	4 test items/questions no time limit	4 test items/questions (1 – 4)* time limit – 1½ mins	32 test items/ questions (5 – 36)* time limit – 12 mins
* Denotes the rearranged sequence of the test items/questions of Practice Section (B) and Response Section (C) in EST3			

See Appendices A and B for versions EST1 and EST3 of Embedded Shapes Test. (EST1 and EST2 are identical, apart from the time allowed for the completion of Response Section (C)).

b) Sense-Word Test, Version Two (SWT2)

As with SWT1, the second version, SWT2, consisted of fifty test items/questions, i.e. a complex word and an associated simple word, presented on one page of A4 size.
Although the words used, complex and simple, and their sequence, i.e. one to fifty, was the same for both versions of the Sense Word Test, the positioning of the complex word in relation to the simple word was not.
In SWT2 the complex word was placed after the simple word and not the other way about as in SWT1 but the same pairs of complex and simple words were used.
The reasons for this change are discussed in Pilot Study Two, whereby the changing of the position of the complex word in relation to the simple word is an attempt to make the task of disembedding more meaningful in terms of measuring field dependence – field independence via the application and manipulation of a possible ‘scanning mechanism’ that may be involved.

Also, the allowed time for the completion of SWT2 was reduced from two minutes (SWT1) to one minute. Again, the reasons for this change in the time allowed are discussed in Pilot Study Two but the major reason for such a change is to make the overall task of completing the SWT2 more meaningful in terms of measuring field dependence – field independence via taking into account the immediate response and reaction of the testee to a given localised perceptual field, i.e. each combination of a complex word and simple word within the overall 'test'.

In spite of the obvious differences between the type of task presented in the Embedded Shapes Tests and the Sense Word Tests (and the Non-Sense Word Test to follow, although this is arguably closer in 'task' characteristics to the Embedded Shapes Tests than the Sense Word Tests because of the abstract nature of their respective test items/questions), it must be borne in mind that the purpose of these instruments is the same, i.e. to measure field dependence – field independence, albeit by a spatial and verbal approach respectively.

SWT2 has the same instructions and one worked example but with the simple word placed before the complex word. The layout for personal information, instructions, Worked Example, and test items/questions, i.e. numerical sequence, and presentation, were the same for both versions of the Sense Word Test.
Also, the complete 'test' was type written for both versions.

c) Non- Sense Word Test, Version One (NSWT1)

A full description of the Non-Sense Word Test (NSWT1) in terms of its origins, formulation and details of its presentation was given in Chapter 6, Section 6.7
Apart from the nature and characteristics of the test items/questions i.e. pairs of complex and simple words that have had the vowels they contain removed, thus rendering them 'non-sense' pairs of complex and simple words or 'none words', the NSWT1 has the same number of test items/questions, i.e. fifty, the same layout/presentation as does the SWT2. However, a different set of complex and simple word pairs were used to those used in SWT1 and SWT2 (which were the same), to generate the pairs of complex and simple, 'non-sense' words.
Also, the positioning of the complex 'non-sense' word in relation to the simple 'non-sense' word was the same as in the SWT2, i.e. simple 'non-sense' word before complex 'non-sense' word.

The time allowed for the completion of the NSWT1 was one minute, the same as that for the completion of the SWT2.

In spite of the modification, i.e. the removal of vowels from the complex and simple words used in the NSWT1, the positioning of the complex 'non-sense' word in relation to simple 'non-sense' word, i.e. simple before complex, was considered to be the better of the two possible alternatives when using pairs of complex and simple words, 'non-sense' or sense/real, for the reasons already discussed in this and previous chapters, i.e. Chapters 6 and 7, Sections 6.7 and 7.7, respectively. Likewise, the allocation of a one minute completion time for the NSWT1, was considered appropriate for the reasons already discussed in this and previous chapters, i.e. Chapters 6 and 7, Sections 6.7 and 7.7, respectively, in relation to SWT2.

d) School Subjects performance/attainment data

The school, from which the testees of the sample came, was asked for recent, in relation to the time of the administration of the field dependence – field independence measures used in this study, school examination results, in any school subjects, achieved by the testees.
The response to the above requests was a Modern Language (French) and Science (General) examination result for each testee.
The French examination result was given as a percentage and the Science examination result as a number out of thirty-five. This fraction was converted to a percentage before being analysed along with the other data associated with this study.

e) Graphical Equipment

Each testee was supplied with an HB pencil and a pencil eraser.

iii) Procedure

General Comments
The sample was divided into two sub-samples of thirty-two and thirty, each sub-sample consisted of the same number of males (16) and females (15).
With each sub-sample the seating positions of the testees were arranged in a normal sized classroom in such a manner so as to maximise the space between each subject.
There was no attempt made to separate males from females.
Although three 'tests' were administered in this study, they were given out and worked through separately.
Each testee was given an HB pencil and a pencil eraser before the first test was given out.
Once the first sub-sample had completed all three tests, they left the room, and were followed by the second sub-sample.

a) Embedded Shapes Test, Version Three (EST3)

The overall administrative procedure for EST3 (apart from the modified time for Practice Section (B)) followed that for EST2 as described in Pilot Study Two, Chapter 9, Section 9.2.2.iii) a).

However, the further modifications to EST2 to produce EST3, i.e. a different allocated time for the completion of the Practice Section (B) and the continuous numbering from the Practice (B) to the Response (C) Section of the test items/questions, were referred to verbally by the administrator at the appropriate points in the procedure of completing EST3. This was done because of the need for the testees to know and to avoid possible confusion, i.e. the time allocated and the change of 'section' in spite of the continuing numbers, respectively.

The third modification, that of the title page, personal details and instructions throughout the test booklet, i.e. at the beginning of the test booklet and the title page of each section, were brought to the attention of the testees by the administrator as EST3 was 'worked through'.

b) Sense Words Test, Version Two (SWT2)

Again, as with EST3, used in this study, the overall administrative procedure for the SWT2, followed that for SWT1 as described in Pilot Study Two, Chapter 9, Section 9.2.2.iii) b).

The modifications between the two versions of the SWT, i.e. time allowed for completion of the test and the arrangement of the complex word in relation to the simple word, were referred to verbally by the administrator at the appropriate points in the procedure. This was done to fully inform the testees of the task they were about to undertake and the parameters applied to the overall task, i.e. completion time, the nature of the task and how each test item/question was to be completed.

c) Non-Sense Words Test, Version One (NSWT1)

After, the collection of the SWT2, the administrator explained to the testees that they were now going to do another activity, which was very similar to the last one in many respects.

When this had been done, the NSWT1 was given out and placed 'face down', by the administrator, and the testees asked not to 'turn over' until told to do so.

Once all of the testees had been given a NSWT1, they were told to turn them over, complete the personal information items, and then listen to the explanation of what they were to do.

After this, the administrator explained to the testees what they were being asked to do and how they were to do it by referring to the worked example.

Also, at this time, a very brief explanation was given to the testees by the administrator of the origin of the complex and simple non-sense words, i.e. both complex and simple non-sense words were, or had been real words that had had the vowels they contained removed, thus, producing the non-sense words (a collection of letters). As with the SWT2, the real simple word is contained in the real complex word and likewise, in the NSWT1 the simple non-sense word was contained in the complex non-sense word. When the administrator was assured that all of the testees understood what they were to do and how they were to do it, the testees were referred to the test items/questions that constituted NSWT1, and told that they were to be allowed one minute to complete all, or as many as possible, of the fifty test items/questions.

Before, starting the NSWT1, the administrator emphasised the importance of drawing around the simple or embedded 'non-sense word' accurately so as to give a clear indication that the simple 'non-sense word' had been located in or disembedded from the complex 'non-sense word', to the testees. Also, the testees were told to remain quiet and stay in their places if they had finished all of the fifty test items/questions before the time allowed had elapsed. The administrator started and stopped the time allowed for the NSWT1, monitoring the time throughout. When the time had elapsed, the administrator told the testees to stop, then collected the NSWT1s, checking that the personal information was complete for each testee. After this, each of the testees was allowed to leave the room.

10.3 Results and Analysis

i) Results

General Comments

The general response of the testees of the sample used in this study was positive in that the majority appeared to readily understand the task they were required to do from the beginning of each of the three 'embedded' tests used, i.e. EST3, SWT2, and NSWT1. This was particularly evident with EST3, which had a Practice Section (B) for the testees of the sample to work through before embarking on the Response Section (C), i.e. very few testees failed to score any points.

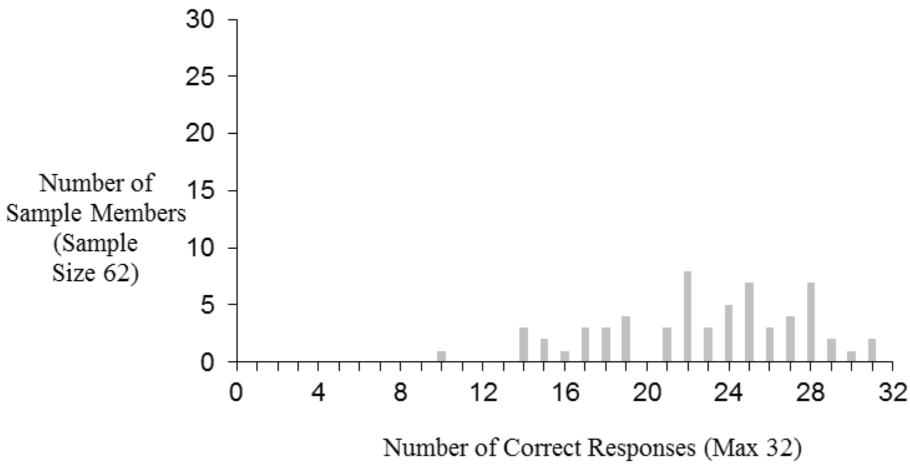
For the purpose of the analysis used in this study, only the raw scores from the Response Section (C) of the EST3 were used, to give a degree of compatibility with the SWT2 and NSWT1, since these two 'embedded' tests did not have a Practice Section. However, all three of the 'embedded' tests had a Worked Examples Section, which was 'worked through', with the participation of the testees, by the administrator, to enable them to attempt/complete the tests.

The outcomes from the sample in relation to each of the 'tests' used and the interactions between them will be investigated and considered in detail in the next sub-section, 'Analysis', and the implications of the outcomes in the 'Discussion' and 'Conclusion' sub-sections.

a) Embedded Shapes Test, Version Three (EST3)

The range of raw scores for the Response Section (C) of the EST3 was somewhat limited, with many raw scores of a high value.
For the overall sample, the range of raw scores for the Response Section (C) of the EST3 was between 10 and 31. In terms of males and females, the ranges were from 10 to 31, and 14 to 28, respectively, Figure 10.1.

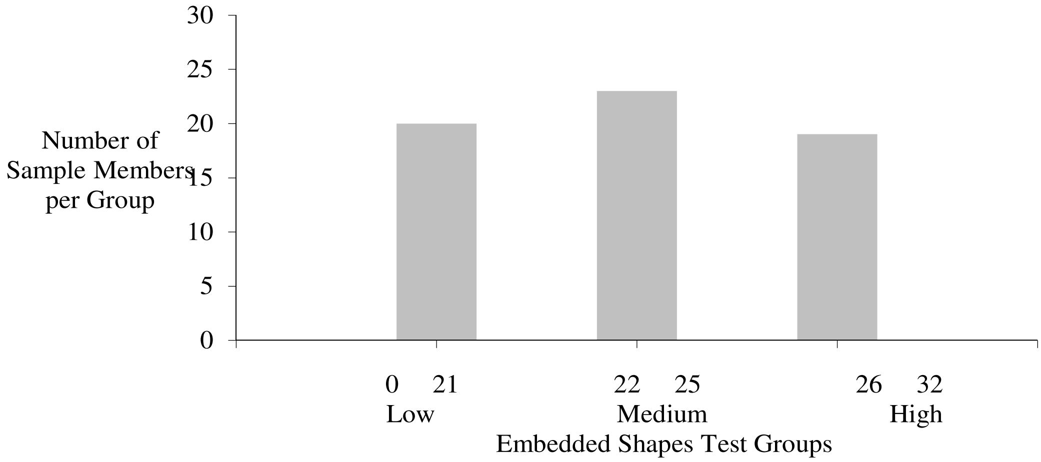
Figure 10.1 Frequency Distribution of Correct Responses (C) (raw scores) for the Embedded Shapes Test, Version 3 (EST3) - Study 1.



The number of correct responses to the test items/questions of the Response Section (C) of the EST3 did not differ very much from the number of test items/questions attempted by the majority of the testees. Also, most testees attempted the majority of the test items/questions presented in the Response Section (C) of the EST3

The raw scores from Response Section (C) of the EST3, were arranged into three groups to give a 'low', 'medium' and 'high' group relative to the field dependent – field independent continuum, Figure 10.2.

Figure 10.2 Correct Responses from Response Section (C) (raw scores) arranged into three groups of Low, Medium and High for the Embedded Shapes Test, Version Three (EST3) - Study 1.

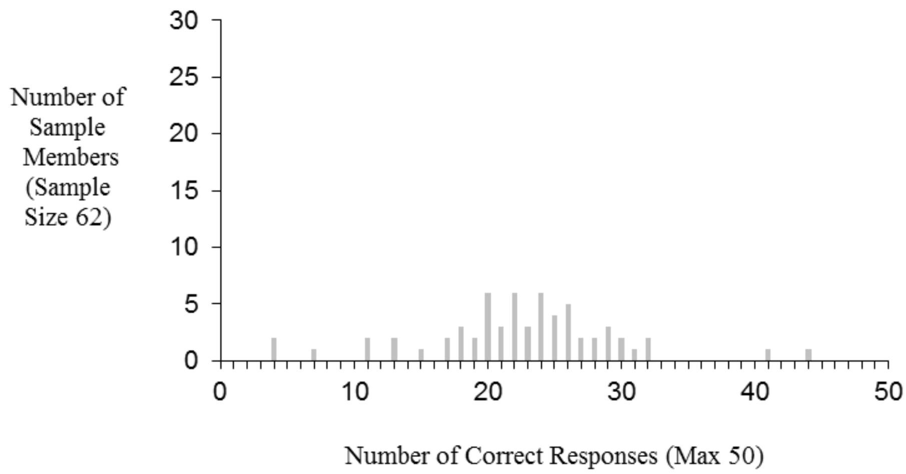


The above arrangement enabled the full range of raw scores to be treated with a greater degree of sensitivity, and to take into account an interface between the designation of field dependence and field independence across a sub-range of raw scores, rather than from the midpoint of the full range of raw scores.

b) Sense Words Test, Version Two (SWT2)

The range of raw scores for the SWT2 was rather limited, throughout the sample. For the overall sample the range of raw scores on this test was from 4 to 44, Figure 10.3. In terms of males and females, the range was from 4 to 32, and 4 to 44, respectively.

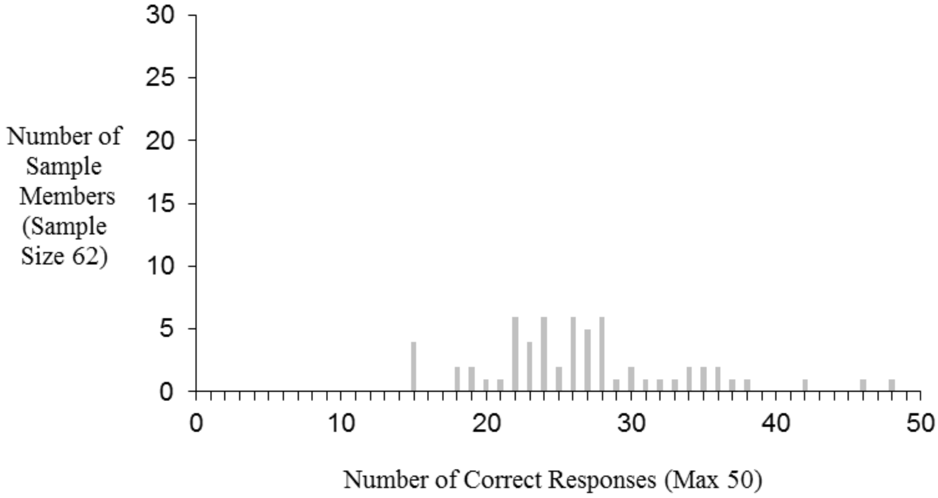
Figure 10.3 Frequency of Correct |Responses (raw scores) for the Sense Word Test, Version Two (SWT") - Study 1



The number of correct responses to the test items/questions presented did not differ very much from the number of test items/questions attempted by the majority of the testees.
Most of the testees of the sample only attempted about half of the test items/questions presented within the allocated time for the completion of the test.

c) Non-Sense Word Test, Version One (NSWT1)
The range of raw scores for the NSWT1 was less than that for the SWT2.
For the overall sample, the range of raw scores for the NSWT1 was from fifteen to forty-eight, Figure 10.4. In terms of males and females, this range was from 15 to 38, and 15 to 48, respectively.

Figure 10.4 Frequency Distribution of Correct Responses (raw scores) for the Non-Sense Word Test, Version One (NSWT1) - Study 1



The number of correct responses to the test items presented did not differ very much from the number of test items/questions attempted by the majority of the testees. The difference between the number of test items/questions attempted and those correctly answered was less with the NSWT1 items, for the majority of the testees than was the difference between similar categories for the SWT2.

Most of the testees only attempted about half of the test items/questions presented within the allocated time for the completion of the NSWT1.
The time for the completion of both the SWT2 and the NSWT1 was the same.

d) School Subject Performance/Attainment Data
Performance/attainment data was obtained for the school subjects of Modern Language (French), and Science (General) for the sample.
The scores for each of these school subjects were treated as a percentage and ranged from 21 to 93 percent for French, and 40 to 97 percent for Science (General), for the overall sample.

ii) Analysis

When discussing the results/analysis of this Study (One), the following 'key' will be employed:-

Embedded Shapes Test (EST3) = EST Groups 1, 2 and 3; Sense Word Test (SWT2) = Sense; Non-Sense Word Test (NSWT1) = Nons; Modern Language (French) = Lang; Science (General) = Sci; Male (Sex 1); Female (Sex 2).

The means and standards deviations for each of the variables and the overall sample of this Study (One) are shown in Table 10.2.

Table 10.2 Means and Standard Deviations for each of the Variables and the Overall Sample of Study 1.

Variable	Cases	Mean	Std Dev
SEX	62	1.4839	0.5038
EST3	62	22.8065	4.7936
Sense (SWT2)	62	22.5645	7.1463
Nons (NSWT1)	62	26.7419	6.9776
Lang (French)	53	59.4717	15.2298
Sci (General)	61	73.9016	15.2542

A Multivariate Analysis of Variance (MANOVA) was first used with EST (1, 3) and Sex (1, 2) designated as a ‘factor(s)’ and ‘Sense’, ‘Nons’, ‘Lang’ and ‘Sci’ designated as a ‘variable(s)’.

The EST factor was divided into three groupings, 1, 2 and 3. These were derived from the EST3 raw scores for the overall sample, which were allocated to a ‘high’, ‘medium’ or Table 10.2‘low’ group (3, 2 and 1 respectively) for both males and females, field dependence – field independence. Figure 10.2

The EST3, three groupings, for both males and females, were then analysed in relation to the variables ‘Sense’, ‘Nons’, ‘Lang’ and ‘Sci’ in terms of sex (male and female), and the overall sample.

Also, the analysis of the EST3, three groupings for both males and females in relation to school subjects performance/attainment, i.e. Modern Language (French) and Science (General), used the sum of the Modern Language and Science scores (separately), as a percentage score for each school subject, in relation to males and females.

A ‘Pearson–Product Moment’ correlation matrix was also generated between the factors and variables within this study (One).

10.4 Discussion and Conclusion

i) Discussion

The terminology 'Main Effect' as utilised by Kepple, G. and Saufley, W.H., Jr., (1980, pp212-218), is used in the MANOVA Tables and Figures throughout Study 1.

The MANOVA revealed some interactions and several significant 'F values' between the different factors and variables used in this Study (One).

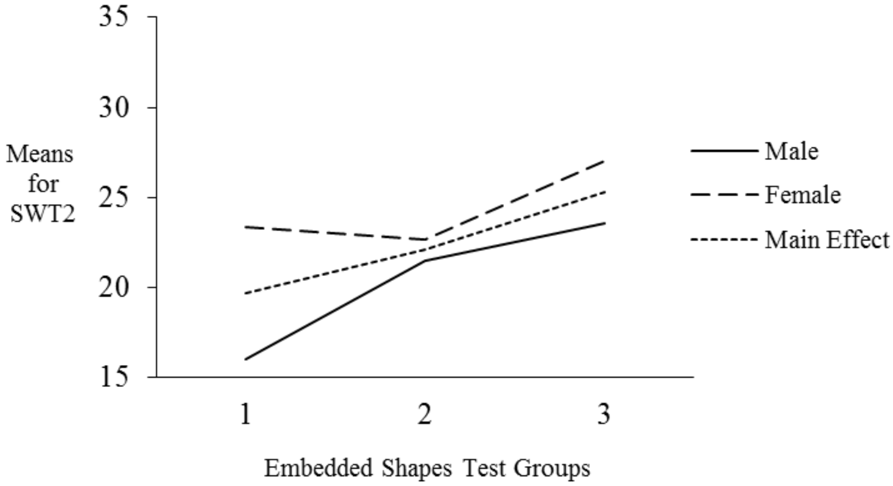
Table 10.3 shows that the mean values for SWT2, the 'Sense' variable, were higher for females than those for males in each of the three EST3 Groups, the greatest difference occurring in EST3 Group 1, (i.e. the low region of the field dependence – field independence continuum), and therefore the testees displaying field dependent characteristics. This is not altogether unexpected since the SWT2 is also a measure of field dependence – field independence, as is the EST3.

Table 10.3 Means for Male, Female and Main Effect for Sense Word Test, Version Two (SWT2) – Study 1.

EST3 Group	1	2	3
Male	16	21.5	23.6
Female	23.4	22.7	27
	(16 + 23.4) ÷ 2	(21.5 + 22.7) ÷ 2	(23.6 + 27) ÷ 2
Main Effect	19.7	22.1	25.3

Also, the 'Sense' means for each sex for EST3 Groups 2 and 3 are closer, medium and high regions of the field dependence – field independence continuum respectively, but Figure 10.5 shows that the difference between the two lines diverges from Group 2 to Group 3.

Figure 10.5 from Table 10.3 for Sense Word Test, Version Two (SWT2) - Study 1



The overall position and shape of the ‘female line’, compared to the ‘male line’, suggests a greater degree of field independence for females than males in terms of the ‘Sense’ means for each of the EST3 Groups used, although the male ‘Sense’ means increase with each consecutive EST3 Group. With both male and female the magnitude of the ‘Sense’ means increase with each consecutive EST3 Group

There is no interaction between the ‘female line’ and the ‘male line’, with a ‘main effect line’ occurring between the two, Figure 10.5.

Table 10.4 shows that the mean values for NSWT1, the ‘Nons’ variable, is higher for the females than those for the males in each of the three EST3 Groups, with the greatest difference between females and males occurring in EST3 Groups 2 and 3.

Table 10.4 Means for Male, Female and Main Effect for Non-Sense Word Test, Version 1 (NSWT1) – Study 1

EST Group	1	2	3
Male	23.8	24.2	25.5
Female	27.5	29.4	30.8
	(23.8 + 27.5) ÷ 2	(24.2 + 29.4) ÷ 2	(25.5 + 30.8) ÷ 2
Main Effect	25.65	26.8	28.15

Also, there is no interaction between the ‘female line’ and the ‘male line’, with a ‘main effect line’ occurring between the two, Figure 10.6.

Figure 10.6 from Table 10.4 for Non-Sense Word Test, Version One (NSWT1) - Study 1

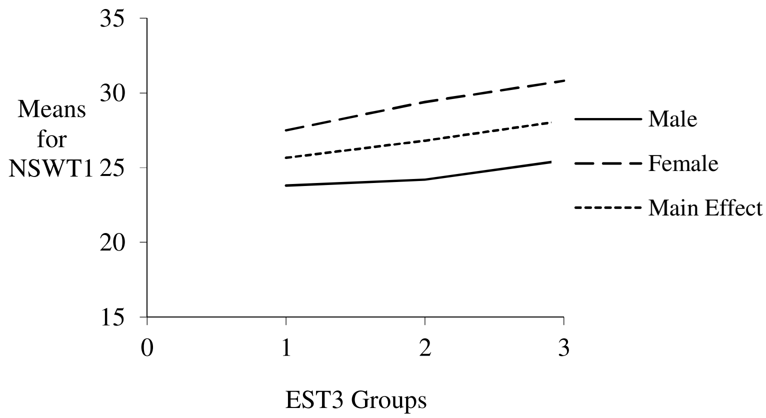


Table 10.4 shows that the mean values for the ‘Nons’ variable were generally higher for both females and males in each of the three EST3 Groups, when compared to the corresponding ‘Sense’ values for both females and males in the same EST3 Groups (except for the male EST3 Group 1 ‘Nons’ when compared to the male EST3 Group 3 ‘Nons’ and the male EST3 Group 3 ‘Sense’, which are approximately the same).

This may suggest that the high/higher field dependence – field independence continuum results occurring for both sexes within the NSWT1, is because the measuring of field dependence – field independence is being done with a finer resolution, and this is reflected in the raw scores.

The NSWT1 can possibly be considered to be a more accurate way of measuring field dependence – field independence because the letter groupings of each test item/question are not familiar, or at least less familiar, to the testees of the sample, than are the SWT2 test items/questions which uses real words. With the ‘Sense’ words and ‘Nons’ words this consideration applies to both the complex and simple word or collection of letters respectively, of each test item/question.

However, the ‘Sense’ raw scores and means are lower than the ‘Nons’ raw scores and means, which could be explained by a ‘practice effect’, since the SWT2 was done before the NSWT1, or the accuracy of drawing a circle around the 'Nons' letter or group of letters was done with greater precision, thus giving more responses deemed to be correct. If this is so, then it can possibly be explained by the testees displaying greater attention to the test items/questions of the NSWT1 than the SWT2 because the former (NSWT1) was less familiar.

Also, the male 'Nons' mean for EST3 Group 1, very nearly corresponds with the female 'Sense' mean for EST3 Group 1, Tables 10.3 and 10.4. Therefore, since EST3 Group 1 testees are deemed to be in the field dependent region of the field dependence – field independence continuum, this suggests that these testees are less able to locate or disembed letters or words, within the NSWT1 or SWT2, respectively. Also, with both male and female, the magnitude of the 'Nons' and the 'Sense' means increase with ascending consecutive EST3 Groups.

With Tables 10.5 and 10.6/ Figure 10.7, the 'Sense' and 'Nons' means for both male and female respectively, have been combined to produce a 'new mean', to enable a composite figure to be obtained.

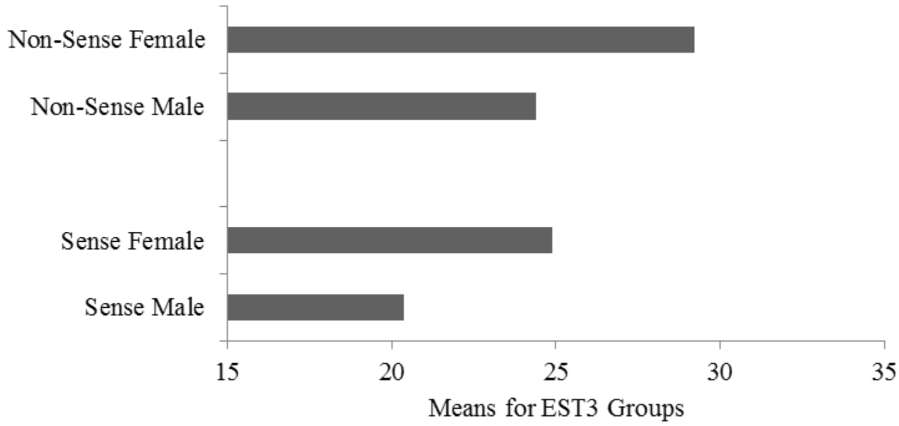
Table 10.5 Means for EST3 Groups by SWT2 and Sex – Study 1

		Male	Female
EST3 Group	1	16	23.4
	2	21.5	24.2
	3	23.6	27
		(16 + 21.5 + 23.6) ÷ 3	(23.4 + 24.2 + 27) ÷ 3
Means		20.37	24.87

Table 10.6 Means for EST3 Groups by NSWT1 and Sex –Study 1

		Male	Female
EST3 Group	1	23.5	27.5
	2	24.2	29.4
	3	25.5	30.8
		(23.5 + 24.2 + 25.5) ÷ 3	(27.5 + 29.4 + 30.8) ÷ 3
Means		24.40	29.23

Figure 10.7 from Tables 10.5 and 10.6 - Means for EST3 Groups by SWT2 and NSWT1 and Sex - Study 1



Since the SWT2 and NSWT1 are considered to be measuring field dependence – field independence, via a verbal modality and in a similar manner, i.e. the testee circling a word or group of letters and within the same time limit. Such an amalgamation was considered to be acceptable to show overall differences between males and females in relation to using this type of arrangement to measure field dependence – field independence.

Therefore, Tables 10.5 and 10.6/ Figure 10.7 show an overall distributed difference between the males and females, with the females achieving a higher level on the field dependence – field independence continuum for 'Sense' and 'Nons', in each of the three EST3 Groups.

The combined mean values for the 'Sense' and 'Nons' variables, for both male and female, have been plotted against the combined mean values for the EST3 factor, across each of its three groupings.

Also, the difference between the 'Sense' and 'Nons' combined mean values for both male and female is approximately the same, giving approximately parallel lines, as seen in Figure 10.7.

Table 10.7/ Figure 10.8 shows that the mean values for the Modern Language (French) variable were higher for females than those for males in each of the EST3 Groups. The greatest difference occurred in EST3 Group 1 (the low region of field dependence – field independence continuum, associated with a field independence designation).

There is no interaction between the female line and the male line, with a 'main effect line' occurring between the two, Table 10.7/ Figure 10.8.

Table 10.7 Means for Male, Female and Main Effect for Modern Language (French) – Study 1

EST3 Group	1	2	3
Male	31.8	56.1	60.2
Female	59.9	64.1	70.3
	(31.8 + 59.9) ÷ 2	(56.1 + 64.1) ÷ 2	(60.2 + 70.3) ÷ 2
Main Effect	45.85	60.1	65.25

Figure 10.8 from Table 10.7 for Modern Language(French) - Study 1

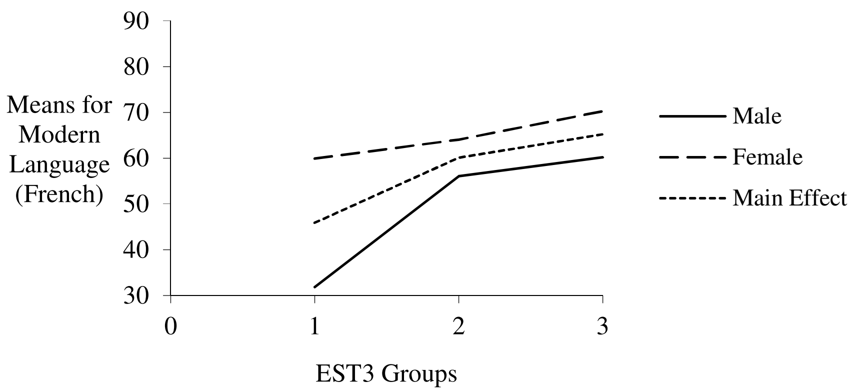


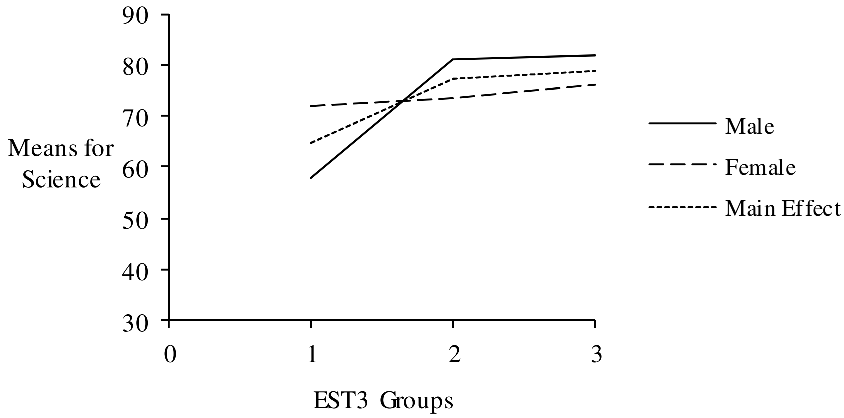
Table 10.8/ Figure 10.9 show that the mean values for the Science (General) variable are less for the males than the females for EST3 Group 1, more for the males than the females for EST3 Group 2, and, again, less for the males than the females at EST Group 3, giving an overlap of the male and female lines, with the greatest difference occurring between the two lines at EST Group 1 (the low region of field dependence – field independence continuum, associated with a field dependence designation).

This situation gives an interaction between the male and female lines, with the 'main effect line' cutting across the two; Table 10.8/ Figure 10.9, i.e. between the Science (General) and Sex variables.

Table 10.8 Means for Male, Female and Main Effect for Science – Study 1

EST3 Group	1	2	3
Male	57.8	81.1	81.7
Female	71.8	73.6	76.1
	(57.8 + 71.8) ÷ 2	(81.1 + 73.6) ÷ 2	(81.7 + 76.1) ÷ 2
Main Effect	64.8	77.35	78.9

Figure 10.9 from Table 10.8 for Science - Study 1



With Tables 10.9 and 10.10/ Figure 10.10, the Modern Language (French) and Science (General) means for both males and females, have been combined to produce a ‘new mean’, to enable a composite figure to be obtained.

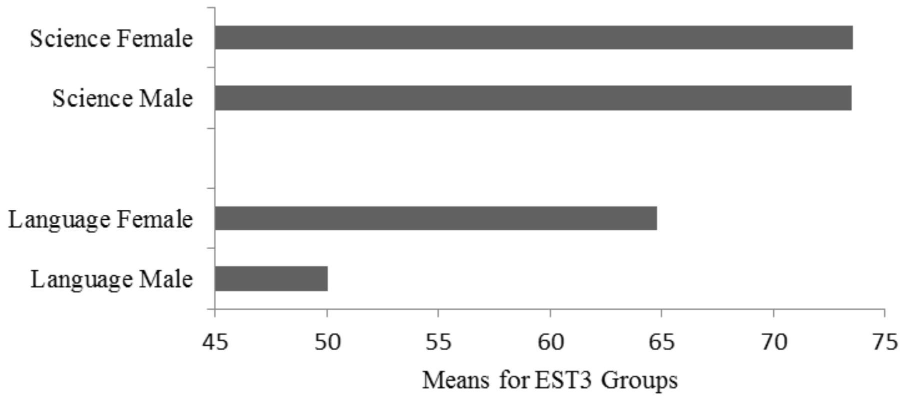
Table 10.9 Means for EST3 by Modern Language (French) and Sex – Study 1

		Male	Female
EST3 Group	1	31.8	59.9
	2	58.1	64.1
	3	60.2	70.3
		(31.8 + 58.1 + 60.2) ÷ 3	(59.9 + 64.1 + 70.3) ÷ 3
Means		50.03	64.77

Table 10.10 Means for EST3 by Science and Sex – Study 1

		Male	Female
EST Group	1	57.8	71.8
	2	81.1	73.6
	3	81.7	75.4
		(57.8 + 81.1+ 81.7) ÷ 3	(71.8 + 73.6 + 75.4) ÷ 3
Means		73.53	73.60

Figure 10.10 from Tables 10.9 and 10.10 - Means for EST3 Groups by Modern Language (French) and Science and Sex - Study 1



By doing this, the two school subject scores can be treated as one, in terms of a single academic performance/attainment, which in turn allows academic performance/attainment in a general sense, i.e. scores from more than one school subject for both males and females, to be compared with each of the EST3 Groups.

The combined mean values for the Modern Language (French) and Science (General) variables, for both male and female, have been plotted against the combined mean values for the EST3 factor across each of its three groups.

It can be seen from Figure 10.10 that the females have achieved a much higher outcome for Modern Language (French), and a slightly higher outcome for Science (General), than the males.

An interesting feature of Figure 10.10, is not only the large difference between the male and female Modern Language (French) outcomes, but also the very small difference between the male and female Science (General) outcomes from the mean of the three EST3 Groups, i.e. while the Modern Language (French) difference is, perhaps, not unexpected, a larger difference in the Science (General) scores would have been reasonably been expected. Such an assumption is based on historical anecdotal evidence as a consequence of societal and cultural influences.

From Table 10.11, Analysis of Variance – Tests of Between – Subjects Effects, it can be seen that the only significant variable is that of Sex (F = 6.68; df 1, 56; P = 0.05).

Table 10.11 Tests of Between-Subjects Effects Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	4680.64	56	83.58		
Constant	70823.09	1	70823.09	847.34	.000
EST3	302.95	2	151.48	1.81	.173
SEX	558.25	1	558.25	6.68	.012
EST3 by SEX	27.55	2	13.78	.16	.848

From Table 10.12, Analysis of Variance – Tests involving Test-Type (SWT2 and NSWT1) within – Subject – Effect, it can be seen that Test-Type is significant (F = 62.27; df 1, 56; P = 0.01), and EST3 by Sex by Test-Type (F = 4.00; df 2, 56; P = 0.05).

Table 10.12 Tests involving 'TEST TYPE' Within-Subject Effect Tests of Significance for T2 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	536.96	56	9.59		
Test Type	597.06	1	597.06	62.27	.000
EST3 by Test Type	44.07	2	22.03	2.30	.110
SEX by Test Type	3.45	1	3.45	.36	.551
EST3 by Sex by Test Type	76.80	2	38.40	4.00	.024

This is perhaps not surprising since there are a number of similar associated elements between each of the variables of EST3 and Test-Type ('Sense' and 'Nons') that are applicable to both sexes.

However, there is no interaction with SWT2, EST3 Groups and Sex, Table 10.11/ Fig 10.5; and no interaction with NSWT1, EST3 Groups and Sex, Table 10.12/ Figure 10.6.
The skills included in the EST3 are essentially perceptual/spatial, and although the SWT2 and NSWT1 use words and letters respectively, there is also a perceptual/spatial skill involved in locating the word or group of letters, since each are designed to measure field dependence – field independence, using the methodology of locating or disembedding a simple element in a more complex whole.

With regards to the sex variable, it could be, that with a 'cultural free' method of assessing perceptual/spatial ability, females can perform at a level comparable with or better than males. Therefore, assuming that the EST3, SWT2 and NSWT1 are able to provide, or begin to provide, such a method, this would help to explain the above results.

From Table 10.13, Analysis of Variance – Tests of Between – Subjects Effects, it can be seen that the two variables of EST3 and Sex, and the interaction between them are all significant, (F = 9.81, df 2, 46; P = 0.01), (F = 6.02, df 1, 46; P = 0.05), and (F = 4.13, df 2, 46; P = 0.05) respectively.

Table 10.13 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	11357.76	46	246.91		
Constant	418016.92	1	418016.92	1693.01	.000
EST3	4846.60	2	2423.30	9.81	.000
SEX	1486.46	1	1486.46	6.02	.018
EST3 by SEX	2040.05	2	1020.02	4.13	.022

From Table 10.14, Analysis of Variance – Tests involving 'Subject '(i.e. School subjects) within – Subject – Effect, it can be seen that 'Sex by Subject' is significant (F = 12.87, df 1, 46; P = 0.01).

Table 10.14 Tests involving 'SUBJECT' Within-Subject Effect
Tests of Significance for T2 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	4094.31	46	89.01		
Subject	6676.92	1	6676.92	75.02	.000
EST3 by Subject	68.61	2	34.31	.39	.682
SEX by Subject	1145.30	1	1145.30	12.87	.001
EST3 by SEX by Subject	.44	2	.22	.00	.998

Subject type (school subjects) is likely to provide an influential variable in terms of its effect on the variable sex, due to possible cultural associations, and conditioning that the males and females in the sample have undergone as an integral part of their educational experience to date.

Therefore, the significance between Sex and Subject (see also Tables 10.7 and 10.8, Figures 10.8 and 10.9) is not altogether surprising, for the reasons already discussed in relation to EST3 and Sex, plus the further notion, arguably, that females relate more readily to language because of its verbal component being a lot stronger than its spatial component, and males relate more readily to science because of its spatial/technical components being a lot stronger than its verbal components. Such a notion reflects the idea of an empathic and systematic way of thinking (Baron-Cohen, 2009).

However, the lack of a significance between EST3 and Subject (school subjects) is a little surprising, again, for the reasons already discussed. Also, the same reasons can be used in attempting to explain the lack of a significant interaction between EST3, Sex and Subject (school subjects).

Also, where testees are associated with school subjects, i.e. Modern Language (French) and Science (General), rather than Test-Type, ‘Sense’ and ‘Nons’, via MANOVA, in spite of the factors EST3, i.e. Groups 1, 2 and 3, and the variable of Sex having F values which are significant, as is that between EST3 and Sex. There is not an interaction with Modern Language (F), EST3 and Sex, Table 10.7/Figure 10.8, whereas there is between Science (General), EST3, and Sex, Table 10.8 /Figure 10.9.

A further analysis involved the production of a correlation matrix/value for each of the variables involved, Table 10.15.

Table 10.15 Correlation Matrix for the Variables of Study 1

	SEX	EST3	Sense (SWT2)	Nons (NSWT1)	Lang (French)	Sci (General)
SEX		-.1167	.2234	.3159	.3703*	-.0567
EST3			.3210	.1774	.4669**	.4006*
Sense (SWT2)				.7851**	.3054	.1765
Nons (NSWT1)					.3057	.0676
Lang (French)						.5380**
Sci (General)						

2- tailed signif: * .01 ** .001

In terms of significance and level of significance, the correlations 'r' between EST3, SWT2 and NSWT1,Modern Language (French) and Science (General), are shown in Table 10.16:-

Table 10.16 Significant Correlations from Table 10.15 – Study 1

Variables	Correlations (r)	Significance (p)
Sex/Language (French)	0.3703	< 0.01
EST/Science (General)	0.4006	< 0.01
EST/Language (French)	0.4669	< 0.001
Sense/Non-Sense	0.7851	< 0.001
Language/Science (General)	0.5308	< 0.001

The low positive correlation between EST3 and SWT2 (.3210), although a little unexpected, could be explained by SWT2 having real words, both for the complex and simple component of each test item/question. As a consequence, there is more reliance on literacy/reading ability than perceptual/spatial ability in terms of assessing and mentally manipulating shapes, whether they are geometrical shapes or shapes formed by words.

However, one would have expected a higher correlation between EST3 and NSWT1 (.1774), because although letters are used to form the complex and simple components of each test item/question, neither are real words and therefore constitute shapes more than words, albeit, nonsense words. Alternatively, the shape of the complex and simple component may be having a strong influence on the overall correlation in that they are very different and therefore, 'like' is not being compared with 'like', i.e. EST3 and NSWT1.

With regards to the school subjects of Modern Language (French) and Science (General), there is a fairly high positive correlation for both and EST3 (.4669 and .4006 respectively), more so with Modern Language (French) than Science (General).

The SWT2 and NSWT1 have similar correlation values with Modern Language (French) (.3054 and .1765 respectively), but lower and approximately equal with EST3 (.3210 and .1774 respectively), and equal and lower correlation values with Science (General) (.1765 and .0676 respectively), particularly NSWT1. So we have the situation where the correlation values for EST3, SWT2, and NSWT1 are lower for Science (General) than they are for Modern Language (French).

This situation may be explained in terms of the unusual nature of SWT2 and NSWT1, more so in the case of NSWT1, the nature of the task, the number of test items/questions and the overall time in which they had to be done, producing relatively low raw scores, and thus contributing to the resulting correlation values. Also, since the correlation value between Language (French) and Science (General) is fairly high (.5208), this supports the above argument in terms of the possible reason for low/very low correlation values between the SWT2 and NSWT1 and school subjects involved. This is likely to lie with SWT2 and NSWT1 and not Language (French) and Science (General) scores used.

Correlations with the sex variable and the other five variables, i.e. EST3, SWT2, NSWT1, Language (French) and Science (General) are low/very low, with the NSWT1 and Language (French) being the highest at .3159 and .3703; $p < .01$ respectively.

ii) Conclusion

Within Study One there have been several lines of enquiry. These could be stated as follows:-

1) The measurement of field dependence – field independence using the Embedded Shapes Test (EST3), i.e. a perceptual/spatial approach.

2) Other ways of measuring field dependence – field independence using the Sense Word Test (SWT2) and the Non-Sense Word Test (NSWT1), i.e. a verbal approach, especially in the case of SWT2.

3) Analysing similarities and differences between EST3, SWT2 and the NSWT1.

4) Comparing performance on the above three measures of field dependence – field independence with performance on school subjects, i.e. Modern Language (French) and Science (General).
5) Identifying possible sex differences in terms of field dependence – field independence, however measured.

Although the raw scores for the EST3, SWT2, and NSWT1 were obtained directly, the raw scores/percentage score for the school subjects of Modern Language (French) and Science (General) were obtained indirectly. Therefore, one can only assume that each of these school subject assessments followed, as would be expected, assessment procedures related to the school subjects' characteristics, i.e. little or no perceptual/spatial ability required in the assessment of Modern Language (French) , i.e. no drawing, and some perceptual/spatial ability required in the assessment of Science (General), i.e. drawing of apparatus and diagrams to help explain experiments and scientific processes.

Therefore, if the above assumptions are correct, meaningful interactions between the three field dependent – field independent measures and the two school subjects, will have been analysed in this study. This is because a mixture of perceptual/spatial and verbal ability for both sexes will have formed an integral part of the interactions of the variables within the overall study and its associated analysis.

The question of academic ability in relation to innate ability or ability gained due to favourable experiences and opportunities, educational or otherwise, is also relevant here. Also, the extent to which any cognitive style, and as far as this study is concerned, the cognitive style of field dependence – field independence, is or is not isolated from general ability or educational/academic ability. In addition, there is the consideration of level of academic achievement and/or learning differences and /or stage of mental development (e.g. Piagetian 'Formal Operational Stage') between males and females, if any, at the age of the individuals in the sample used in this study.

For example, the level of reading attainment applicable to the SWT2 and to an extent the NSWT1, and level of familiarity with basic mathematical shapes, e.g. circles and triangles, applicable to the EST3, in terms of a level of confidence to readily engage with and 'work through' a number of test items/questions, particularly when time constraints are involved.

Although the above questions and considerations are relevant to the present study in a variety of ways and details, they will have to be taken into account in a global manner since there is no way of investigating further the academic experiences or achievements of the individuals in the sample used in this study. These issues would apply to males and females of any sample selected to cover a 'range of ability' as determined by a given school.

Therefore, looking at the Tables 10.3 to 10.16, and Figures 10.5 to 10.10, of this study, it can be seen that the females' perform at a higher level in all but one aspect of the overall study, i.e. Figure 10.9 the Science (General) mean at EST3 Groups 2 and 3.

The reasons for these overall outcomes from this Study (One) could be explained in the following terms:-

1) A number of studies show that females achieve higher field independent outcomes than field dependent outcomes, than males on embedded shape tests, i.e. females are more field independent (Witkin, 1972).

2) A difference in level of maturity, cognitively and socially, between females and males at a particular age, e.g. the age of the individuals used in the sample for this Study, which allows a higher level of cognitive functioning and conscientiousness (social maturity/ responsibility) to be directed towards academic performance/attainment, which includes school tests and examinations, i.e. Piagetian developmental stage of Formal Operations.

3) The females of the sample for the Study are likely to have approached the three field dependent – field independent tests more seriously because they were more conscientious as referred to in item (2) above.

4) The females were generally more 'able' cognitively and academically than the males in the sample for this Study (as possibly evidenced by the school subject attainment/ performance scores, supplied by the school attended by the sample members).

5) The traditional school curriculum is changing to allow females to experience school subjects once predominantly allocated to males, i.e. school subjects having a large spatial element within them, e.g. product design and realisation. This coupled with the 'extended' aspects of embedded shapes (figures) tests as they relate to wider perceptions which are likely to include environmental and verbal/language skills, may account for the overall performance superiority of females compared to males within this Study (Witkin, 1962 and 1972).

6) The nature of the three embedded tests and two school subject scores used, only the EST3 was totally spatial, the SWT2 and NSWT1 has an associated verbal component, as do the

school subjects of Science (General) and Modern Language (French), all of which, arguably, favoured the females more than the males.

So therefore, the investigation of the use of the EST3, SWT2 and NSWT1, requires to be explored further in terms of the measurement of field dependence – field independence using spatial and verbal modalities; how these instruments/ measurements relate to performance/ attainment in school subjects from a field dependence – field independence perspective; and do such investigations reveal any differences between males and females.

Chapter 11

Study Two

11.1 Introduction

The purpose of Study Two was to use the Embedded Shapes Test, Version Three (EST3); Sense Words Test, Version Two (SWT2); and Non-Sense Words Test, Version One (NSWT1) as measures of field dependence – field independence with a larger sample than that used in Study One. Also, to continue the investigation of possible relationships between field dependence – field independence, as measured by the above 'tests', and school subjects performance/attainment.
Therefore, the research questions, i.e.

1. Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?

2. Is it possible to measure field dependence – field independence using a verbal modality?

3. Is it possible to show a relationship between the measurement of field dependence – field independence, ability, and attainment in school subjects?

continue to be valid in the context of this Study (Two).

The school subjects used in Study Two were a Modern Language (French), and Design and Technology (Product Design). These subjects were considered appropriate because of the verbal component in the case of a Modern Language (French), and the spatial components in the case of Design and Technology (Product Design), in relation to SWT2, NSWT1 and EST3, respectively.

11.2 Method

i) Sample

The sample consisted of ninety-three Year Eight students, forty-nine males and forty-four females, from an urban comprehensive school.
This school was a different one to that used in Study One, situated in a different Local Education Authority, and the two schools separated geographically by approximately ten miles.

Selection of the students for the sample was governed (as with Pilots One and Two, and Study One) by timetabling convenience on the part of the school, and consisted of three mixed ability classes.

ii) Materials

The following three tests/versions were used in Study Two. A full description of each of these tests/versions has already being given in terms of their initial and modified forms, i.e. subsequent versions, where applicable, in Chapter 9 (Pilot Studies One and Two), and Chapter 10 (Study One).

a) Embedded Shapes Test, Version Three (EST3).

b) Sense Words Test, Version Two (SWT2)

c) Non-Sense Words Test, Version One (NSWT1)

d) School Subjects Performance/Attainment Data

The school from which the testees of the sample came, was asked for recent, in relation to the time of the administration of the field dependence – field independence measures used in this study, school examination results, in any school subjects achieved by the testees.
The response to the above requests was a Modern Language (French) and Design and Technology (Product Design) examination result for each testee.
Both of the above school subject examination results were given as a percentage.

e) Graphical Equipment

Each testee was supplied with an HB pencil and a pencil eraser.

iii) Procedure

General Comments
The sample was divided into three sub-samples of approximately thirty, each sub-sample consisted of approximately equal numbers of males and females.
With each sub-sample the seating positions of the testees were arranged in a small sized lecture theatre in such a manner so as to ensure that there was space between each testee and that the opportunity for one testee to look at the work of another testee, i.e. either side or in front of, was minimised.
There was no attempt made to separate males from females.

Although three ‘tests’ were administered in this Study in one session, they were given out, ‘worked through’, and collected in separately.
Each subject was given an HB pencil and a pencil eraser before the ‘first test’ was given out. Once the first sub-sample had completed all three tests, it left the lecture theatre and was followed by the second and then the third sub-samples.
Throughout the administration of each ‘test’ and within the overall session, the need for maintaining standard test/examination conditions, at all times, was emphasised. The procedure for the administration of each of the following three ‘tests’, i.e. EST3, SWT2 and NSWT1, was the same as that described in the corresponding section to this one,11.2 Method/ iii) Procedure, in Study One, Chapter10.

11.3 Results and Analysis

i) Results

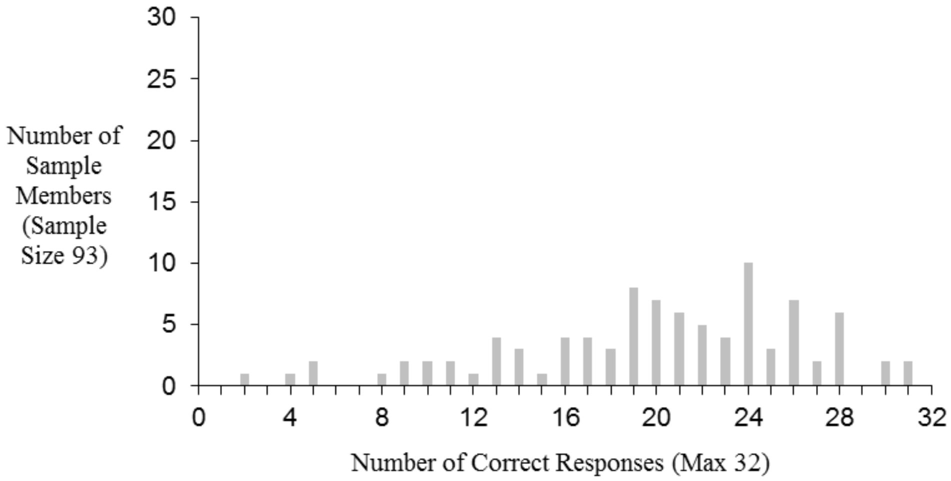
General Comments
The general response of the sample members used in this Study was positive in that the majority appeared to understand readily the task they were required to do with each of the three ‘embedded’ tests used, i.e. EST3, SWT2, and NSWT1. However, some of the sample members were unable to achieve any correct responses to the Practice Section (B) for the EST3, although they did achieve some correct responses to the Response Section (C) of this test. Also, the same sample members achieved various numbers of correct responses to the SWT2 and NSWT1.

For the purpose of the analysis used in this study, only the raw scores from the Response Section (C) of the EST3 were used, to give a degree of compatibility with the SWT2 and NSWT1, since these two ‘embedded’ tests did not have a Practice Section. All three of the ‘embedded’ tests had a Worked Example(s) Section, which was ‘worked through’, with the participation of the testees, by the administrator, to enable them to attempt/complete the tests.

a) Embedded Shapes Test, Version Three (EST3)

The range of raw scores from the Response Section (C) of the EST3, was wide, ranging from 2 to 31 (32 was the maximum score possible). However, most of the scores occurred in the upper part of this range, Figure 11.1. In terms of males and females, this range was from 2 to 28 and 9 to 31 respectively.

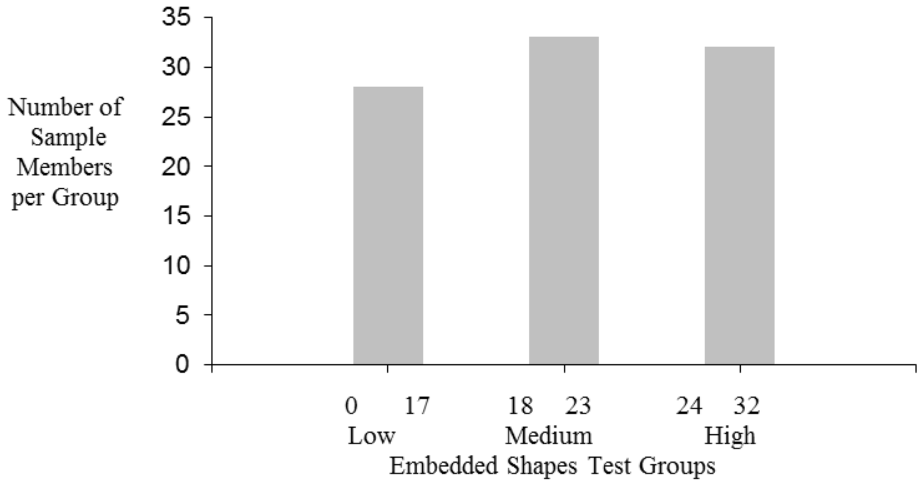
Figure 11.1 Frequency Distribution of Correct Responses (C) (raw scores) for the Embedded Shapes Test, Version Three (EST3) - Study 2



The number of correct responses to the test items/questions of the Response Section (C) did not differ very much from the number of test items/questions attempted by the majority of the testees, although there were six notable exceptions, i.e. six testees who obtained very few correct responses in relation to the number of test items/questions they attempted. Also, all of the testees attempted in excess of half of the test items/questions presented in the Response Section (C), with most attempting the majority of the test items/questions.

The raw scores from Response Section (C) of the EST3, were arranged into three groups to give a 'low', 'medium' and 'high' group relative to the field dependent – field independent continuum, Figure 11.2.

Figure 11.2 Correct Responses from Response Section (C) (raw scores) arranged into three groups of Low, Medium and High for the Embedded Shapes Test, Version Three (EST3) - Study 2

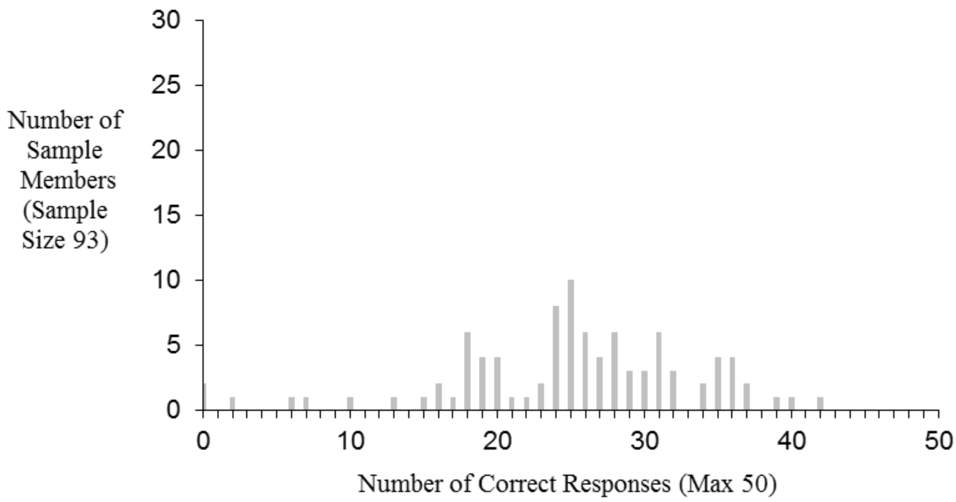


The above arrangement enabled the full range of raw scores to be treated with a greater degree of sensitivity, and to take into account an interface between the designation of field dependence and field independence across a sub-range of raw scores, rather than from the midpoint of the full range of raw scores.

b) Sense Word Test, Version Two (SWT2)

The range of raw scores for the SWT2 was limited, throughout the sample. The range of raw scores was from 0 to 42, Figure 11.3. In terms of males and females, the range was from 7 to 39, and from 0 to 42 respectively.

Figure 11.3 Frequency Distribution of Correct Responses (raw scores) for the Sense Word Test, Version 2 (SWT2) - Study 2

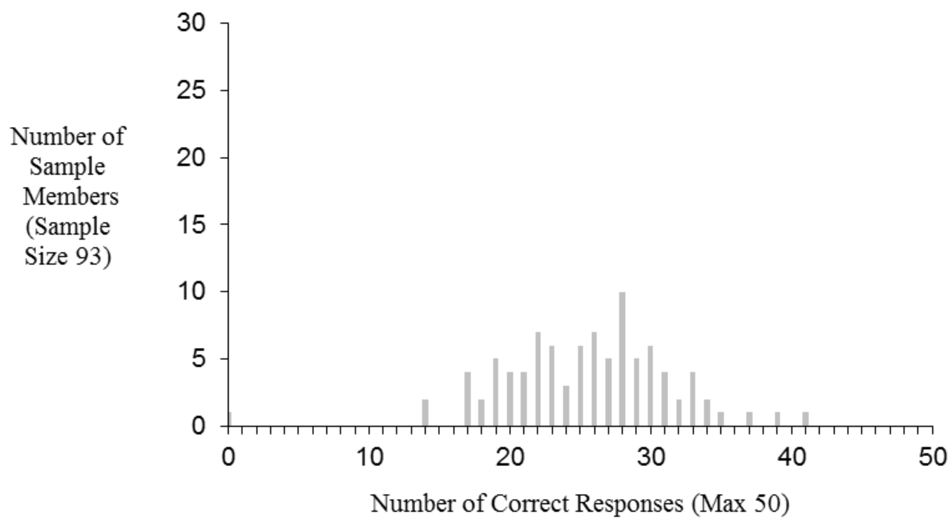


The number of correct responses to the test items/questions presented did not differ very much from the number of test items/questions attempted by the majority of the testees, although there was one notable exception. Most of the testees only attempted about a half (some slightly higher and some slightly lower, in roughly equal proportions) of the test items/questions presented, within the allocated time for the completion of the SWT2.

c) Non-Sense Word Test, Version One (NSWT1)

The range of raw scores for the NSWT1 was similar to that of the SWT2 in that the overall range was very nearly the same, but the spread of raw scores was concentrated near the middle of the range, Figure 11.4

Figure 11.4 Frequency Distribution of Correct Responses (raw scores) for the Non-Sense Word Test, Version 1 (NSWT1) - Study 2



For the sample, the range of raw scores on the NSWT1 was from 0 to 41. In terms of males and females, the range was from 14 to 41 and from 19 to 39 respectively.

The number of correct responses to the test items/questions presented did not differ very much from the number of items attempted for all of the testees. Also, the difference between the number of test items/questions attempted and those correctly answered was about the same for the SWT2 for all of the testees, apart from one notable exception. Again, most of the testees only attempted about a half (some slightly higher and some slightly lower, in roughly equal proportions) of the test items/questions presented, within the allocated time for the completion of the NSWT1.

d) School Subject Performance/Attainment Data

Performance/attainment data was obtained for the school subjects of Modern Languages (French) and Design and Technology (Product Design).

The scores for each of these school subjects were given as a percentage and ranged from 23 to 78 for French, and 23 to 59 for Product Design, for the sample.

However, for Design and Technology (Product Design), there were only twenty-one scores supplied, by the school, out of a possible total of ninety-three sample members. Therefore, to attempt to use this number of scores, with the seventy-one scores obtained for Modern Language (French), would have produced invalid outcomes when used with an MANOVA.

ii) Analysis

When discussing the results/analysis of this Study (Two), the following 'key' will be employed:- Embedded Shapes Test, Version Three (EST3) = EST3, Groups 1, 2, and 3; Sense Word Test, Version Two (SWT2) = 'Sense'; Non-Sense Word Test, Version One (NSWT1) = 'Nons'; Modern Language (French) = 'Lang'; Male (Sex 1) and Female (Sex 2).
The means and standard deviations for each of the variables and the overall sample of this Study (Two) are shown in Table 11.1.

Table 11.1 Means and Standard Deviations for each of the Variables and the Overall Sample for Study 2

Variable	Cases	Mean	Std Dev
SEX	93	1.4731	.5020
EST3	93	19.9140	6.3957
Sense (SWT2)	93	25.1075	8.3033
Nons (NSWT1)	93	25.4516	6.0244
Lang (French)	93	37.5806	24.0269
DT (Prod. Des.)	93	8.0000	15.5480

A Multivariate Analysis of Variance (MANOVA) was first used with EST3 (1, 3) and Sex (1, 2) designated as a 'factor(s)' and 'Sense', 'Nons' and 'Lang' designated as a 'variable(s)'. The EST3 factor was divided into three groupings. These were derived from the EST3 raw scores for the sample in terms of males and females, which were allocated into a 'high', 'medium' or 'low' group (3, 2 and 1 respectively) for both males and females, in relation to a designated region of the field dependence – field independence continuum, Figure 11.2.
The EST3, three groupings, for both males and females, were then analysed in relation to the variables 'Sense', 'Nons' and 'Lang' in terms of Sex (male and female), and for the total sample.

Also, the analysis of the EST3, three groupings, for both males and females in relation to school subject performance/attainment, i.e. Modern Language (French), used a percentage score in relation to each male and female of the sample. A 'Pearson-Product Moment' correlation matrix was also generated between the factors within this Study (Two).

11.4 Discussion and Conclusion

i) Discussion

The terminology 'Main Effect' as utilised by Kepple, G. and Saufley, W.H., Jr., (1980, pp212-218), is used in the MANOVA Tables and Figures throughout Study 2306.

The MANOVA revealed some interactions with several significant 'F' values between the different factors and variables used in this Study (Two).
Table 11.2 shows that the mean values for the SWT2, 'Sense' variable, were higher for females than those for males in each of the three EST3 Groups.

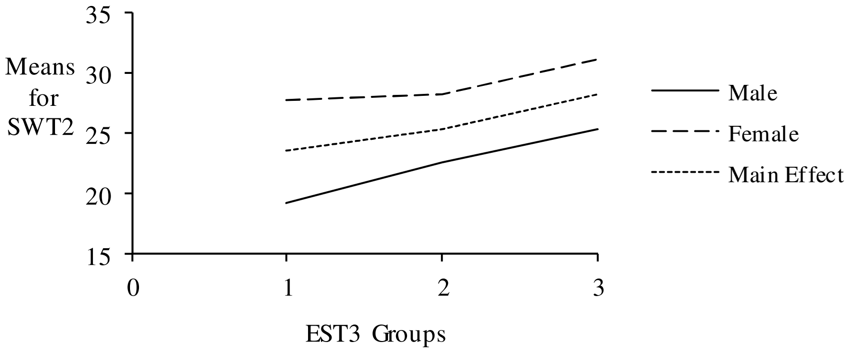
Table 11.2 Means for Male, Female and Main Effect for Sense Word Test, Version Two (SWT2) – Study 2

EST3 Group	1	2	3
Male	19.3	22.6	25.4
Female	27.8	28.2	31.1
	(19.3 + 27.8) ÷ 2	(22.6 + 28.2) ÷ 2	(25.4 + 31.1) ÷ 2
Main Effect	23.55	25.4	28.25

The greatest difference occurring in EST3 Group 1, the 'low field dependent - field independent group', which is not altogether unexpected since the 'Sense' test is considered to be a measure of the field dependence – field independence, as is EST3.

On this basis the SWT2, 'Sense' values for each sex for EST3, Groups 2 and 3, are closer giving an approximate constant difference between the two lines and therefore, a virtual parallel shape, Figure 11.5.

Figure 11.5 from Table 11.2 for Sense Word Test, Version Two (SWT2) - Study 2



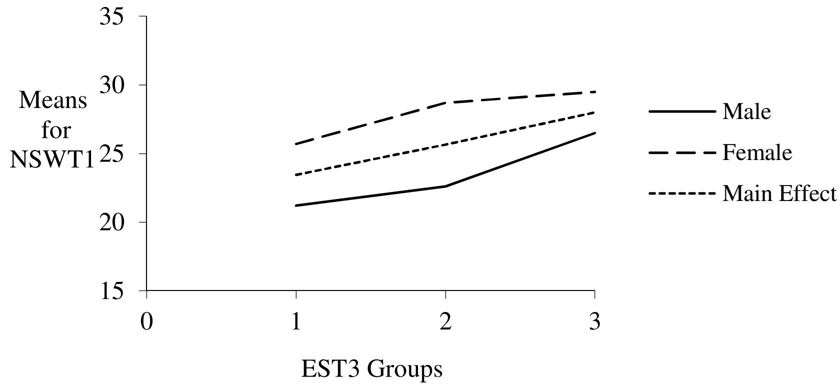
The overall position and shape of the ‘female line’ compared to the ‘male line’, suggests a greater degree of field independence for females than males in terms of the ‘Sense’ means for each of the EST3 Groups used, although the male ‘Sense’ means increase with each consecutive EST3 Group. With both male and female the magnitude of the ‘Sense’ means increase with each consecutive EST3 Group. There is no interaction between the ‘female line’ and the ‘male line’, with a ‘main effect line’ occurring between the two, Figure 11.5

Table11.3/Figure11.6 show that the mean values for the ‘Nons’ variable is higher for females than males in each of the EST3 Groups, with the greatest difference occurring in EST3, Group 2.

Table 11.3 Means for Male, Female and Main Effect for Non-Sense Word Test, Version One (NSWT1) – Study 2

EST3 Group	1	2	3
Male	21.2	22.6	26.5
Female	25.7	28.7	29.5
	$(21.2 + 25.7) \div 2$	$(22.6 + 28.7) \div 2$	$(26.5 + 29.5) \div 2$
Main Effect	23.45	25.65	28

Figure 11.6 from Table 11.3 for Non-Sense Word Test, Version One (NSWT1) - Study 2



There is relatively little difference between the 'Nons' means for females and males across each of the EST3 Groups, although there is an increase in the magnitude of the 'Nons' means with each consecutive EST3 Group. There is no interaction between the 'male line' and the 'female line', with a 'main effect line' occurring between the two, Figure11.6.

With Tables 11.4 and 11.5/ Figure11.7, the 'Sense' and 'Nons' means for both male and female have been added to enable a composite figure to be obtained.

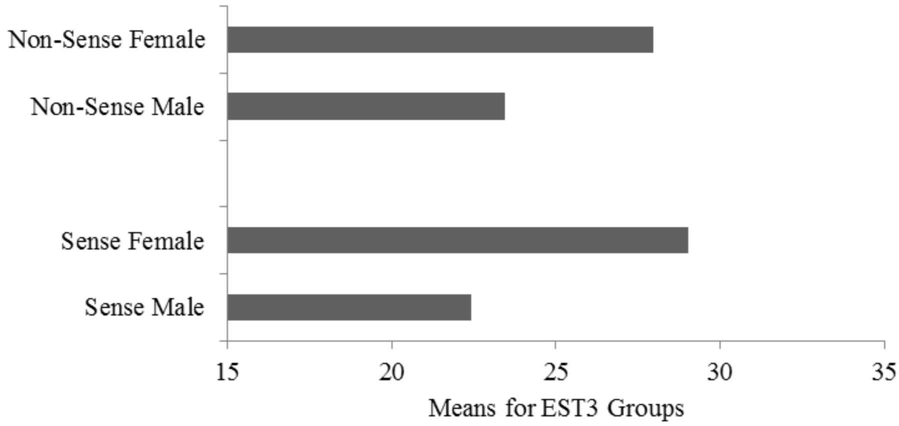
Table 11.4 Means for EST3 Groups by SWT2 and Sex

		Male	Female
EST3 Group	1	19.3	27.8
	2	22.6	28.2
	3	25.4	31.1
		(19.3 + 22.6 + 25.4) ÷ 3	(27.8 + 28.2 + 31.1) ÷ 3
Means		22.43	29.03

Table 11.5 Means for EST3 Groups by NSWT1 and Sex

		Male	Female
EST Group	1	21.2	25.7
	2	22.6	28.7
	3	26.5	29.5
		(21.2 + 22.6 + 26.5) ÷ 3	(25.7 + 28.7 + 29.5) ÷ 3
Means		23.43	27.97

Figure 11.7 from Tables 11.4 and 11.5 - Means for EST3 Groups by SWT2 and NSWT1 and Sex - Study 1



Since the 'Sense' and 'Nons' tests are considered to be measuring the same thing, in essence, i.e. field dependence – field independence, and in a similar manner, i.e. the testee circling groups of letters, forming real words ('Sense') and non-real words ('Nons'), within the same time limit, this amalgamation was considered to be worthy of exploration from the point of view of possibly giving greater insights into differences between males and females when using this type of arrangement to measure field dependence – field independence.

From Tables 11.4 and11.5 /Figure 11.7, the combined mean values for the 'Sense' and 'Nons' variables for both male and female have been plotted against the combined mean values for the EST3 factor across each of its three groupings.

Therefore, Figure 11.7 shows a more evenly distributed difference between males and females, across the three EST3 Groups, with the females obtaining higher levels on the field dependence – field independence continuum for both 'Sense' and 'Nons' within and across each of the three EST3 Groups.

However, the difference between the 'Sense' and 'Nons' combined mean values, Tables 11.4 and 11.5, for both male and female is not very large with the two lines intersecting at their mid-points, corresponding to the EST3 value for Group 2, Figure 11.7.

As with Study One, both males and females are producing better results, i.e. a greater number of correct responses, thus giving a greater magnitude of raw score, for SWT2 test items/questions than NSWT1 test items/questions.

Table 11.6/ Figure 11.8 shows that the mean values for the Modern Language (French) variable are higher for females than those for males in each of the EST3 Groups, the greatest difference occurring in EST3 Group 2, corresponding to a medium level on the field dependence – field independence continuum. Also, there is no interaction between the 'female line' and the 'male line', with the 'main effect line' occurring between the two, Figure 11.8.

Table 11.6 Means for Male, Female and Main Effect for Modern Language (French) – Study 2

EST3 Group	1	2	3
Male	39.1	39.7	53.4
Female	46.2	52.1	58.6
	(39.1 + 46.2) ÷ 2	(39.7 + 52.1) ÷ 2	(53.4 + 58.6) ÷ 2
Main Effect	42.65	45.9	56

Figure 11.8 from Table 11.6 for Modern Language (French) Study 2

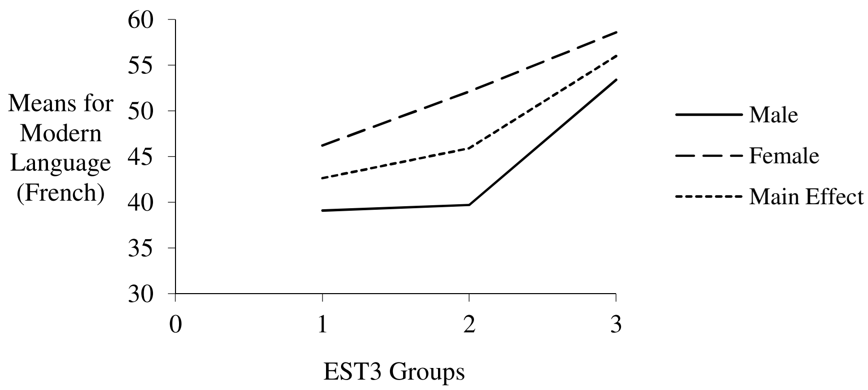


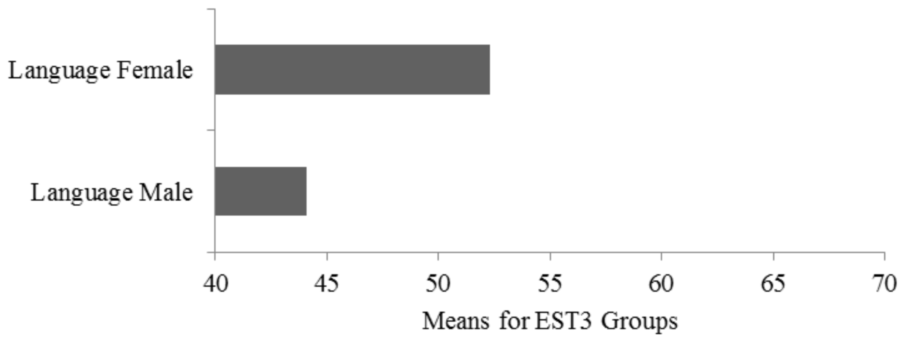
Table11.7/ Figure 11.9 show the combined mean values for the Modern Language (French) variable, for both male and female, plotted against the combined mean values for the EST3 factor across each of its three groupings.

It can be seen from Figure 11.9 that the females have achieved a higher outcome than the males, within and across each of the three EST3 Groups, which corresponds to relatively higher levels of field independent functioning.

Table 11.7 Means for EST3 by Modern Language (French) and Sex

		Male	Female
EST3 Group	1	39.1	46.2
	2	39.7	52.1
	3	53.4	58.6
		(39.1 + 39.7 + 53.4) ÷ 3	(46.2 + 52.1 + 58.6) ÷ 3
Means		44.07	52.30

Figure 11.9 from Table 11.7 - Means for EST3 Groups by Modern Language (French) and Sex - Study 2



From Table 11.8, Analysis of Variance, Tests of Between-Subject Effects, it can be seen that both the EST3 factor and Sex variable are significant (F = 9.44; df 2,85; p = 0.001 and F = 28.03; df 1, 85; p = 0.001 respectively).

Table 11.8 Tests of Between-Subjects Effects
Tests of Significance for T1 using SEQUENTIAL Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	4025.80	85	47.36		
Constant	120445.74	1	120445.74	2543.07	.000
EST3	894.65	2	447.32	9.44	.000
SEX	1327.76	1	1327.76	28.03	.000
EST3 by SEX	34.06	2	17.03	.36	.699

From Table 11.9, Analysis of Variance, Tests involving ‘Test Type’ Within-Subject-Effect, it can be seen that none of the variables are significant.

Table 11.9 Tests involving 'TESTTYPE' Within-Subject Effects
Tests of Significance for T2 using SEQUENTIAL Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	1338.32	85	15.74		
Test Type	.79	1	.79	.05	.823
EST3 by Test Type	5.51	2	2.76	.17	.840
SEX by Test Type	40.37	1	40.37	2.56	.113
EST3 by SEX by Test Type	39.00	2	19.50	1.24	.295

(It should be noted that Table 11.8 is displaying Between-Subject Effects whereas Table 11.9 is displaying Within-Subject Effects)

From Table 11.10, Analysis of Variance Test of Between-Subjects Effects, it can be seen that the two variables of EST3 and Sex, are significant ($F = 8.07$, df 2, 70; $p = 0.001$), and ($F = 9.10$; df 1, 70; $p = 0.004$), respectively, but the interaction between EST3 and Sex is not significant ($F = 0.664$; df 2, 70; $p = 0.518$).

Table 11.10 Tests involving Tests of Between-Subjects Effects

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Main Effects EST3 SEX	3662.054 2131.798 1201.258	3 2 1	1220.685 1065.899 1201.258	9.253 8.079 9.106	.000 .001 .004
2-way Interactions EST 3 SEX	175.110 175.110	2 2	87.555 87.555	.664 .664	.518 .518
Explained	3837.164	5	767.433	5.817	.000
Residual	8575.230	65	131.927		
Total	12412.394	70	177.320		

Since there were only sufficient raw scores available for one school subject in this Study (Two), it was not possible to perform an Analysis of Variance-Tests involving 'Subject' (i.e. school subject(s)) Within-Subject-Effect.

A further analysis for this Study involved the production of a correlation matrix/value for each of the variables involved, Table 11.11

Table 11.11 Correlation Matrix for the Variables of Study 2

	SEX	EST3	Sense (SWT2)	Nons (NSWT1)	Lang (French)	DT (Prod.Des.)
SEX		.2159	.4023**	.4354**	.2996*	-.1852
EST3			.4343**	.4696**	.3830**	-.1253
Sense (SWT2)				.7002**	.4571**	-.0342
Nons (NSWT1)					.5435**	-.2120
Lang (French)						-.3015*
DT (Prod. Des.)						

2- tailed signif: * .01 ** .001

In terms of significance and level of significance, the correlations 'r' between EST3, SWT2 and NSWT1, Modern Language (French) and Design and Technology (Product Design), are shown in Table 11.12

Table 11.12 Significant Correlations from Table 11.11 – Study 2

Variables	Correlations (r)	Significance (p)
Sex/Lang (French)	0.2996	< 0.01
DT(Prod. Des.)/Lang(French)	-0.3015	< 0.01
Sex/Sense (SWT2)	0.4023	< 0.001
Sex/Non-Sense (NSWT1)	0.4354	< 0.001
EST3/Sense (SWT2)	0.4343	< 0.001
EST3/Non-Sense (NSWT1)	0.4696	< 0.001
EST3/Lang (French)	0.3830	< 0.001
Sense (SWT2)/Non-Sense (NSWT1)	0.7002	< 0.001
Sense (SWT2)/Lang (French)	0.4571	< 0.001
Non-Sense (NSWT1)/Lang (French)	0.5435	< 0.001

The correlations between EST3, SWT2 and NSWT1 are both positive and fairly high at 0.4343 and 0.4696 respectively, both with a significance of $p<0.001$.

Such values are to be expected since all three 'tests' are considered to be measuring field dependence – field independence, using a similar methodology, i.e. disembedding, in spite of a difference in modality and degree of modality between the three 'tests'.

This is an interesting result because it tends to over-ride the strong influence of the verbal nature of the SWT2, i.e. the use of real words for both the complex and simple component of each test item/question within the test, suggesting that 'disembedding ability' is taking place which in turn is related to the level of field dependence - field independence and the designation of a location on the bi-polar continuum.

A similar situation to that of the SWT2 appears to have taken place with the NSWT1, but producing a slightly higher correlation, i.e. 0.4696 compared to 0.4343. This difference between the SWT2 and the NSWT1 is not unexpected since the 'words' for the NSWT1, for both the complex and simple component of each test item/question, consist of a collection of letters which in turn resemble overall shapes rather than real words. Therefore, since these 'shapes' cannot be read as real words they have to be perceived and considered more in terms of shapes than real words, thus making them more akin to geometrical shapes than real words because their verbal usage and comprehension no longer applies or applies very little.

In other words, when one tries to locate the simple 'non-sense word' within the complex 'non-sense word', because both of them consist of a number of letters which do not relate to any known words, i.e. phonetically, verbal thinking is not possible. Therefore, in attempting to locate the simple shape in the complex shape one is forced to consider the shapes of the letters or overall shape of the collection of letters for both the complex and simple component of each test item/question.

Even if a testee thinks in terms of looking for particular letters by name, they would have to look for the letter shape that corresponds to the letter name they are looking for, in order to locate or disembed it. Arguably, a knowledge of letter shapes assists the task of locating or disembedding the required letter(s) but the 'modus operandi' is more to do with shape than verbal meaning.

The opposite approach and therefore a different type of thinking is taking place with the SWT2, i.e. since real words are used for both the complex and simple component of each test item/question, the verbal aspect is likely to be an influencing factor in the level of efficiency and success with which each test item/question can be completed to gain a correct response.

This consideration may also be influential in relation to the speed at which the simple word can be 'circled' within the complex word of the SWT2. Table 11.4 and Table 11.5/ Figure

11.7 show higher means for SWT2 when compared to NSWT1, across each of the three EST3 Groups for the females. Although, when the means for both males and females are considered from Table 11.4 and Table 11.5, the influence of a field dependent – field independent designation is in evidence.

However, in spite of these considerations applicable to the SWT2, there remains a substantial disembedding skill within it and therefore, an influence on the measurement of field dependence - field independence.

The correlations between EST3, SWT2, NSWT1, and Modern Language (French) are 0.3830, 0.4571, and 0.5435 respectively, all of which have a significance value of $p<0.001$.
For Design and Technology (Product Design), EST3, SWT2 and NSWT1, the correlations are -0.1253, -0.0342, and -0.2120 respectively, none of which are significant at any level.
The correlation between SWT2 and NSWT1 is 0.7002 at significance level $p<0.001$.

This is not altogether surprising since the tasks are similar, i.e. circling a small group of letters in a larger group of letters, and the methodology of each, i.e. the presentation of a disembedding task, is essentially the same, in spite of real words being used in one, and 'non-sense' words (collections of letters) being used in the other. Therefore, whether there is a verbal component, i.e. SWT2, real words, or a partially verbal and geometrical component, i.e. NSWT1, 'non-sense' words/collections of letters, both are influential in designating the sample members a position on the field dependence – field independence continuum.

The correlations between Sex and EST3 is not significant at a value of 0.2159, whereas the correlation between Sex, SWT2 and NSWT1, at 0.4023 and 0.4354 respectively, are significant at the $p < 0.001$ level.

The correlation between Sex and Modern Language (French) is not significant at a value of 0.2996, or between Sex and Design Technology (Product Design) at a value of -0.1852.

It may be possible to explain the above results, i.e. the non-significant correlations between Sex, Modern Language (French) and Design Technology (Product Design) respectively, in terms of the following influential factors:-
First, although the characteristics of the school subject of Design Technology (Product Design) are predominantly spatial, it could be argued that 'spatial' can be differentiated into an abstract and/or concrete level, i.e. abstract – greater mental agility required to visualise an

object (2D or 3D) represented graphically, compared to the same object, as a real object existing in the 'real world', i.e. concrete , which can be viewed physically from different angles and touched or handled, and therefore, rendering the task of transposing the object from a graphical representation to that of a real object in the real world (or vice versa), unnecessary. Level of experience of this two-way interaction can have a significant influence in performance/attainment achieved in Design and Technology (Product Design). The notion of level of experience also applies to Modern Language (French), for students/testees whose first language is English and who have had little or no experience of using French on a regular basis for everyday living. This presents particular difficulties when French is required to be spoken or written as part of the school curriculum. Therefore, different difficulties will be experienced with each school subject, e g Design and Technology (Product Design) and Modern Languages (French), for both males and females, which would help to explain (for the reasons given above) the low correlations associated with both of these subjects within this Study (Two).

Secondly, the characteristics of the SWT2 are essentially verbal, in contrast to that of the NSWT1, in spite of letters being used. This would help to explain the higher, significant values, because the testees, whatever their position on the field dependent - field independent continuum, have more experience of using and manipulating letters/words as part of everyday language, in terms of the use of language, i.e. spoken, read and written, in all subjects of the school curriculum.

Thirdly, there is also the further possibility of there being a differential level of spatial vs verbal ability between the males and females of the sample, which may have been influential on the outcomes produced.

ii) Conclusion

The lines of enquiry in this Study (Two) were the same as those for Study One. This was done to confirm, or otherwise, the findings from Study One. Therefore, the five lines of enquiry, i.e. (1) to (5) stated at the beginning of Section 10.4,ii) Conclusion, of Chapter 10, Study One, are applicable to the following statements:-

The raw scores for the EST3, SWT2 and NSWT1 were obtained directly and the raw score/ percentage score for the school subjects of Modern Language (French) and Design and Technology (Product Design), obtained indirectly.

Therefore, assuming, as in Study One, that the assessment of Modern Language (French) in Study Two was achieved without recourse to spatial ability, i.e. viewing pictures or drawing, whereas one would expect the use of diagrams and drawings in Design and Technology (Product Design), then one would reasonably expect meaningful interactions between the EST3, SWT2 and NSWT1, and Modern Language (French) and Design and Technology (Product Design) scores in relation to verbal and spatial ability for both sexes, i.e. EST3 requires a full range of thinking skills, including spatial, and the SWT2 and NSWT1, especially the SWT2, require verbal skills, with all three considered to be measuring field dependence – field independence it terms of a spatial and verbal modality respectively (although arguably, NSWT1 requires a higher degree of spatial skills than does SWT2).

Again, as in Study One, considerations of innate ability or apparent ability gained due to particular educational experiences and opportunities, as well as academic achievement/ attainment and learning differences between male and female, are subsumed within the range of ability of the sample used for this Study (Two).

Therefore, examining the Tables 11.2 to 11.10 and Figures 11.5 to 11.9 respectively, of this Study (Two), it can be seen that the females performed at a higher level than the males in each of the three groups for the EST3, SWT2, NSWT1, and Modern Language (French) outcomes.

The reasons for the overall outcomes from Study Two can be explained in a similar way to those given in Study One, i.e. (1) to (5) inclusive.

If there had been more Design and Technology (Product Design) raw scores/percentages, making it possible to have included them in the MANOVA, then it is interesting to speculate as to whether or not the females would have outperformed the males of the sample used in this Study(Two), as was the case with the correlation data.

Chapter 12

Study Three

12.1 Introduction

The purpose of this Study (Three) is:-

1. To continue to investigate the use of the three field dependence – field independence measures or 'tests'/instruments, i.e. Embedded Shapes Test, Version Three (EST3); Sense Words Test, Version Two (SWT2); and Non-Sense Words Test, Version One (NSWT1);
2. To investigate the measurement of field dependence – field independence within a verbal modality using the medium of text, through the use of the Chronological Order Integration Test (COIT);
3. To investigate associated psychological attributes that are possibly related to the measurement of field dependence – field independence by use of alternative measurements through the use of additional instruments, i.e. Chronological Order Integration Test (COIT) (Riding, 1990); and Gestalt Picture Completion Test (GPCT) (Street, 1931).
4. To provide a comparison between the results achieved on the above measures/'tests' and those achieved on a range of school and GCSE subjects, by the members of the sample used in this Study (Three); and
5. To investigate possible relationships between all of the above measures/'tests', and school and GCSE subjects performance/attainment, by the use of statistical analysis.

In addition to the above aims, the sample size was more than doubled to that of Study Two. A detailed description of the Chronological Order Integration Test (COIT) and the Gestalt Picture Completion Test (GPCT), will be given in Section 12.2 - Method, Sub-section 12.2

ii) – Materials of this Chapter - 12.
The theoretical basis of the Chronological Order Integration Test (COIT) and the Gestalt Picture Completion Test (GPCT) is referred to in Chapter 8, Further Developments, Sections 8.2 and 8.3 respectively.

Also, Passages A and B to the COIT, and the 'test booklet' and 'test items/questions answer sheet' to the GPCT, can be found in the Appendices.

In addition, details of the school and GCSE subjects used, will be given in Section 12.2 - Method, Sub-section 12.2ii) - Materials.

With regards to the research questions of the thesis, i.e.

1. *Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?*
2. *Is it possible to measure field dependence – field independence using a verbal modality?*
3. *Is it possible to show a relationship between the measurement of field dependence – field independence, ability, and attainment in school subjects?*

they are further addressed as follows:-

1. Using the EST3 with an additional sample of testees to explore its capacity to measure the construct of field dependence – field independence throughout its continuum.
In addition, by including the GPCT, the assessment/ measurement of an ability which appears to be opposite yet complementary to field dependence – field independence, using a spatial modality, can be made and compared to field dependence – field independence.
2. Using the SWT2 and NSWT1 the measurement of field dependence – field independence using a verbal modality is further explored with an additional sample. Also, the inclusion of the COIT extends the measurement of field dependence – field independence using a verbal modality in terms of 'text'.
Thus, under the auspices of research questions 1 and 2, attempting to further the understanding of the mechanism(s) involved in the assessment of the construct of field dependence – field independence.
3. With the addition of another sample (to that of Studies One and Two)measurements of field dependence – field independence using both a spatial and verbal modality can continue to be compared (as an extension from Studies One and Two) to performance/ attainment in school subjects. In addition, with this Study (Three) such a comparison can include performance/ attainment in GCSE subjects.

12.2 Method

i) Sample

The sample consisted of two hundred and twenty-four Year Eight students, one hundred and twenty-two males and one hundred and two females, from a comprehensive school situated in a spa town in England. Since the above sample consisted of the entire Year Eight cohort of students, a wide ability range was automatically included and there was no need for 'selection' considerations to be made in arranging the administration of the tests.

The sample consisted of seven ‘forms’ or groups, composed of males and females (each group was of mixed ability) as shown in Table 12A.

Table 12.1 Composition of the Overall Sample into Groups, Males and Females

Group	Males	Females	Total
1	14	17	31
2	16	15	31
3	15	18	33
4	14	18	32
5	15	18	33
6	14	18	32
7	14	18	32

ii) Materials

a) Embedded Shapes Test, Version Three (EST3)

b) Sense Words Test, Version Two (SWT2)

c) Non-Sense Words Test, Version One (NSWT1)

A full description of each of the above tests/versions has already been given in terms of their initial and modified form, i.e. subsequent versions, where applicable, in Chapter 6, Development, Chapter 7, Comparisons, Chapter 9, Pilot Studies One and Two, and Chapter 10, Study One. In Chapter 11 (Study Two), they were used in exactly the same way in terms of their format and the procedure followed, which will be duplicated in this Study (Three)

d) The Chronological Order Integration Test (COIT)

Passages A and B (to be read out to the testees by the administrator) and lined writing paper for the responses of the testees.

e) The Gestalt Picture Completion Test (GPCT)

The pictures to the GCPT were arranged in booklet form, one for each testee. For the responses of the testees, to the test items/questions, an answer sheet was formulated by the researcher.

f) School Subjects Performance/Attainment Data

Information was requested from the school for each member of the sample on all school subjects in terms of 'test' results, i.e. percentages, and level of performance/ attainment, i.e. grades A to E.

Since the response to the above requests was limited, the researcher was given access to the school subjects report for each member of the sample. This meant that the performance/attainment levels for each school subject, for each member of the sample, at the end of the Summer Term/Academic Year of Year Eight, were obtained.

The administration of all of the 'tests' used was completed before or soon after this period i.e. summer and autumn term, which meant that both tests and school subject performance/attainment data were obtained within a relatively short time period, giving research validity.

The school subjects for which the above information was obtained were English (a combination of Language and Literature), Mathematics, Science (General), History, Geography, Design and Technology (Product Design and Food), Religious Education, Art, Music, Modern Language (French and German), and Physical Education.

g) GCSE Subjects Performance/Attainment Data

By the time of the final 'write up' of this thesis as a whole, the members of the sample had completed their G.C.S.E. Examinations. At the request of the researcher, the school provided all of the GCSE Examination results for each member of the sample.

As a consequence of the availability of this data, certain subjects were analysed (selected for statistical reasons) in relation to the other data obtained from this Study (Three).
The GCSE subjects were English Language, English Literature, Mathematics, Science (General), History, Geography, Design and Technology (Product Design).

h) Graphical Equipment

Each testee was supplied with an HB pencil and a pencil eraser.

iii) Procedure

General Comments

Since the overall sample consisted of seven ‘forms’ or groups, each of mixed ability, each of the ‘tests’ was administered using one ‘form’ at a time.

However, all of the ‘tests’ were not administered consecutively, one at a time, with each form, because of time-table considerations, and in the case of the Chronological Order Integration Test (COIT), it was administered over several days (See Below).

Therefore, the pattern of administration of all of the ‘tests’ was as follows:-

a) Embedded Shapes Test, Version Three (EST3);

b) Sense Words Test, Version Two (SWT2); and

c) Non-Sense Word Test, Version One (NSWT1) were administered in this order and consecutively;

The procedure for the administration of each of the above three ‘tests’ was exactly as that described in the corresponding section to this one, i.e. 2.iii), in Study One, Chapter 10 and 2.iii), in Study Two, Chapter 11.

d) Chronological Order Integration Test (COIT)

The administration of the COIT used the sequence of —Passage A; Passage B; written account of Passage A and Passage B, but not on consecutive days.

Therefore, the sequence of administering this ‘test’ for each ‘form’ of the overall sample was as follows:-

First day - Passage A - read to the testees by the administrator

Miss a day

Second day - Passage B - read to the testees by the administrator

Miss a day

Third day – the testees were asked to provide a written account of the story (contained in passages A and B) whether from passages A, B or a combination of the two, on an individual basis.

Each ‘form’ started and completed the overall sequence before another ‘form’ started the sequence. This was because the overall sequence for this ‘test’ fitted conveniently into a school week. Consequently, the ‘first day’ was Monday, the ‘second day’, Wednesday, and the ‘third day’, Friday.

First Day – Reading of Passage A

At the start of the above sequence for each 'form', a brief explanation was given with regards to the various activities involved in this 'test', i.e. listening, remembering and writing, as well as when they would be done.

Before the reading of Passage A, aloud to the 'form', by the administrator, the importance of sitting and listening quietly was referred to by the administrator.

The administrator also requested the testees not to make any notes or write anything down with regards to anything to do with the passage about to be read.

Once the above explanation and procedural points had been made to the 'form', the administrator read out Passage A.

No title was given to the passage, i.e. the Life and Work of David Livingstone, which was the subject of Passage A and Passage B to follow.

After the completion of the reading, the 'form' was allowed to go to their timetabled lessons.

Second Day – Reading of Passage B

Again, as with the general procedure prior to the reading of Passage A, testees were reminded of what they had to do and how to maximise their retention of the information contained in the story, i.e. by sitting still and listening quietly, and not to write anything down.

Once the above points had been made, Passage B was read out by the administrator, to the 'form'. As with Passage A, no title was given for Passage B.

After the reading of Passage B, the 'form' was allowed to go to their timetabled lessons.

Before the testees left the room, the administrator requested them not to discuss the 'Passage(s)' with their friends in the other 'forms' of Year 8.

Third Day - Written Account of Passage A and/or B

Each member of the 'form' was given a lined piece of paper, asked to put their name, form and date on the top, and then write down as many facts/pieces of information that they could remember from both of the Passages A and B that they had heard in the last few days.

They were also told that the order in which they remembered and wrote down facts/pieces of information in either Passage A or B did not matter, nor did attempting to match Passage A to B or the mixing up of facts/pieces of information from Passage A and B.

Also, that there was no time limit for this written component of the test.

No advice was given to the 'form' with regards to how they should present the facts/pieces of information, i.e. notes or prose.

Examination conditions were established and maintained with each of the sessions associated with the administration of the COIT, particularly the written session.
Once all members of the ‘form’ had written as much as they could, their written accounts were ‘collected in’ by the administrator and the ‘form’ allowed to go to their time-tabled lessons.

Due to the relatively small amount of time required to read Passages A and B, to each ‘form’ by the administrator, compared to the possible time required to produce a written account of remembered facts/pieces of information from Passages A and B, the two types of activity, i.e. reading - listening and writing, were arranged to be done either in a morning or an afternoon, to fit in with the school time-tabling arrangements.
However, the day-to-day sequence was maintained for all ‘forms’.
Within each ‘form’, the seating positions of the subjects were arranged in a normal sized classroom in such a manner so as to maximise the space between each testee.
There was no attempt made to separate males from females.

Although the first three ‘tests’ were administered in this Study (Three) in one session, per ‘form’, they were given out and worked through separately.
The additional two ‘tests’ in this Study (Three) were administered on other occasions.
All of the ‘forms’ and therefore the overall sample, worked through the same ‘tests’ in the same time period, i.e. the three field dependence – field independence measures/tests, i.e. EST3, SWT2, and NSWT1, before the COIT, which in turn was completed before the GPCT.

e) Gestalt Picture Completion Test (GPCT)

The test items/questions answer sheet was first given to the testees, and they were asked to complete the personal information section of the sheet.
Once this had been done, the test booklets were given out, face down, and the testees asked not to look at them until told to do so.
When all of the testees had been given a test booklet, the administrator briefly explained the nature and purpose of the test, i.e. to identify and name the common figure or object represented by the series of black and white patches in each of the presented pictures.
This was followed by the administrator referring to the practice items, and the testees looking at and attempting to name, by writing down their considered answers on the answer sheet, the figure or object in each of the two practice items.
The administrator then gave the official answers to the two practice items/questions, i.e. a

man's head/face and a type of aeroplane), to the testees so that they could check their responses. Assurances were also obtained from the testees that they fully understood what they were being asked to do and how to do it.

Before the testees attempted the practice items, the following points were made by the administrator:-

1. When looking at the presented pictures, each picture (and therefore the complete test booklet) can be turned around so that any one of the pictures can be viewed from a different or series of angles to the usual angle of viewing (varied orientation).
2. The test booklet can be held closer to or further away from one's eyes, in attempting to decipher any one of the presented pictures (varied distance).
3. A combination of the techniques employed in 1) and 2) above can be used together (varied orientation and distance simultaneously).
4. A single word or a short phrase would be acceptable as a means of providing an answer.
5. There was no time limit allocated to the completion of the two practice items.

Reference was now made to the main section of the test booklet and the corresponding section on the answer sheet by the administrator.

Also points 1) to 4) were reiterated and, in the case of point 5), the additional information of there being thirteen items/questions in the main section and no time limit for their completion.

The two practice and the thirteen response test items/questions included the following:-

Practice items/questions

A man, A man's face; An airplane (An aeroplane).

Response items/questions

A dog, A puppy; A boat, A sailboat; A cat, A pussy; A stove, An oven, A range;

A baby, A child, A boy; A table; A soldier, A Japanese soldier; A man on horse back;

A rabbit, A bunny; A locomotive, An engine; A boy on a tricycle or bicycle;

A man's face; A camera man, A picture man.

(Street, 1931)

Before the testees were allowed to start the thirteen test items/questions, they were told that if they were to finish while others were still working, to put their pencils down and wait quietly until all of the 'form' had finished.

Once all of the 'form' had completed the thirteen test items/questions, or done as much as they

could, the test items/questions answer sheet from each subject were collected in, as were the test booklets, by the administrator, and the 'form' allowed to go to their timetabled lesson at the appropriate time.
The GPCT was administered to each 'form' one after the other, as close to each other as timetabling requirements for Year 8 would allow.

Further General Comments
With all of the above 'tests', except the COIT, it was possible to administer them within a relatively short time, i.e. general organisation of each form, explanation and working time, but it was not possible to work with more than one 'form' in the time slots allocated for 'testing' purposes because of school/form time-tabling constraints.
This was particularly so with the COIT because it required three sessions per 'form', i.e. the reading of Passages A and B, and a written account of a combination of both passages, and it was not possible for them to be done on consecutive days because of the methodology employed in the administration of the 'test'.
As a consequence of the above factors, the administration of all of the 'tests' with each 'form', and therefore, the overall sample, took place over a period of several weeks.
Consequently, as each 'form' experienced the various 'tests' given, they were asked not to talk about the 'tests' to members of Year 8 in other 'forms'.

f) School Subjects

No procedural activity was necessary in relation to the need to administer tests or examinations to acquire data from school subjects.

g) GCSE Subjects

No procedural activity was necessary in relation to the need to administer examinations to acquire data from GCSE subjects.

h) Graphical Equipment

Each testee was given an HB pencil and a pencil eraser at the beginning of the session involved with the three field dependence – field independence tests.
For the written component of the COIT and the GPCT, each testee used their own pens.
Throughout the administration of each 'test' within each session, the need for standard test/examination conditions to be maintained at all times was emphasised.

12.3 Results and Analysis

i) Results

General Comments

The general response of the sample members/testees was positive in that the majority appeared to readily understand the tasks they were required to do in each of the 'tests' used, i.e. EST3; SWT2; NSWT1; COIT; and GPCT.

As with the previous two studies, the response of the sample members to the Practice Section of the EST3 was such that very few sample members failed to score any points.

For the purpose of analysis used in this study, as with the previous two studies, only the raw scores from the Response Section (C) of the EST3 were used, to give a degree of compatibility with the SWT2 and NSWT1, since these two 'embedded tests' did not have a Practice Section. Also, all three of the 'embedded tests' had a Worked Example(s) Section, which was 'worked through', with the participation of the sample members, by the administrator of the 'tests', following the same procedure as for Studies One and Two.

The outcomes for the COIT, provided a skewed range of scores in each of the 'A', 'B', 'S', 'T' Categories, i.e. stated facts from A and/or B, the number of times a change or 'switch' was made from A to B or B to A, and the summation of the facts from both A and B, respectively. Arguably, such a set of outcomes is integral to the characteristics of the COIT. However, the sample members appeared to have followed the procedural details and genuinely done the best they could.

The outcomes of the GPCT practice items were better than that for the practice items of the EST3, in that there was only one testee that failed to score any points.

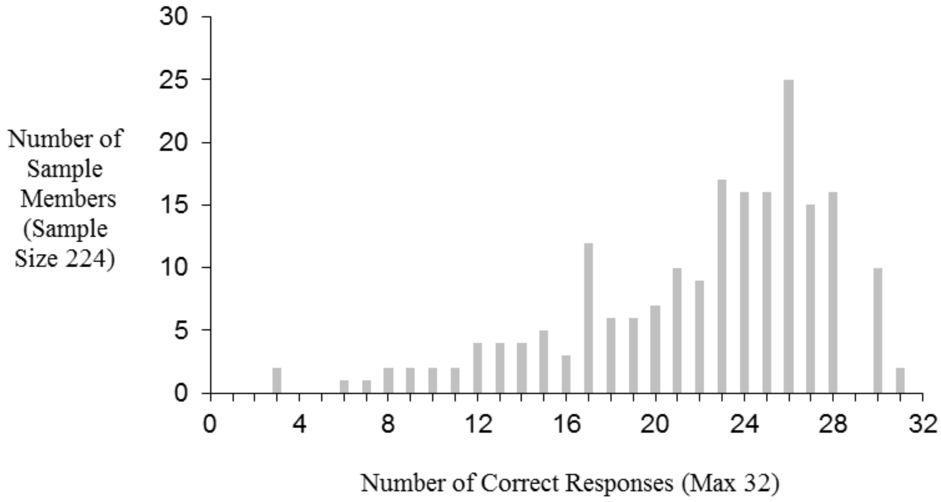
The outcomes for the sample in relation to each of the tests/variables used, and the investigation of the interactions between them, are considered in detail in the next sub-section – ii)'Analysis', and the implications of the outcomes in the following sub-sections of :- i)'Discussion' and ii) 'Conclusion'.

a) Embedded Shapes Test, Version 3 (EST3)

The range of raw scores for the Response Section (C) of the EST3 was wide, with many of them being high, i.e. between 17 and 28.

For the overall sample, the range of raw scores on this 'test' was from 3 to 31.
In terms of males and females, the range of raw scores was from 3 to 31, and 9 to 30, respectively (see Figure 12.1).

Figure 12.1 Frequency Distribution of Correct Responses (C) (raw scores) for the Embedded Shapes Test, Version Three - Study 3



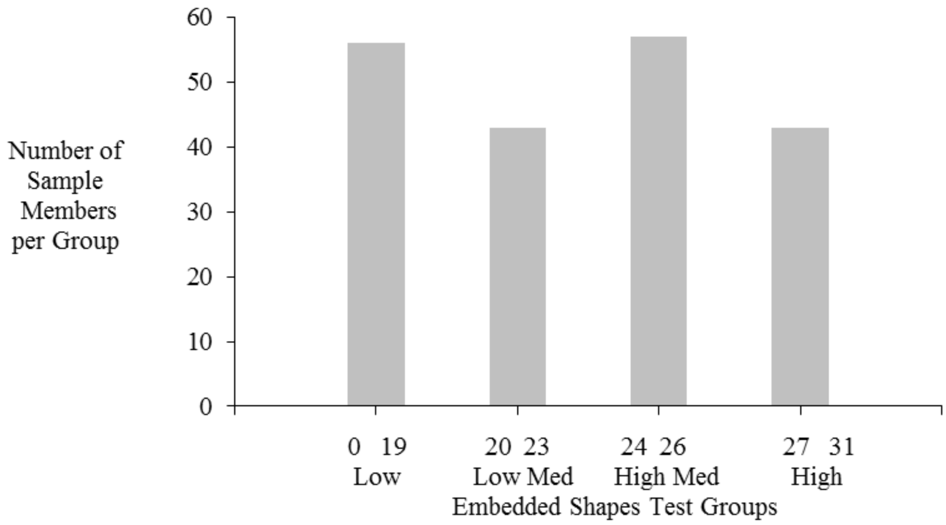
The number of correct responses to the test items/questions of the Response Section (C) did not differ very much from the number of Test items/questions attempted by the majority of the sample members.
Also, most sample members attempted the majority of the test items/questions presented in the Response Section (C).
The raw scores from the EST3 were arranged into four groups. This was done in an attempt to designate the sample members onto the field dependence – field independence continuum with greater sensitivity, i.e. accuracy, in view of the relatively large size of the sample.
Consequently, the 'Medium Group' (used in Studies One and Two), was split into two, i.e. 'Low Medium' and 'High Medium'.
The range of raw scores within each of the EST3 groups is shown in Table 12.2.

Table 12.2 Range of Raw Scores for EST3 – Low, Low-Medium, High-Medium and High Groups

Group	Raw Score Range
1 (Low)	0 to 19
2 (Low-Medium)	20 to 23
3 (High-Medium)	24 to 26
4 (High)	27 to 31

The distribution of the scores within each of the four groups is shown in Figure 12.2.

Figure 12.2 Correct Responses from Response Section (C) (raw scores) in four groups of Low, Low-Medium, High-Medium and High for the Embedded Shapes Test,Version Three (EST3) - Study 3

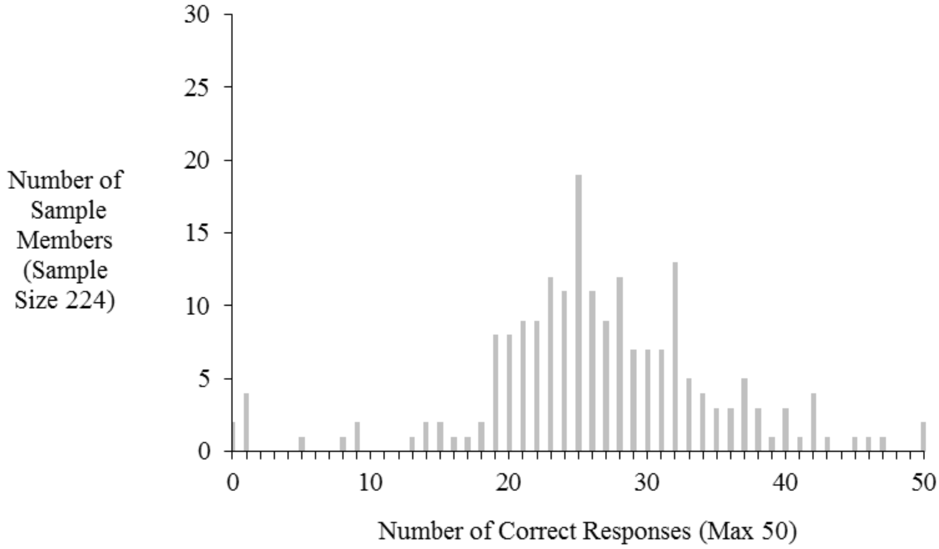


b) Sense Words Test, Version Two (SWT2)

The range of raw scores for the SWT2 spanned the complete range from 0 to 50, with most of the scores occurring between 19 and 33.

In terms of males and females the range was from 0 to 50, and 1 to 50, respectively (see Figure 12.3).

Figure 12.3 Frequency Distribution of Correct Responses (raw scores) for the Sense Word Test, Version 2 (SWT2) - Study 3



The number of correct responses to the test items/questions presented differed very little from the number of test items/questions attempted for the majority of the sample members.

Most of the sample members only attempted about three-fifths of the test items/questions presented, within the allocated time for the completion of the test.

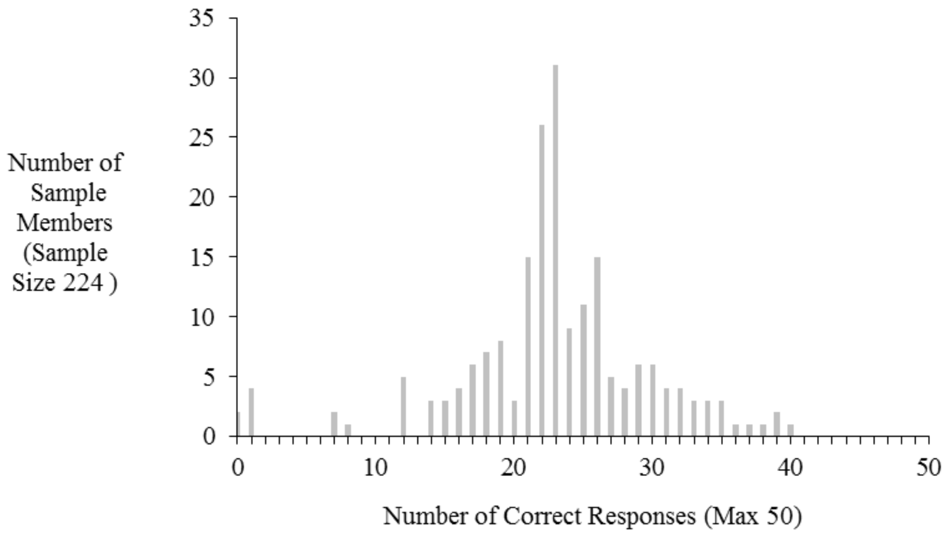
c) Non-Sense Word Test, Version One (NSWT1)

The range of raw scores for the NSWT1 was less than that of the SWT2, the highest raw score achieved being 40 as compared to 50 (the highest score possible).

For the overall sample, the range of raw scores on the NSWT1 was from 0 to 40.

In terms of males and females the range of raw scores was from 1 to 38 and 0 to 40, respectively (see Figure 12.4).

Figure 12.4 Frequency Distribution of Correct Responses (raw scores) for Non-Sense Word Test, Version One (NSWT1) - Study 3



The number of correct responses to the test items/questions presented, differed very little from the number of test items/questions attempted for most of the sample members,

The majority of the sample members attempted about three-fifths of the test items/questions presented, within the allocated time for the completion of the 'test'.

d) Chronological Order Integration Test (COIT)

The ranges of raw scores for the COIT, for each of its four categories, were as follows:–

Passage A , (A), 0 to 10; Passage B, (B), 0 to 14; and Switch (S) from (A) to (B), 0 to 10; and facts recalled (T) from Passages A and B, 0 to 20

In terms of males and females the range of raw scores for each of the above four categories were as follows:–

(A) 0 to 10 (males); 1 to 10 (females)

(B) 0 to 9 (males); 0 to 14 (females)

(S) 0 to 10 (males); 0 to 10 (females)

(T) 0 to 10 (males); 0 to 10 (females)

For each of the above categories, the distribution of raw scores was skewed towards the small numbers of raw scores within the overall range of raw scores (see Figures 12.5, 12.6, 12.7 and 12.8, respectively)

Figure 12.5 Frequency Distribution of Correct Responses (raw scores) for the Chronological Order Integration Test (COIT) (Category A) - Study 3

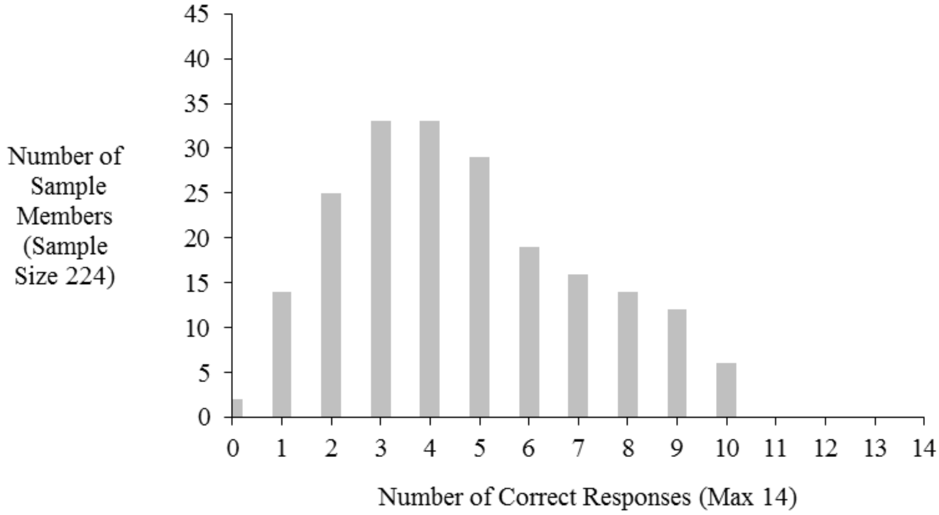


Figure 12.6 Frequency Distribution of Correct Responses (raw scores) for the Chronological Order Integration Test (COIT) (Category B) - Study 3

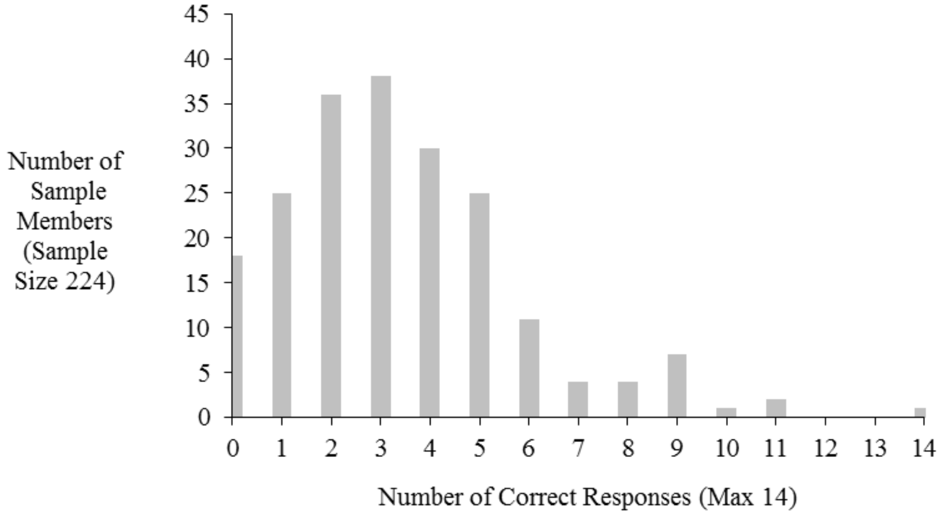


Figure 12.7 Frequency Distribution of Correct Responses (raw scores) for the Chronological Order Integration Test (COIT) (Category S - Switch between Categories A and B) - Study 3

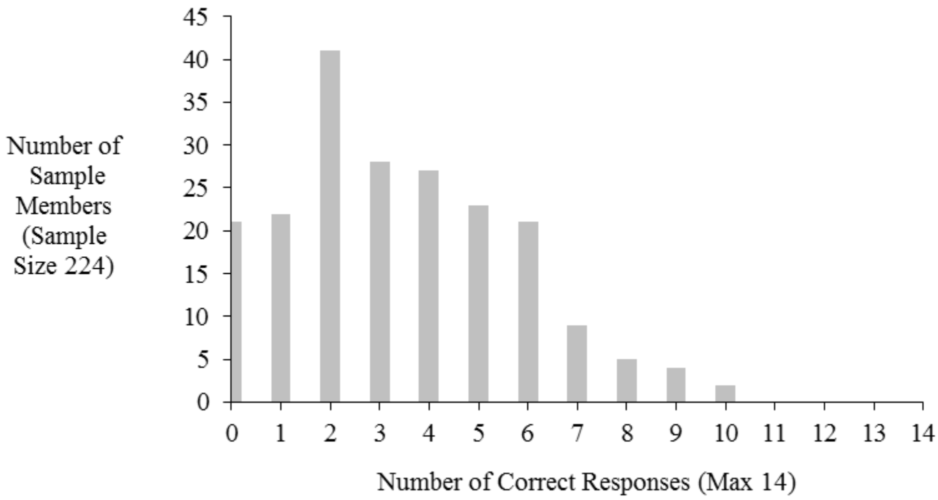
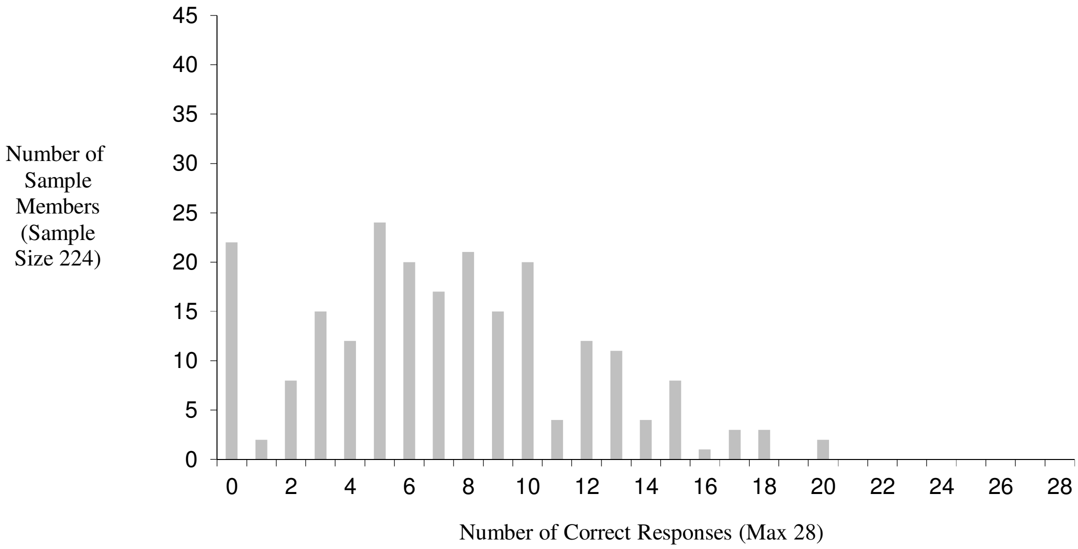


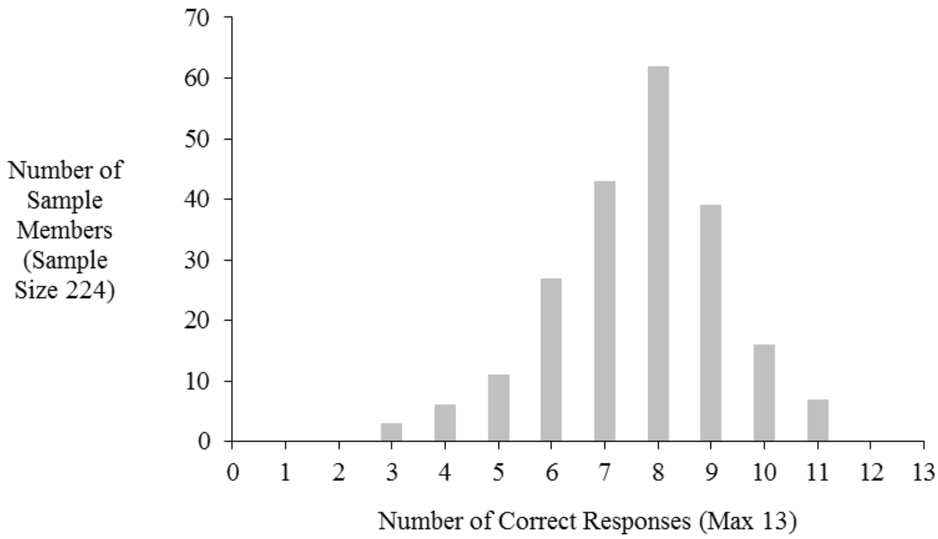
Figure 12.8 Frequency Distribution of Correct Responses (raw scores) for Chronological Order Integration Test (COIT) (Category T - Combined scores for Categories A and B) - Study 3



e)Gestalt Picture Completion Test (GPCT)

The range of raw scores for the GPCT was from 3 to 11, with the overall sample scores providing a well-defined 'normal' distribution by inspection In terms of males and females the range of raw scores for both was from 3 to 11 (see Figure 12.9).

Figure 12.9 Frequency Distribution of Correct Responses (raw scores) for the Gestalt Picture Completion Test (GPCT) - Study 3



The number of correct responses, compared to the number of test items/questions presented, differed by about fifty percent for most of the testees. The majority of the testees attempted all of the test items/questions presented.

f) School Subjects Performance/Attainment Data

Performance data was analysed for the school subjects of English (Language and Literature), Mathematics, Science (General), History, Geography, Design and Technology (Product and Food), Religious Education, Art, Music and Modern Language (French).

Although performance data was also available for the school subjects of Modern Language (German) and Physical Education, there were not enough testees for whom data was available for these school subjects, to justify their inclusion within the analysis of the data, compared to the other variables, for the overall sample.

The raw scores for the school subjects performance/attainment consisted of attainment rankings related to a five point scale, i.e. A = 5, B = 4, C = 3, D = 2 and E = 1 (where A is very good, B good, C average, D below average and E well below average).

g) GCSE Subjects Performance/Attainment Grades

GCSE subjects performance/attainment data was available on a wide range of GCSE subjects taken by the sample members, as shown in Section 12.2 iii) g) of this Study (Three). However, since none of the sample members studied each of the GCSEs within the overall range of GCSEs, available for the purpose of this Study (Three), there were not enough sample members to justify the inclusion of all of the GCSE subjects in the overall analysis of the data. This decision was based on statistical reasoning related to 'cell sizes' in the analysis used, MANOVA.

As a consequence of this, data for the GCSE subjects of English Language; English Literature; Mathematics; Science (General) (Double Science); History; Geography and Design and Technology (Product Design) was processed.

The GCSE subjects were designated a numerical values for each grade it was possible to obtain, i.e. A = 8, B = 7, C = 6, D = 5, E = 4, F = 3, G = 2, and U = 1 (where A is very good, B good, C average, D below average, E well below average, F bare fail, G fail, and U absent, (i.e. unspecified absence from the GCSE examination), to enable a statistical analysis to be performed.

ii) Analysis

As with the previous two studies, when discussing the results/analysis of this Study (Three), the following key will be employed; Embedded Shapes Test, Version 3 (EST3) Groups 1, 2, 3 and 4; Sense Words Test, Version Two (SWT2)(Sense); Non-Sense Word Test, Version 1 (NSWT1)(Non-Sense).

The additional 'tests', school subjects and GCSE subjects, to this Study (Three), are designated as follows:-

Chronological Order Integration Test (COIT), Category A (DLA), Category B (DLB), Category S (DLS) and Category T (DLT), where DL = story of the life and work of David Livingstone, and A = Passage A, B = Passage B, S = number of switches from Passage A to Passage B, and T = the total number of facts recalled from Passages A and B).

Gestalt Picture Completion Test (GPCT) (Pict).

School subjects of English (Language and Literature) (sub 1); Mathematics (sub 2);Science (General) (sub 3); History (sub 4); Geography (sub 5); Design and Technology (Product sub 6;and Food sub 7); Religious Education (sub 8); Art (sub 9); Music (sub 10); and Modern Languages (French sub 11), were designated by their names or subject number.

GCSE subjects of English Language (1); English Literature (2); Mathematics (4); Science (Science)(Double Science)(5); and Geography (6), were designated their names or number.
Sex - Male (Sex 1) and Female (Sex 2).
The means and standards deviations for each of the variables and the overall sample of this Study (Three) are shown in Table 12.3.

Table 12.3 Means and Standard Deviations for each of the Variables and the Overall Sample for Study 3

Variable	Cases	Mean	Std Dev
SEX	224	1.5446	0.4991
EST3	224	2.4322	1.1255
SWT2	224	26.4422	8.7007
NSWT1	224	22.8442	6.9406
Category A	224	4.6146	2.4600
Category B	224	3.3707	2.4653
Category S	224	3.4927	2.4507
Category T	224	Not calculated	Not calculated
GPCT	224	7.6402	1.6204
Sub 1 English (Lang and Lit)	201	2.2736	0.7140
Sub 2 Mathematics	205	2.3659	1.0038
Sub 3 Science (General)	207	2.3913	0.9066
Sub 4 History	204	2.5441	0.8839
Sub 5 Geography	204	2.3578	0.9121
Sub 6 D and T (Product)	185	2.2649	0.7591
Sub 7 D and T (Food)	204	2.3873	0.9375
Sub 8 Religious Education	201	2.1990	0.9001
Sub 9 Art	206	2.4903	0.7947
Sub 10 Music	206	204417	0.9748
Sub 11 Mod Lang (French)	199	2.3869	0.7694
GCSE 1 English Language	196	6.1224	1.1301
GCSE 2 English Literature	163	5.8834	1.0086
GCSE 3 Drama	38	6.5526	1.2455
GCSE 4 Mathematics	193	4.8187	1.9347
GCSE 5 Science (General)	194	5.2216	1.3145
GCSE 6 History	78	5.6667	1.7258
GCSE 7 Geography	126	5.6508	1.7633
GCSE 8 D and T (Product)	43	4.8837	1.6505

The GCSE Subjects of Drama, History and Design and Technology (Product) are included in the above table but were not included in the MANOVA Analysis, although they were included in the correlation analysis/matrix.

A Multivariate Analysis of Variance (MANOVA) was first used with EST3 (Groups 1 to 4) and Sex (1, 2) designated as a 'factor(s)' and (SWT2)'Sense'; (NSWT1)'Non-Sense'; Categories A, B, S, T; and (GPCT) 'Pict', designated as a 'variable(s)'.

The EST3 factor was divided into four groupings. These were derived from the EST3 raw scores for the overall sample in terms of males and females, which were allocated into a high, high-medium, low-medium or low group (4, 3, 2, and 1 respectively) for both males and females, to give a designation on the field dependence – field independence continuum relative to the total number of raw scores for the overall sample.

The EST3 four Groupings, for both males and females, were then analysed in relation to the variables (SWT2) 'Sense', (NSWT1) 'Non-Sense' in terms of sex (male and female) and the overall sample.

An analysis of the EST3 four groupings for both male and female, in relation to the school subject variables of performance/attainment to provide a comparison between school subject performance/attainment and designation on the field dependence - field independence continuum.

A similar investigation was carried out with the GCSE subject variables.

A further analysis for Study Three involved the production of a correlation matrix for each of the variables involved.

12.4 Discussion and Conclusion

i) Discussion

General Comments

The terminology 'Main Effect' as utilised by Kepple, G. and Saufley, W.H., Jr., (1980, pp212-218), is used in the MANOVA Tables and Figures throughout Study 3.

Overall the MANOVA revealed some interactions with several significant 'F ratio' values between the different variables used in this Study (Three).

The various tables and figures given in the last Section, 12.3.ii) Analysis, will now be discussed.

Discussion of the various tables and figures given in the last Section, 12.3.ii) Analysis, shows that the mean values for the (SWT2) 'Sense' variable were higher for females than those for males in each of the four EST3 Groups. This suggests a higher level of field independence for the females as measured by SWT2, The greatest difference occurring in EST3 Group 3, the high-medium field independent group.

This is a little unexpected because one would have assumed that such a difference would have occurred with EST Group 4, since the 'Sense' test, like the EST, is purported to be a measure of field dependence – field independence. In other words as the degree of field independence increases from Group 1 to Group 4, then any difference between the males and females would remain approximately constant. This is not the case with Group 3 and 4 which diverge and then converge respectively, between the sexes.

There is no interaction between the 'female line' and the 'male line', with a 'main effect line' occurring between the two (see Table 12.4 and Figure 12.10).

Table 12.4 Means for Male, Female and Main Effect for Sense Word Test, Version Two (SWT2) – Study 3

EST3 Group	1	2	3	4
Male	22.3	24.5	23.9	27
Female	24.4	27.7	31.5	28.9
	(22.3 + 24.4) ÷ 2	(24.5 + 27.7) ÷ 2	(23.9 + 31.5) ÷ 2	(27 + 28.9) ÷ 2
Main Effect	23.35	26.1	27.7	27.95

Figure 12.10 from Table 12.4 for Sense Word Test, Version Two (SWT2) - Study 3

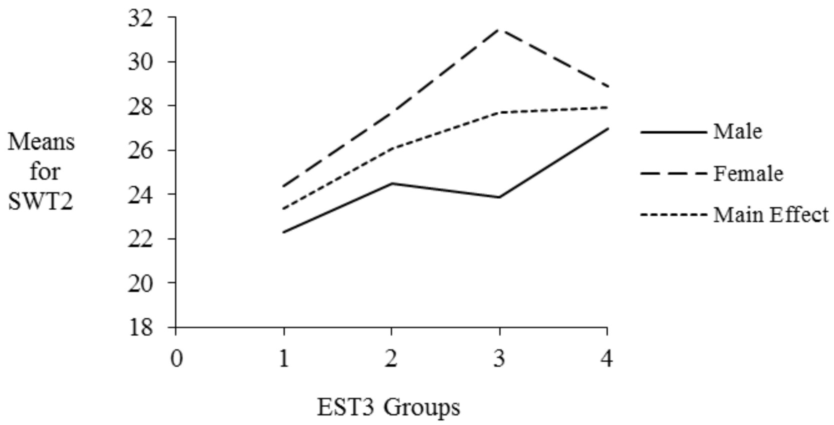
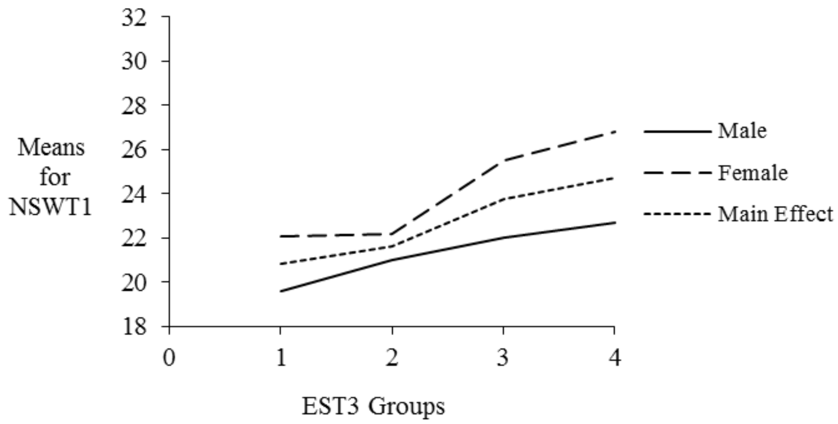


Table 12.5 Figure 12.11 shows that the mean values for the Non-Sense variable were higher for the females than the males.

Table 12.5 Means for Male, Female and Main Effect for Non-Sense Word Test, Version 1(NSWT1) – Study 3

EST3 Group	1	2	3	4
Male	19.6	21	22	22.7
Female	22.1	22.2	25.5	26.8
	(19.6 + 22.1) ÷ 2	(21 + 22.2) ÷ 2	(22 + 25.5) ÷ 2	(22.7 + 26.8) ÷ 2
Main Effect	20.85	21.6	23.75	24.75

Figure 12.11 from Table 12.5 for Non-Sense Word Test, Version One (NSWT1) - Study 3



Apart from similar Non-Sense mean values from EST Group 1 to EST Group 2 for the females, the Non-Sense means increase with increasing EST Group number for the remaining female line, i.e. from EST Group 2 through to Group 4, and for all of the male line, i.e. from EST Group 1 through to Group 4. This sort of line/graph shape would be expected in terms of an increasing level of field independence ability as measured with both the EST and the Non-Sense Test from Group 1 through to Group 4.

There is no interaction between the ‘female line’ and the ‘male line’, with a ‘main effect line’ occurring between the two (see Table 12.5 and Figure 12.11).

Tables 12.6 and 12.7 and Figure 12.12 show that the combined mean values for the Sense and Non-Sense variables for both male and female were obtained from each of the four groupings of the EST factor, and plotted against male and female. It can be seen from Figure 12.12 that the females achieved a higher outcome than the males for both the Sense and the Non-Sense measures of field dependence/independence.

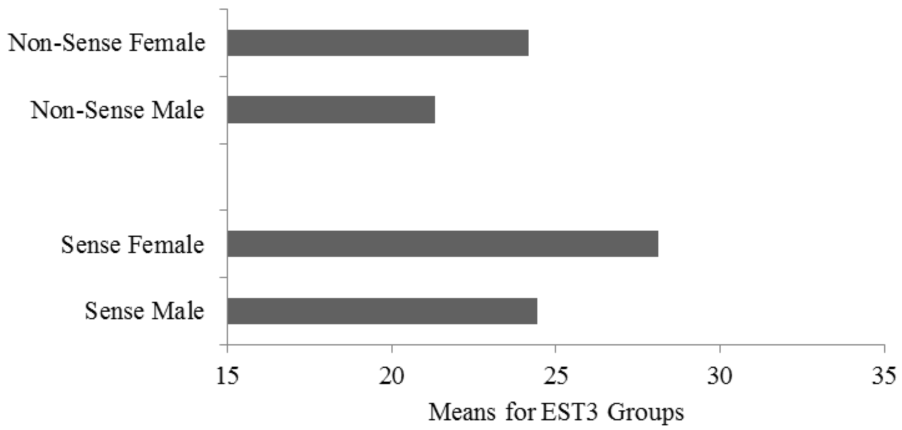
Table 12.6 Means for EST3 by Sense Word Test, Version 2 (SWT2) and Sex - Study 3.

		Male	Female
EST3 Group	1	22.3	24.4
	2	24.5	27.7
	3	23.9	31.5
	4	27	28.9
		(22.3 + 24.5 + 23.9 + 27) ÷ 4	(24.4 + 27.7 + 31.5 + 28.9) ÷ 4
Means		24.43	28.13

Table 12.7 Means for EST3 by Non-Sense Word Test, Version 1 (NSWT1) and Sex – Study 3

		Male	Female
EST 3 Group	1	19.6	22.1
	2	21	22.2
	3	22	25.5
	4	22.7	26.8
		(19.6 + 21 + 22 + 22.7) ÷ 4	(22.1 + 22.2 + 25.5 + 26.8) ÷ 4
Means		21.33	24.15

Figure 12.12 from Tables 12.6 and 12.7 - Means for EST3 Groups by SWT2 and NSWT1 and Sex - Study 3



With both male and female, the combined (SWT2) Sense means are higher than those for the combined (NSWT1) Non-Sense means, with the greatest difference occurring with the females.

Tables 12.8, 12.9, 12.10 and 12.11 /Figures 12.13, 12.14, 12.15 and 12.16 show the means from the raw score for the Chronological Order Integration Test (COIT) in terms of Categories A, B, S and T, for the total sample.

Table 12.8/Figure 12.13
(Passage A, Points obtained by males and female separately).
The females achieved a higher mean score in these of the four groupings of the EST factor than the males, apart from group 4, where they are the same. The 'main effect line' showed no interaction but it does meet the 'male and female lines' at group 4.

Table 12.8 Means for Male, Female and Main Effect for Chronological Order Integration Test (COIT) - Category A - Study 3

EST3 Group	1	2	3	4
Male	4	4.2	4.5	5.2
Female	4.6	4.4	4.8	5.2
	(4 + 4.6) ÷ 2	(4.2 + 4.4) ÷ 2	(4.5 + 4.8) ÷ 2	(5.2 + 5.2) ÷ 2
Main Effect	4.3	4.3	4.65	5.2

Figure12.13 from Table12.8 for Chronological Order Integration Test (COIT) - Category A - Study 3

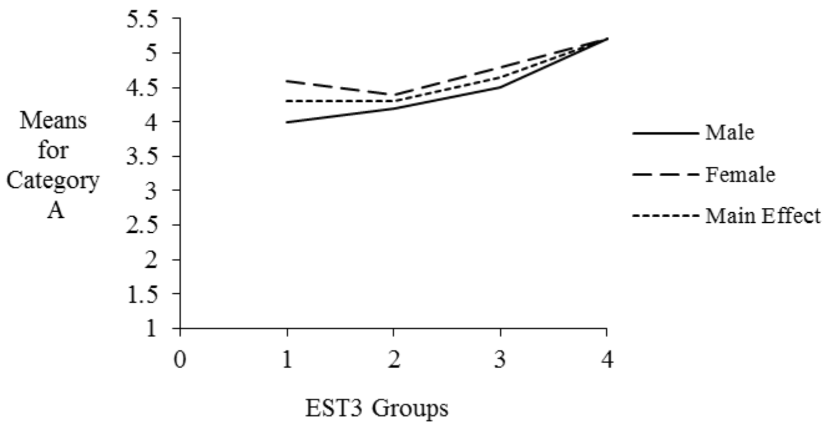


Table 12.9 Figure 12.14

(Passage B, Points obtained by males and females separately).

In this figure for 'Passage B', the difference between the male and female lines is greater than it is for Figure 12.13 'Passage A', for each of the four EST factor groupings. Also, the male and female line alternates from group to group so that no one sex has overall dominance. The 'main effect line' also alternates between groups giving an 'interaction' across all four groups for the male and female lines.

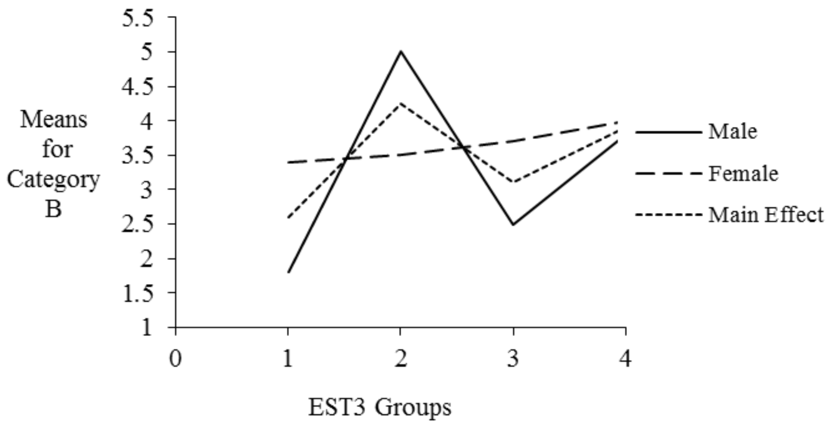
Table 12.9 Means for Male, Female and Main Effect for Chronological Order Integration Test (COIT) - Category B - Study 3

EST3 Group	1	2	3	4
Male	1.8	5	2.5	3.8
Female	3.4	3.5	3.7	4
	(1.8 + 3.4) ÷ 2	(5 + 3.5) ÷ 2	(2.5 + 3.7) ÷ 2	(3.8 + 4) ÷ 2
Main Effect	2.6	4.25	3.1	3.9

Figures 12.13 and 12.14 show that the sample members (male and female) obtained a greater number of points from Passage A than they did from Passage B.

In the case of Figure 12.13, Passage A, there is an increase in the number of points retained corresponding with an increase in field independence from Groups 2 to 4 of the EST3 factor.

Figure12.14 from Table12.9 for Chronological Order Integration Test (COIT) - Category B - Study 3



With Figure 12.14, Passage B, there is a fluctuation in the number of points retained across the four groups, especially Groups 1 and 3.

Table 12.10/Figure 12.15

(Switch from Passage A to Passage B. Number of 'switches' made by males and females, separately).

This figure shows the male and female lines alternating across three of the four groups of the EST factor, but converging to the same mean value for group 4.

Consequently, the 'main effect line' shows an interaction across groups 1 to 3, with its mean value coinciding with the male and female mean value at group 4.

Table 12.10 Means for Male, Female and Main Effect for Chronological Order Integration Test (COIT) –Category S - Study 3

EST3 Group	1	2	3	4
Male	2.1	4	2.8	3.9
Female	4.1	3.2	4	3.9
	(2.1 + 4.1) ÷ 2	(4 + 3.2) ÷ 2	(2.8 + 4) ÷ 2	(3.9 + 3.9) ÷ 2
Main Effect	3.1	3.6	3.4	3.9

Figure 12.15 from Table 12.10 for Chronological Order Integration Test (COIT) - Category S - Study 3

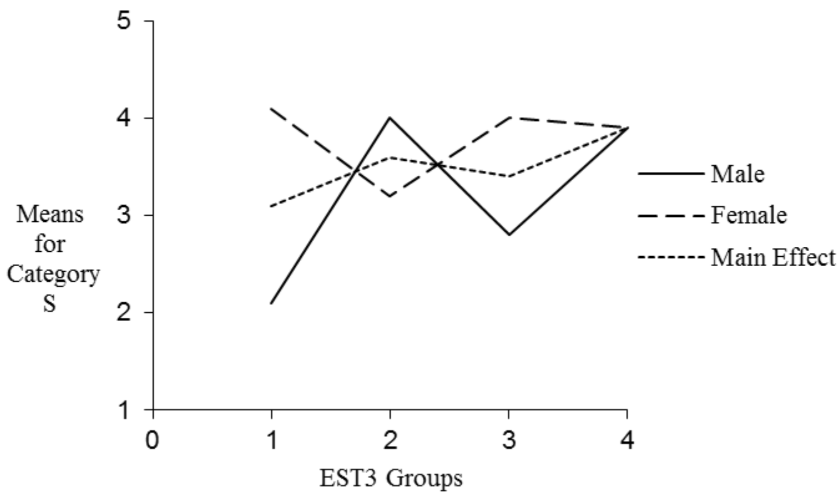
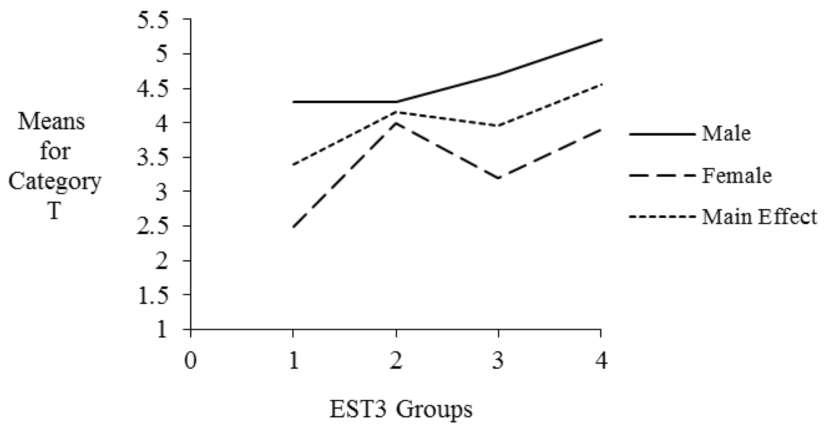


Table 12.11/Figure 12.16
(Passage A, Points obtained by males and females combined; Passage B, Points obtained by males and females combined)
The 'main effect line' shows some fluctuation across the four groups of the EST factor, but there is no interaction.

Table 12.11 Means for Male, Female and Main Effect for Chronological Order Integration Test (COIT) –Category T- Study 3

EST3 Group	1	2	3	4
Male	4.3	4.3	4.7	5.2
Female	2.5	4	3.2	3.9
	(4.3 + 2.5) ÷ 2	(4.3 + 4) ÷ 2	(4.7 + 3.2) ÷ 2	(5.2 + 3.9) ÷ 2
Main Effect	3.4	4.15	3.95	4.55

Figure12.16 from Table12.11 for Chronological Order Integration Test (COIT) - Category T - Study 3



From Tables 12.12 and 12.13/ Figure 12.17, the Category A and Category B means for both males and females respectively, have been combined to produce a 'new mean' to enable a composite figure (Figure 12.17) to be obtained.

The above technique was also done with Tables 12.14 and 12.15 / Figure 12.18, for Category S and Category T males and females respectively, to produce Figure 12.18.

Figures 12.17 and 12.18 enable the differences between males and females to be readily seen across the four Categories (A, B, S and T) of the COIT.

Table 12.12 Means for EST3 by Chronological Order Integration Test (COIT) – Category A and Sex – Study 3.

		Male	Female
EST Group	1	4	4.6
	2	4.2	4.4
	3	4.5	4.8
	4	5.2	5.2
		(4 + 4.2 + 4.5 + 5.2) ÷ 4	(4.6 + 4.4 + 4.8 + 5.2) ÷ 4
Means		4.48	4.75

Table 12.13 Means for EST3 by Chronological Order Integration Test (COIT) – Category B and Sex – Study 3

		Male	Female
EST Group	1	1.8	3.4
	2	5	3.5
	3	2.5	3.7
	4	3.8	4
		(1.8 + 5 + 2.5 + 3.8) ÷ 4	(3.4 + 3.5 + 3.7 + 4) ÷ 4
Means		3.28	3.65

Figure 12.17 from Tables 12.12 and 12.13 - Means for EST3 Groups by Categories A and B and Sex - Study 3

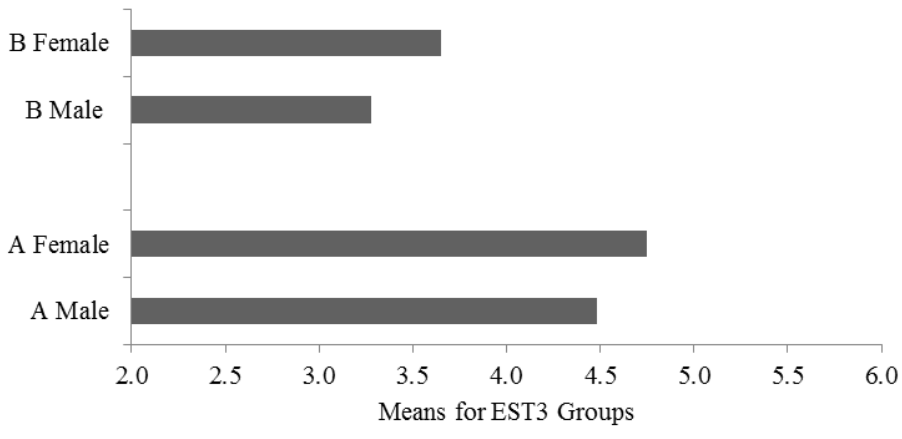


Table 12.14 Means for EST by Chronological Order Integration Test (COIT) – Category S and Sex – Study 3

		Male	Female
EST Group	1	2.1	4.1
	2	4	3.2
	3	2.8	4
	4	3.9	3.9
		(2.1 + 4 + 2.8 + 3.9) ÷ 4	(4.1 + 3.2 + 4 + 3.9) ÷ 4
Means		3.20	3.80

Table 12.15 Means for EST3 by Chronological Order Integration Test (COIT) – Category T and Sex – Study 3

		Male	Female
EST3 Group	1	4.3	2.5
	2	4.3	4
	3	4.7	3.2
	4	5.2	3.9
		(4.3 + 4.3 + 4.7 + 5.2) ÷ 4	(2.5 + 4 + 3.2 + 3.9) ÷ 4
Means		4.63	3.40

Figure 12.18 from Tables 12.14 and 12.15 - Means for EST3 Groups by Categories S and T and Sex - Study 3

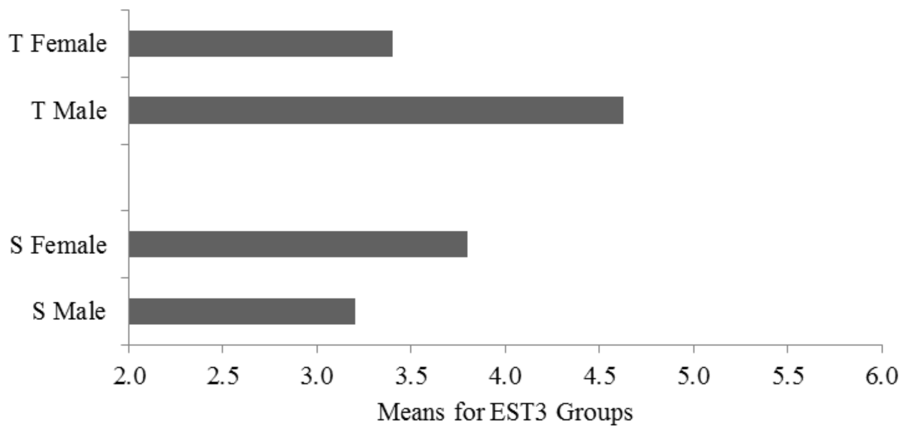


Table 12.16/Figure 12.19 shows the EST3 Groups mean values for the Gestalt Picture Completion Test (GPCT) variable. It can be seen from Figure 12.19 that the males scored higher in Groups 1, 3 and 4 than did the females. The 'main effect line' shows some 'interaction' between Groups 2, 3 and 4.

Table 12.16 Means for Male, Female and Main Effect for Gestalt Picture Completion Test (GPCT) – Study 3

EST3 Group	1	2	3	4
Male	7.2	7.7	8.2	7.7
Female	7.1	7.8	7.9	7.7
	(7.2 + 7.1) ÷ 2	(7.7 + 7.8) ÷ 2	(8.2 + 7.9) ÷ 2	(7.7 + 7.7) ÷ 2
Main Effect	7.15	7.75	8.05	7.7

Figure 12.19 from Table 12.16 Means for the Gestalt Picture Completion Test (GPCT) - Study 3

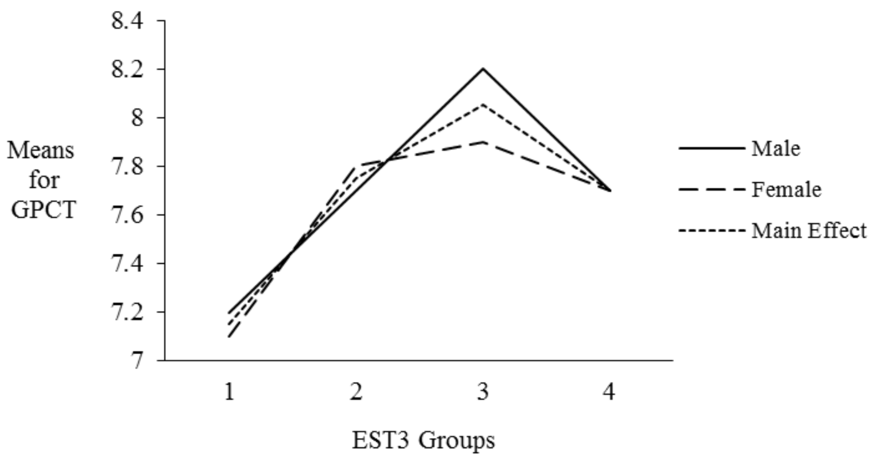


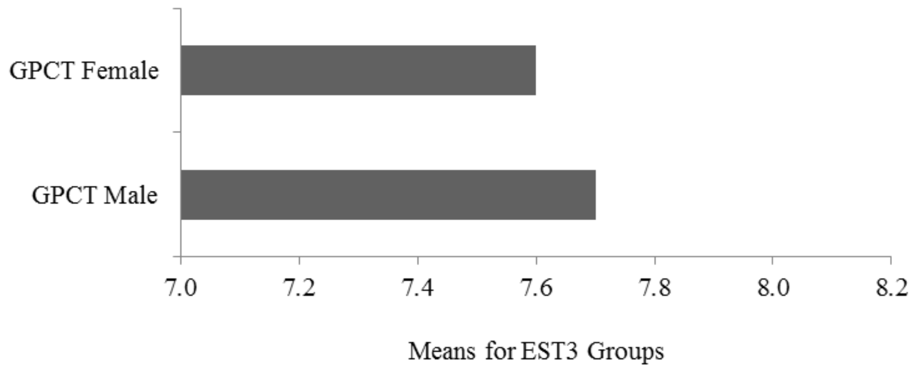
Table 12.17 /Figure 12.20 shows the combined mean values for the Picture Completion variable for both male and female were obtained from each of the four groupings of the EST factor, and plotted against male and female.

This gave the result of the male achieving a slightly higher score than the females, i.e. a combined mean score of 7.7 compared to 7.62 respectively.

Table 12.17 Means for EST3 by Gestalt Picture Completion Test (GPCT) and Sex – Study 3

		Male	Female
EST3 Group	1	7.2	7.1
	2	7.7	7.8
	3	8.2	7.9
	4	7.7	7.7
		(7.2 + 7.7 + 8.2 + 7.7) ÷ 4	(7.1 + 7.8 + 7.9 + 7.7) ÷ 4
Means		7.7	7.6

Figure 12.20 from Table 12.17 - Means for EST3 Groups for Gestalt Picture Completion Test (GPCT) and Sex - Study 3



School Subjects

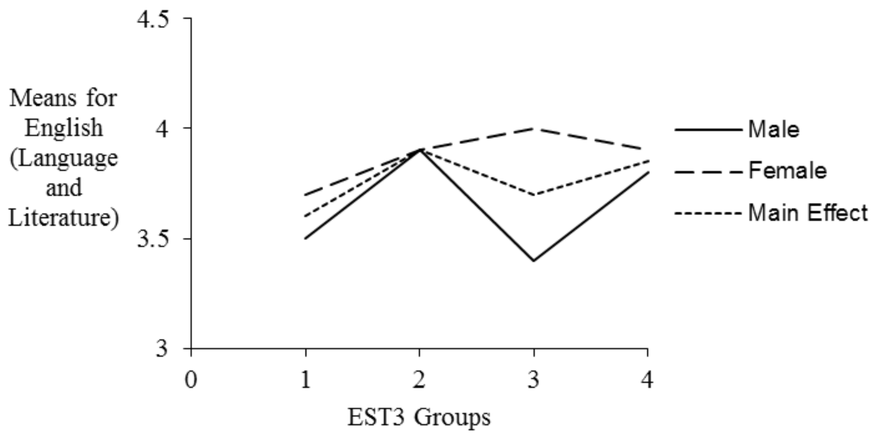
Tables 12.18 to 12.28/Figures 12.21 to 12.31 show the means from the raw scores, in terms of performance/attainment for eleven school subjects, i.e. English (Language and Literature), Mathematics, Science (General), History, Geography, Design and Technology (Product), and Design and Technology (Food), Religious Education, Art, Music, and a Modern Language (French).

Table 12.18/Figure 12.21 – English (Language and Literature)

Table 12.18 Means for Male, Female and Main Effect for English (Language and Literature) – Study 3

EST3 Group	1	2	3	4
Male	3.5	3.9	3.4	3.8
Female	3.7	3.9	4	3.9
	(3.5 + 3.7) ÷ 2	(3.9 + 3.9) ÷ 2	(3.4 + 4) ÷ 2	(3.8 + 3.9) ÷ 2
Main Effect	3.6	3.9	3.7	3.85

Figure 12.21 from Table 12.18 - Means for English (Language and Literature) by EST3 Groups and Sex - Study 3



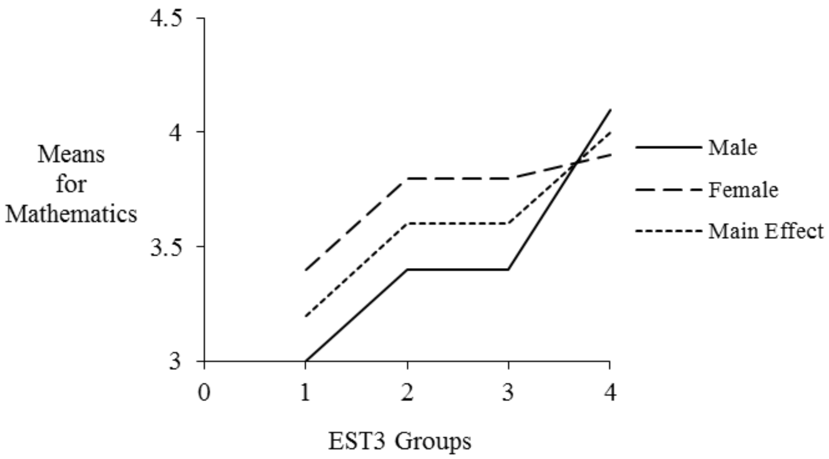
The females scored higher than the males in each of the four groups of the EST factor, with the greatest difference occurring within EST group 3. The ‘main effect line’ followed the shape of the male and female lines to a close degree, with no interaction taking place.

Table 12.19/Figure 12.22 – Mathematics

Table 12.19 Means for Male, Female and Main Effect for Mathematics – Study 3

EST3 Group	1	2	3	4
Male	3	3.4	3.4	4.1
Female	3.4	3.8	3.8	3.9
	(3 + 3.4) ÷ 2	(3.4 + 3.8) ÷ 2	(3.4 + 3.8) ÷ 2	(4.1 + 3.9) ÷ 2
Main Effect	3.2	3.6	3.6	4

Figure 12.22 from Table 12.19 for Mathematics - Study 3



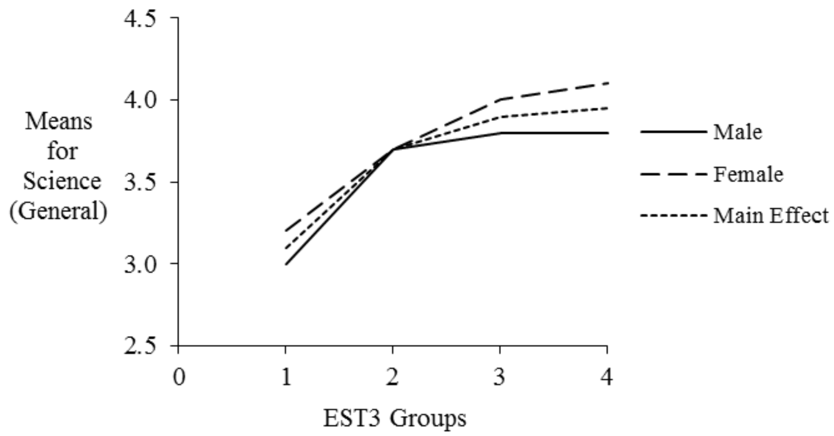
The females scored higher than the males in all but one of the four groups of the EST factor, i.e. group 4, with the greatest difference occurring within group 2. The 'main effect line' showed an interaction taking place between the males and females from EST Group 3 to 4.

Table 12.20/Figure 12.23 - Science (General)

Table 12.20 Means for Male, Female and Main Effect for Science (General) – Study 3

EST3 Group	1	2	3	4
Male	3	3.7	3.8	3.8
Female	3.2	3.7	4	4.1
	(3 + 3.2) ÷ 2	(3.7 + 3.7) ÷ 2	(3.8 + 4) ÷ 2	(3.8 + 4.1) ÷ 2
Main Effect	3.1	3.7	3.9	3.95

Figure 12.23 from Table 12.20 for Science (General) - Study 3



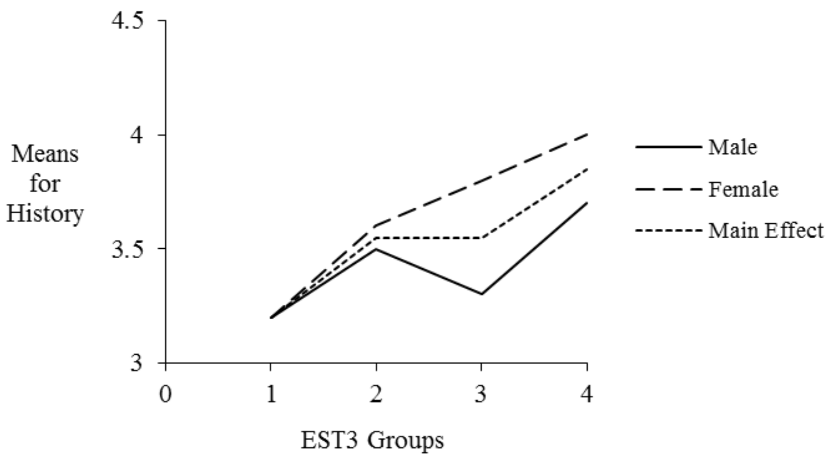
The females scored higher than the males in all four groups of the EST factor, with the smallest difference occurring within group 2. There was a marked difference in the magnitude of the means, from Group 1 to 2 when compared with the difference between EST Group 2 and 3 or EST Group 3 and 4 of the EST factor, for both males and females. The 'main effect line' followed the shape of the male and female lines to a close degree and showed no interaction taking place.

Table 12.21/ Figure 12.24 – History

Table 12.21 Means for Male, Female and Main Effect for History – Study 3

EST3 Group	1	2	3	4
Male	3.2	3.5	3.3	3.7
Female	3.2	3.6	3.8	4
	(3.2 + 3.2) ÷ 2	(3.5 + 3.6) ÷ 2	(3.3 + 3.8) ÷ 2	(3.7 + 4) ÷ 2
Main Effect	3.2	3.55	3.55	3.85

Figure 12.24 from Table 12.21 for History - Study 3



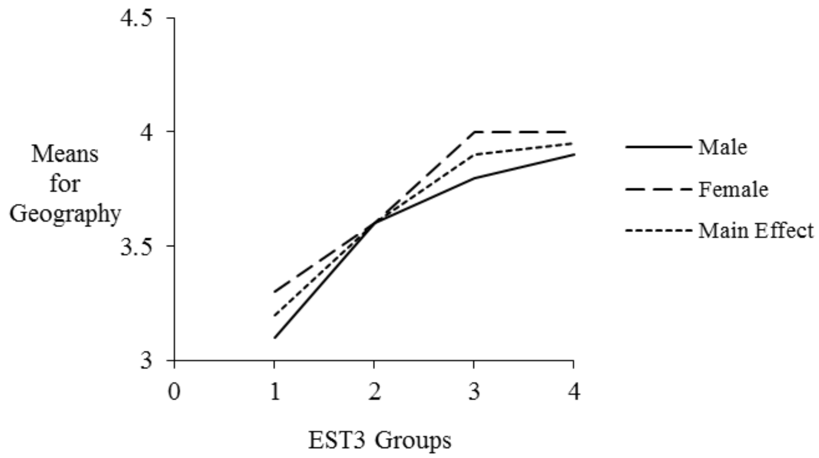
The females scored higher than the males in all four groups of the EST factor, with the greatest difference occurring within group 3. The female mean scores coincided with each EST factor group, whereas the males achieved a lower mean score in EST factor group 3, than the other groups. The 'main effect line' showed an interaction between EST factor group 1 and 2, after which it followed the shape of the male and female line to a close degree.

Table 12.22/Figure 12.25 – Geography

Table 12.22 Means for Male, Female and Main Effect for Geography – Study 3

EST3 Group	1	2	3	4
Male	3.1	3.6	3.8	3.9
Female	3.3	3.6	4	4
	(3.1 + 3.3) ÷ 2	(3.6 + 3.6) ÷ 2	(3.8 + 4) ÷ 2	(3.9 + 4) ÷ 2
Main Effect	3.2	3.6	3.9	3.95

Figure 12.25 from Table 12.22 for Geography - Study 3



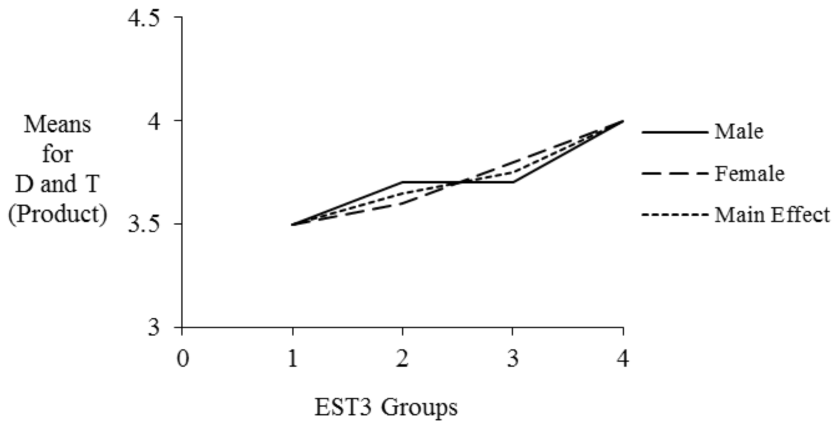
The females scored higher than the males in all four groups of the EST factor, with the greatest difference occurring within group 1. However, both the female and male scores concurred with each EST factor group. The 'main effect line' showed no interaction and its followed the male and female line closely.

Table 12.23/Figure 12.26 - Design and Technology (Product)

Table 12.23 Means for Male, Female and Main Effect for Design and Technology (Product) – Study 3

EST3 Group	1	2	3	4
Male	3.5	3.7	3.7	4
Female	3.5	3.6	3.8	4
	(3.5 + 3.5) ÷ 2	(3.7 + 3.6) ÷ 2	(3.7 + 3.8) ÷ 2	(4 + 4) ÷ 2
Main Effect	3.5	3.65	3.75	4

Figure 12.26 from Table 12.23 for Design and Technology (Product) - Study 3



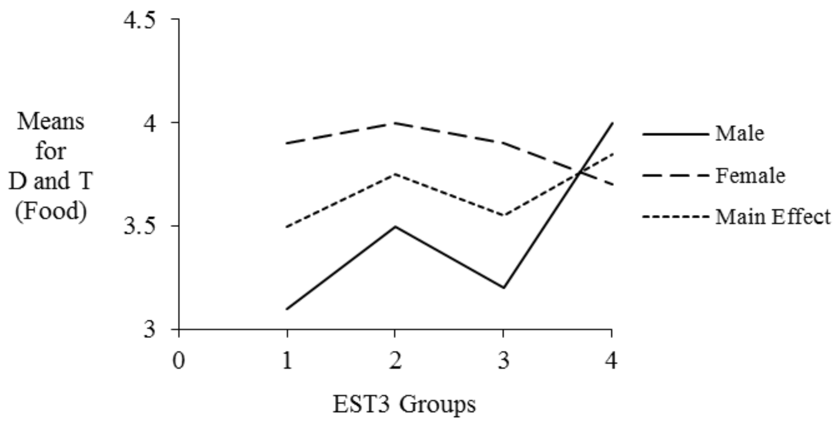
The male scores were higher than the females in group 2, with both males and females achieving the same score in groups 1 and 4 of the EST factor. The ‘main effect line’ showed an interaction between EST factor group 2 and 3.

Table 12.24/Figure 12.27 - Design and Technology (Food)

Table 12.24 Means for Male, Female and Main Effect for Design and Technology (Food) – Study 3

EST3 Group	1	2	3	4
Male	3.1	3.5	3.2	4
Female	3.9	4	3.9	3.7
	(3.1 + 3.9) ÷ 2	(3.5 + 4) ÷ 2	(3.2 + 9) ÷ 2	(4 + 3.7) ÷ 2
Main Effect	3.5	3.75	3.55	3.85

Figure12.27 from Table 12.24 for Design and Technology (Food) - Study 3



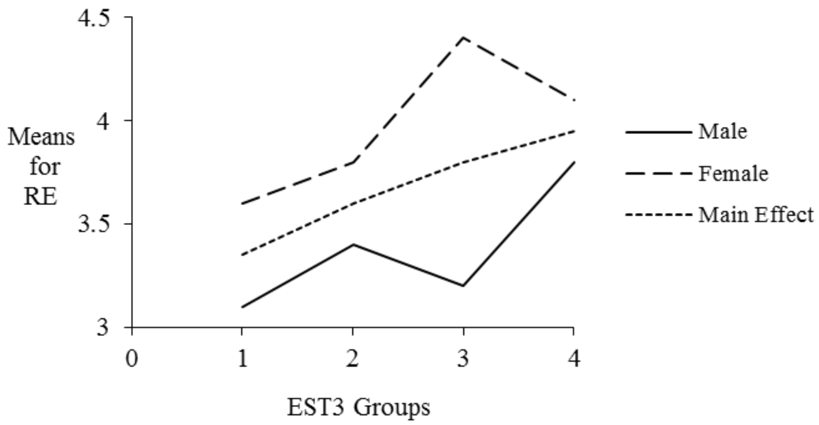
The female scores were higher than the males except for group 4 for the EST factor, with the greatest difference occurring with group 3. Also, the female score declined with increasing group number from group 2, and although the same thing happened from group 2 to group 3 for the males, from group 3 to group 4, the male score increased to exceed the female score at group 4. The ‘main effect line’ showed an interaction between groups 3 and 4.

Table 12.25/Figure 12.28 - Religious Education

Table 12.25 Means for Male, Female and Main Effect for Religious Education – Study 3

EST3 Group	1	2	3	4
Male	3.1	3.4	3.2	3.8
Female	3.6	3.8	4.4	4.1
	(3.1 + 3.6) ÷ 2	(3.4 + 3.8) ÷ 2	(3.2 + 4.4) ÷ 2	(3.8 + 4.1) ÷ 2
Main Effect	3.35	3.6	3.8	3.95

Figure 12.28 from Table 12.25 for Religious Education - Study 3



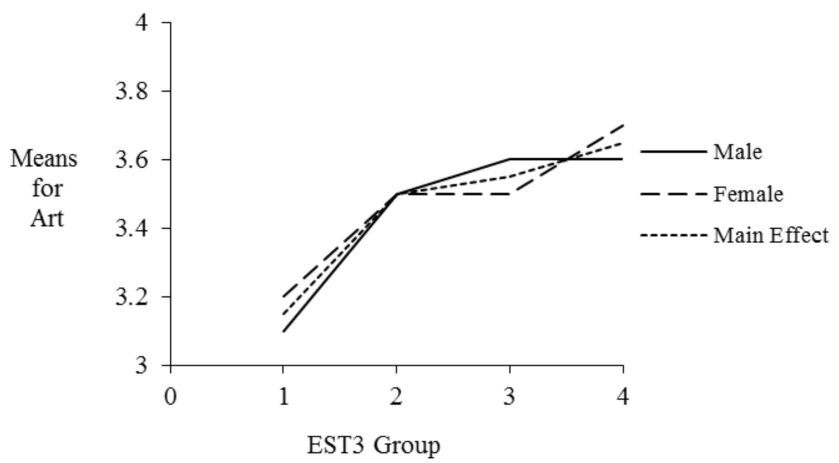
The female scores were higher than the males in each of the four groups of the EST factor, with the greatest difference occurring in group 3. The 'main effect line' showed no interaction; in fact its plot did not come close to either the male or female lines.

Table 12.26/Figure 12.29 – Art

Table 12.26 Means for Male, Female and Main Effect for Art – Study 3

EST3 Group	1	2	3	4
Male	3.1	3.5	3.6	3.6
Female	3.2	3.5	3.5	3.7
	(3.1 + 3.2) ÷ 2	(3.5 + 3.5) ÷ 2	(3.6 + 3.5) ÷ 2	(3.6 + 3.7) ÷ 2
Main Effect	3.15	3.5	3.55	3.65

Figure12.29 from Table 12.26 for Art - Study 3



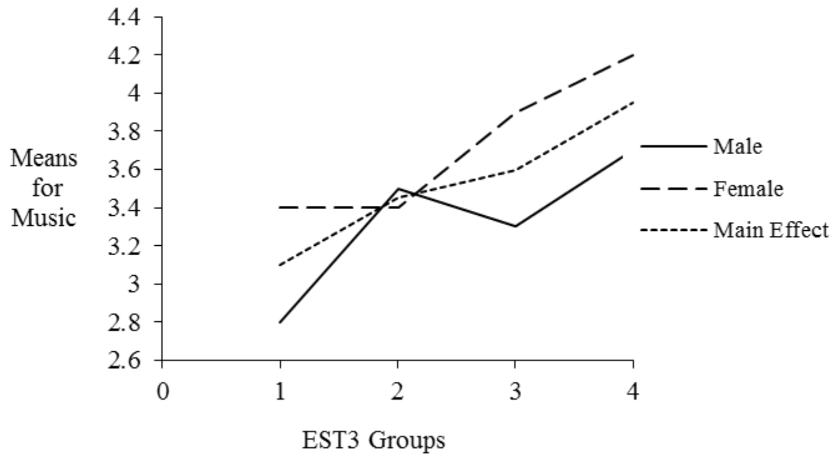
The male scores were higher than the female scores for group 3, but lower for groups 1 and 4, and the same for group 2 of the EST factor. Consequently, the 'main effect line' showed an interaction between group 3 and 4 of the EST factor.

Table 12.27/Figure 12.30 – Music

Table 12.27 Means for Male, Female and Main Effect for Music – Study 3

EST3 Group	1	2	3	4
Male	2.8	3.5	3.3	3.7
Female	3.4	3.4	3.9	4.2
	(2.8 + 3.4) ÷ 2	(3.5 + 3.4) ÷ 2	(3.3 + 3.9) ÷ 2	(3.7 + 4.2) ÷ 2
Main Effect	3.1	3.45	3.6	3.95

Figure12.30 from Table 12.27 for Music - Study 3



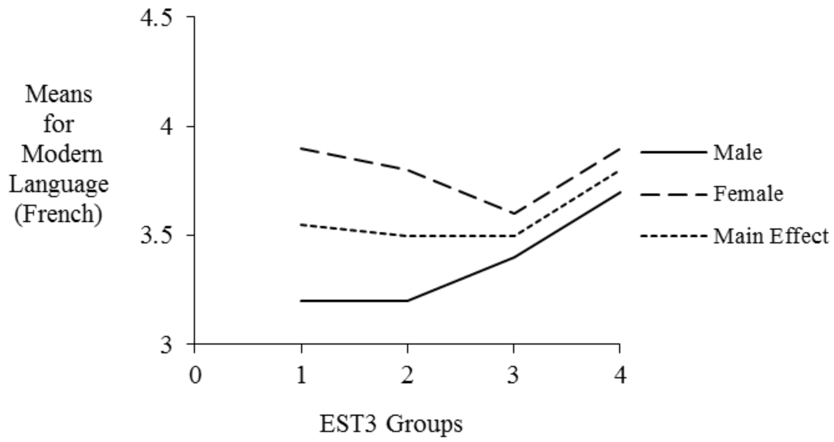
The female scores were higher than the males for groups 1, 3 and 4, with the males slightly higher than the females for group 2, i.e. 3.5 and 3.4 respectively, of the EST factor.
The ‘main effect line’ showed an interaction with group 2 of the EST factor.

Table 12.28/Figure 12.31 - Modern Language (French)

Table 12.28 Means for Male, Female and Main Effect for Modern Language (French) – Study 3

EST3 Group	1	2	3	4
Male	3.2	3.2	3.4	3.7
Female	3.9	3.8	3.6	3.9
	(3.2 + 3.9) ÷ 2	(3.2 + 3.8) ÷ 2	(3.4 + 3.6) ÷ 2	(3.7 + 3.9) ÷ 2
Main Effect	3.55	3.5	3.5	3.8

Figure 12.31 from Table 12.28 for Modern Language (French) - Study 3



The females' scores were higher than the males for all four groups of the EST factor, with the greatest difference occurring at group 1, i.e. 3.9 and 3.2 respectively. Consequently the 'main effect line' showed no interaction.

School Subjects – Combined Tables and Figures

The combined mean values for each of the school subjects (variables) for both male and female, were obtained from each of the four groupings of the EST3 factor, and plotted against male and female.

Tables 12.29 and 12.30/Fig 12.32

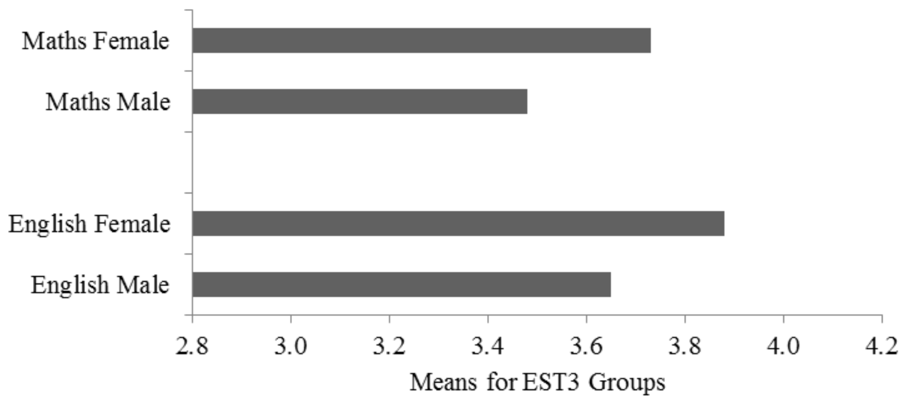
Table 12.29 Means for EST3 Groups by English (Language and Literature) and Sex – Study 3

		Male	Female
EST3 Group	1	3.5	3.7
	2	3.9	3.9
	3	3.4	4
	4	3.8	3.9
		(3.5 + 3.9 + 3.4 + 3.8) ÷ 4	(3.7 + 3.9 + 4 + 3.9) ÷ 4
Means		3.65	3.88

Table 12.30 Means for EST3 Groups by Mathematics and Sex – Study 3

		Male	Female
EST3 Group	1	3	3.4
	2	3.4	3.8
	3	3.4	3.8
	4	4.1	3.9
		(3 + 3.4 + 3.4 + 4.1) ÷ 4	(3.4 + 3.8 + 3.8 + 3.9) ÷ 4
Means		3.48	3.73

Figure 12.32 from Tables 12.29 and 12.30 - Means for EST3 Groups by English (Language and Literature) and Mathematics and Sex - Study 3



Tables 12.31 and 12.32/Fig 12.33

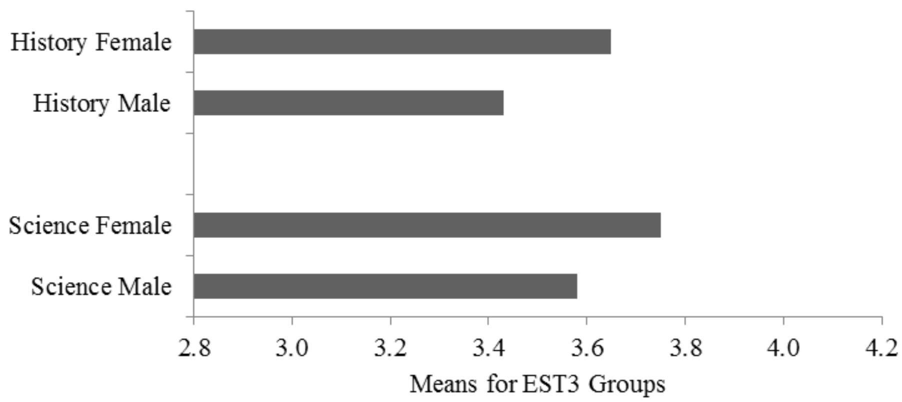
Table 12.31 Means for EST3 Groups by Science (General) and Sex – Study 3

		Male	Female
EST3 Group	1	3	3.2
	2	3.7	3.7
	3	3.8	4
	4	3.8	4.1
		(3 + 3.7 + 3.8 + 3.8) ÷ 4	(3.2 + 3.7 + 4 + 4.1) ÷ 4
Means		3.58	3.75

Table 12.32 Means for EST3 Groups by History and Sex – Study 3

		Male	Female
EST3 Group	1	3.2	3.2
	2	3.5	3.6
	3	3.3	3.8
	4	3.7	4
		(3.2 + 3.5 + 3.3 + 3.7) ÷ 4	(3.2 + 3.6 + 3.8 + 4) ÷ 4
Means		3.43	3.65

Figure 12.33 from Tables 12.31 and 12.32 - Means for EST3 Groups by Science (General) and History and Sex - Study 3



Tables 12.33 and 12.34/Fig 12.34

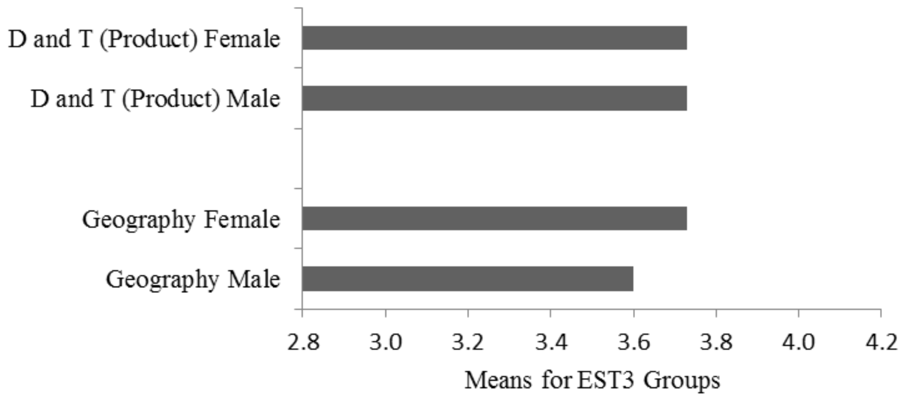
Table 12.33 Means for EST3 Groups by Geography and Sex – Study 3

		Male	Female
EST3 Group	1	3.1	3.3
	2	3.6	3.6
	3	3.8	4
	4	3.9	4
		(3.1 + 3.6 + 3.8 + 3.9) ÷ 4	(3.3 + 3.6 + 4 + 4) ÷ 4
Means		3.60	3.73

Table 12.34 Means for EST3 Groups by Design and Technology (Product) and Sex – Study 3

		Male	Female
EST3 Group	1	3.5	3.5
	2	3.7	3.6
	3	3.7	3.8
	4	4	4
		(3.5 + 3.7 + 3.7 + 4) ÷ 4	(3.5 + 3.6 + 3.8 + 4) ÷ 4
Means		3.73	3.73

Figure 12.34 from Tables 12.33 and 12.34 - Means for EST3 Groups by Geography and Design and Technology (Product) and Sex - Study 3



Tables 12.35 and 12.36/Fig 12.35

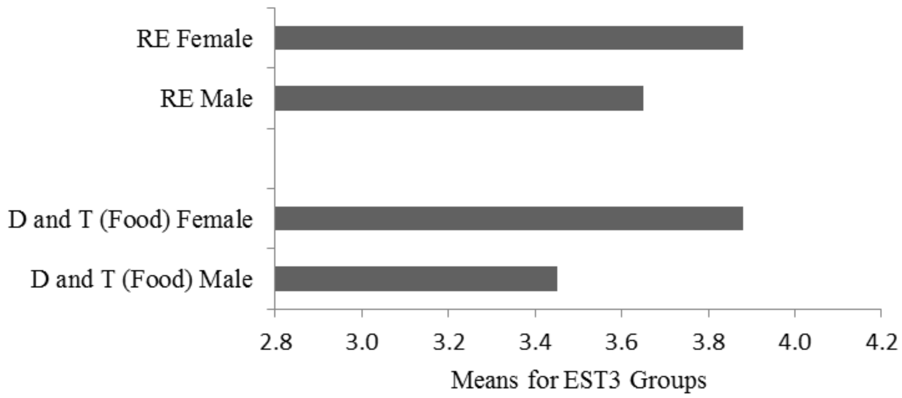
Table 12.35 Means for EST3 Groups by Design and Technology (Food) and Sex – Study 3

		Male	Female
EST3 Group	1	3.1	3.9
	2	3.5	4
	3	3.2	3.9
	4	4	3.7
		(3.1 + 3.5 + 3.2 + 4) ÷ 4	(3.9 + 4 + 3.9 + 3.7) ÷ 4
Means		3.45	3.88

Table 12.36 Means for EST3 Groups by Religious Education and Sex – Study 3

		Male	Female
EST3 Group	1	3.5	3.7
	2	3.9	3.9
	3	3.4	4
	4	3.8	3.9
		(3.5 + 3.9 + 3.4 + 3.8) ÷ 4	(3.7 + 3.9 + 4 + 3.9) ÷ 4
Means		3.65	3.88

Figure 12.35 from Tables 12.35 and 12.36 - Means for EST3 Groups by Design and Technology (Food) and Religious Education and Sex - Study 3



Tables 12.37 and 12.38/Fig 12.36

Table 12.37Means for EST3 Groups by Art and Sex – Study 3

		Male	Female
EST3 Group	1	3.1	3.2
	2	3.5	3.5
	3	3.6	3.5
	4	3.6	3.7
		(3.1 + 3.5 + 3.6 + 3.6) ÷ 4	(3.2 + 3.5 + 3.5 + 3.7) ÷ 4
Means		3.45	3.48

Table 12.38 Means for EST3 Groups by Music and Sex – Study 3

		Male	Female
EST3 Group	1	2.8	3.4
	2	3.5	3.4
	3	3.3	3.9
	4	3.7	4.2
		(2.8 + 3.5 + 3.3 + 3.7) ÷ 4	(3.4 + 3.4 + 3.9 + 4.2) ÷ 4
Means		3.33	3.73

Figure 12.36 from Tables 12.37 and 12.38 - Means for EST3 Groups by Art and Music and Sex - Study 3

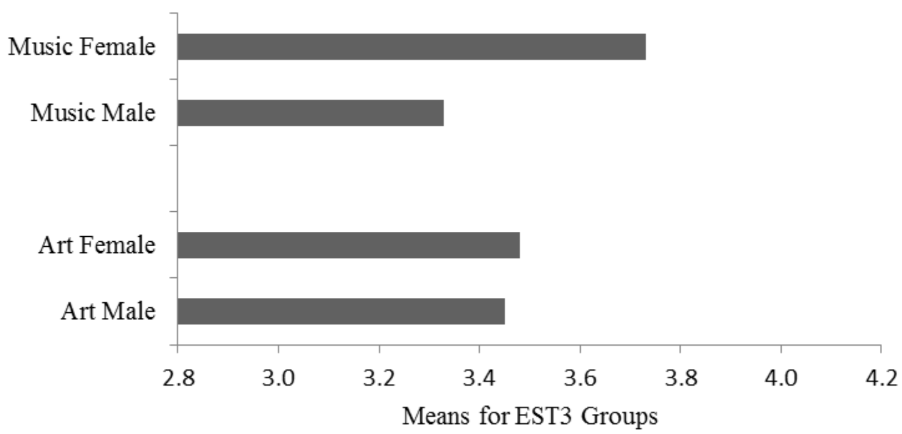
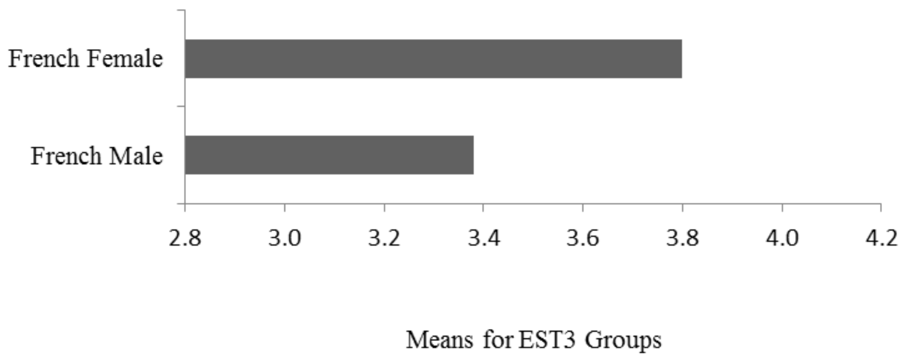


Table 12.39 /Fig 12.37

Table 12.39 Means for EST3 Groups by Modern Language (French) and Sex – Study 3

		Male	Female
EST3 Group	1	3.2	3.9
	2	3.2	3.8
	3	3.4	3.6
	4	3.7	3.9
		(3.2 + 3.2 + 3.4 + 3.7) ÷ 4	(3.9 + 3.8 + 3.6 + 3.9) ÷ 4
Means		3.38	3.80

Figure 12.37 from Table 12.39 for EST3 Groups by Modern Language (French) and Sex - Study 3



The results of this show that for the school subjects of English (Language and Literature), Geography, Design and Technology (Product), and Art, males and females achieved the same overall outcome. However, for the other school subjects of Mathematics, Science (General), History, Design and Technology (Food), Religious Education, Music and Modern Language (French), the females achieved a higher overall outcome.

Overall, the females achieved higher means than the males not only in terms of school subject type but also across the majority of the EST3 factor groupings. There were two notable deviations from this general situation where the males achieved a higher mean value than the females. These were in Mathematics, male mean 4.1, female mean 3.9 at group 4; and in Design and Technology (Food), male mean 4.0, female mean 3.7 from EST group 4.

Both of these outcomes can be explained in terms of a positive difference in spatial ability between male and female (for whatever reason) in the case of Mathematics; and perhaps a novelty or enhanced interest factor of the males in comparison to the females in the case of Design and Technology – Food, i.e. it was a relatively new school subject for the male members of the sample when the school subject data was obtained.

In general, the means for the raw scores for each of the eleven school subjects, increase across the four groups of the EST3 factor. Since these EST3 groupings reflect an increase in field independence from 1 to 4, there is a strong association between school performance/attainment and level of field dependence – field independence. This suggests, and possibly provides further evidence for the notion that level of field dependence – field independence as measured using the EST3, or similar approaches, is related to innate ability, which can manifest itself in academic or practical terms.

From this, there follows the further suggestion that embedded figure tests are really measuring a part of general intelligence 'g', (Spearman, 1923) (See Chapter 3, Section 3.4), i.e. in this context, the ability to systematically analyse the components, lines and internal shapes, of a given complex figure, so as to be able to locate the simple figure within it; and not only an aspect of perception as reflected in measurements of field dependence/ independence; or field dependence/independence as a measurement of how individuals approach, analyse and attempt to solve a given problem or situation, whether they have physical or social characteristics.

However, the use of embedded figures tests does not have to be considered to be only measuring one aspect of thinking? It could be that embedded figures tests are also measuring several aspects of thinking that lead or do not lead to perceived high levels of ability, be they academic as reflected in school, college or university performance/attainment, or something else of a practical or social nature.

GCSE Subjects

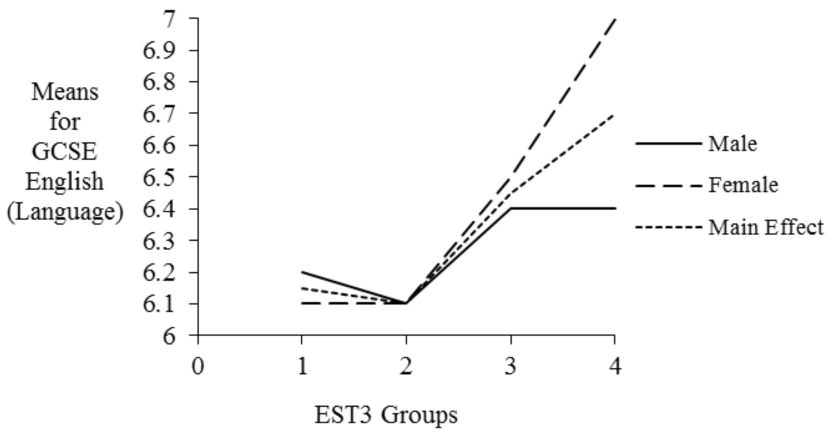
Tables 12.40 to 12.44 /Figures 12.38 to 12.42 show the means from the raw scores designated to GCSE Grade obtained, i.e. A=8, B=7 . . . E=4, F=3, G=2, U=1, in following five subjects, English Language, English Literature, Mathematics, Science (General) and Geography.

Table 12.40/Figure 12.38 – GCSE English (Language)

Table 12.40 Means for Male, Female and Main Effect for GCSE English (Language) – Study 3

EST3 Group	1	2	3	4
Male	6.2	6.1	6.4	6.4
Female	6.1	6.1	6.5	7
	(6.2 + 6.1) ÷ 2	(6.1 + 6.1) ÷ 2	(6.4 + 6.5) ÷ 2	(6.4 + 7) ÷ 2
Main Effect	6.15	6.1	6.45	6.7

Figure 12.38 from Table 12.40 for GCSE English (Language) - Study 3



There was little difference between the male and female lines except with group 4 of the EST factor, where the females achieved a higher score than the males by several decimal points, i.e. 7.0 and 6.4 respectively, producing the biggest difference between the males and females across the four EST factor groups.

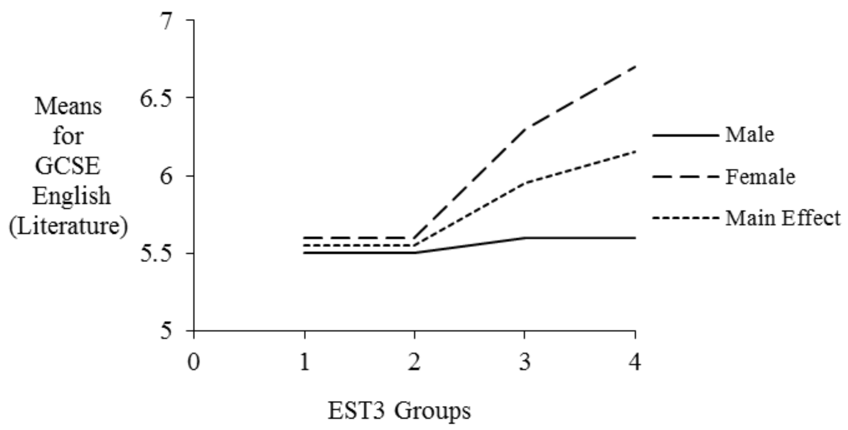
The 'main effect line' showed an interaction taking place between the males and females at Group 2.

Table 12.41/Figure 12.39 – GCSE English (Literature)

Table 12.41 Means for Male, Female and Main Effect for GCSE English (Literature) - Study 3

EST3 Group	1	2	3	4
Male	5.5	5.5	5.6	5.6
Female	5.6	5.6	6.3	6.7
	(5.5 + 5.6) ÷ 2	(5.5 + 5.6) ÷ 2	(5.6 + 6.3) ÷ 2	(5.6 + 6.7) ÷ 2
Main Effect	5.55	5.55	5.95	6.15

Figure 12.39 from Table 12.41 for GCSE English (Literature) - Study 3



The females scored higher than the males in all of the EST factor groupings, with the greatest difference occurring with groups 3 and 4, especially group 4.

Although there was a small difference, i.e. 0.1, between the male and female scores for groups 1 and 2, the scores for each sex were the same. However, whereas the female scores increased with increasing group number from group 2, this did not happen with the males, who after a slight increase from group 2 to 3, i.e. 0.1, achieved the same score for group 3 and 4.

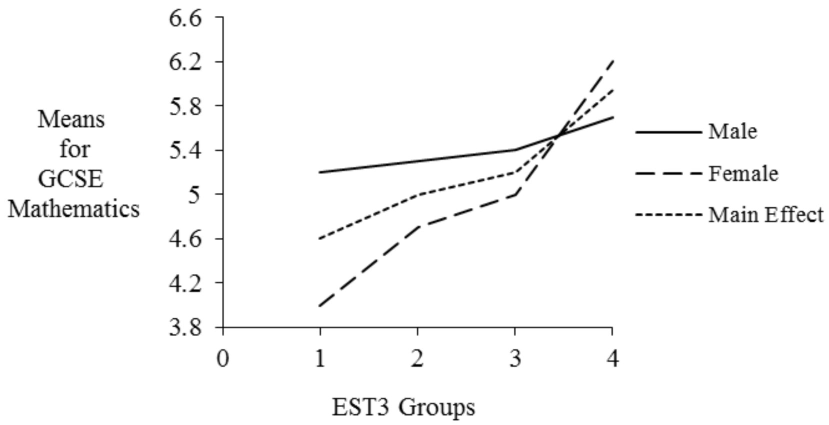
The ‘main effect line’ showed no interaction between the males and females.

Table 12.42/Figure 12.40 – GCSE Mathematics

Table 12.42 Means for Male, Female and Main Effect for GCSE Mathematics – Study 3

EST3 Group	1	2	3	4
Male	5.2	5.3	5.4	5.7
Female	4	4.7	5	6.2
	(5.2 + 4) ÷ 2	(5.3 + 4.7) ÷ 2	(5.4 + 5) ÷ 2	(5.7 + 6.2) ÷ 2
Main Effect	4.6	5	5.2	5.95

Figure 12.40 from Table 12.42 for GCSE Mathematics - Study 3



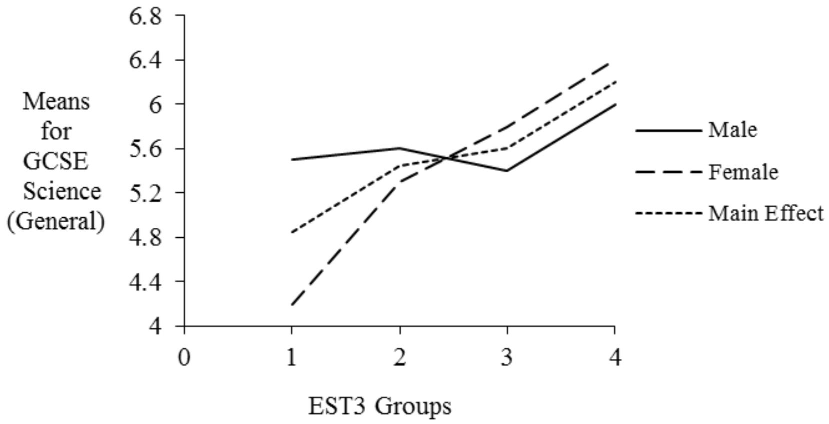
The males achieved higher scores than the females in each of the EST factor groupings apart from group 4. However, the biggest difference between males and females occurred in group 1. The 'main effect line' showed an interaction taking place between the males and females from group 3 and 4.

Table 12.43/Figure 12.41 – GCSE Science (General)

Table 12.43 Means for Male, Female and Main Effect for GCSE Science (General) – Study 3

EST3 Group	1	2	3	4
Male	5.5	5.6	5.4	6
Female	4.2	5.3	5.8	6.4
	(5.5 + 4.2) ÷ 2	(5.6 + 5.3) ÷ 2	(5.4 + 5.8) ÷ 2	(6 + 6.4) ÷ 2
Main Effect	4.85	5.45	5.6	6.2

Figure 12.41 from Table 12.43 for GCSE Science (General) - Study 3



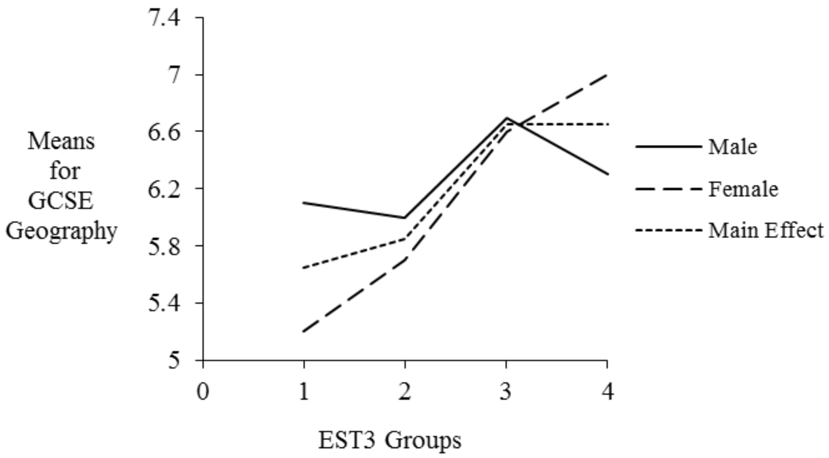
The males achieved a higher score than the females in groups 1 and 2 of the EST factor, but this situation was reversed for groups 3 and 4. The greatest difference in the male and female scores occurred in group 1. The ‘main effect line’ showed an interaction taking place between the males and females from group 2 to 3.

Table 12.44/Figure 12.42 – GCSE Geography

Table 12.44 Means for Male, Female and Main Effect for GCSE Geography – Study 3

EST3 Group	1	2	3	4
Male	6.1	6	6.7	6.3
Female	5.2	5.7	6.6	7
	(6.1 + 5.2) ÷ 2	(6 + 5.7) ÷ 2	(6.7 + 6.6) ÷ 2	(6.3 + 7) ÷ 2
Main Effect	5.65	5.85	6.65	6.65

Figure 12.42 from Table 12.44 for GCSE Geography - Study 3



The males achieved a higher score than the females in groups 1 and 2 of the EST factor, but this situation was reversed for groups 3 and 4. The greatest difference in the male and female scores occurred in group 1, and whereas the female scores increased as the group numbers increased, the male score dipped slightly at group 2. The 'main effect line' showed an interaction taking place between the males and females between group 2 and 3.

GCSE Subjects – Combined Tables and Figures

The combined mean values for each of the GCSE subject (variables) for both male and female, were obtained from each of the four groupings of the EST3 factor, and plotted against male and female.

Tables 12.45 and 12.46 /Figure 12.43

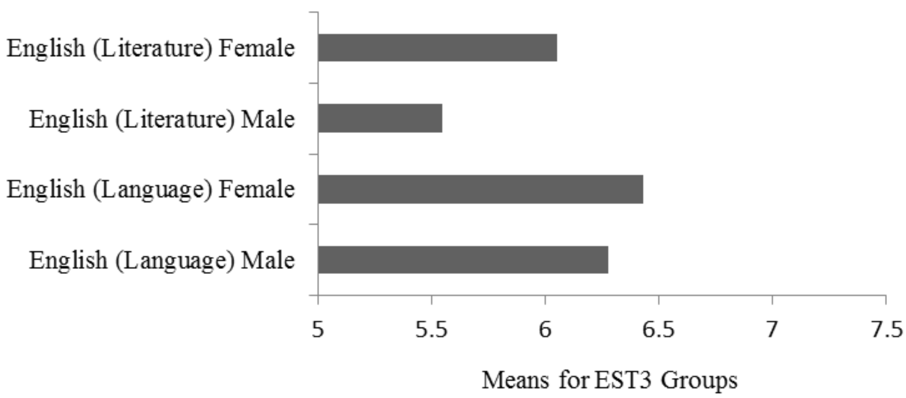
Table 12.45 Means for EST3 Groups by GCSE English (Language) and Sex - Study 3

		Male	Female
EST3 Group	1	6.2	6.1
	2	6.1	6.1
	3	6.4	6.5
	4	6.4	7
		(6.2 + 6.1 + 6.4 + 6.4) ÷ 4	(6.1 + 6.1 + 6.5 + 7) ÷ 4
Means		6.28	6.43

Table 12.46 Means for EST3 Groups by GCSE English (Literature) and Sex - Study 3

		Male	Female
EST3 Group	1	5.5	5.6
	2	5.5	5.6
	3	5.6	6.3
	4	5.6	6.7
		(5.5 + 5.5 + 5.6 + 5.6) ÷ 4	(5.6 + 5.6 + 6.3 + 6.7) ÷ 4
Means		5.55	6.05

Figure 12.43 from Tables12.45 and 12.46 - Means for EST3 Groups by GCSE English (Language) and GCSE English(Literature) and Sex - Study 3



Tables 12.47 and 12.48 /Figure 12.44

Table 12.47 Means for EST3 Groups by GCSE Mathematics and Sex – Study 3

		Male	Female
EST3 Group	1	5.2	4
	2	5.3	4.7
	3	5.4	5
	4	5.7	6.2
		(5.2 + 5.3 + 5.4 + 5.7) ÷ 4	(4 + 4.7 + 5 + 6.2) ÷ 4
Means		5.40	4.98

Table 12.48 Means for EST3Groups by GCSE Science (General) and Sex – Study 3

		Male	Female
EST Group	1	5.5	4.2
	2	5.6	5.3
	3	5.4	5.8
	4	6	6.4
		(5.5 + 5.6 + 5.4 + 6) ÷ 4	(4.2 + 5.3 + 5.8 + 6.4) ÷ 4
Means		5.63	5.43

Figure 12.44 from Tables 12.47 and 12.48 - Means for EST3 Groups by GCSE Mathematics and GCSE Science (General) and Sex - Study 3

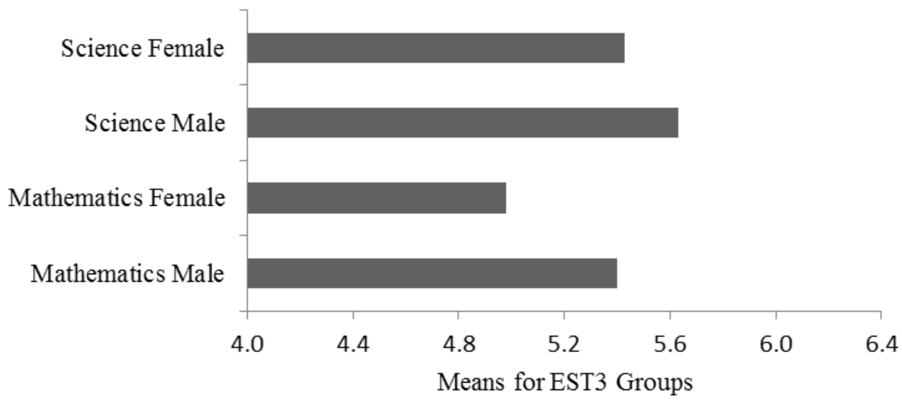
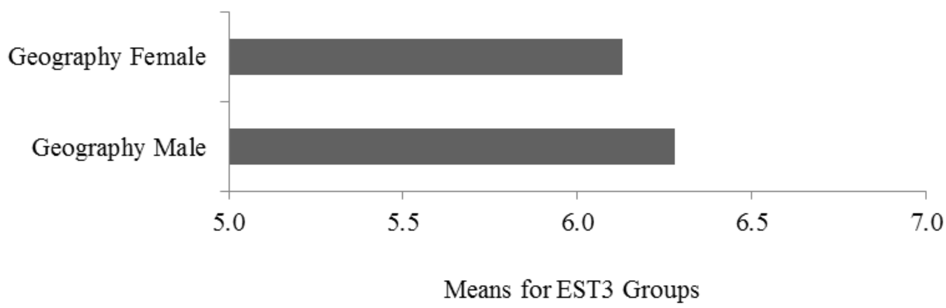


Table 12.49/Figure 12.45 – GCSE Geography

Table 12.49 Means for EST3 Groups by GCSE Geography and Sex – Study 3

		Male	Female
EST3 Group	1	6.1	5.2
	2	6	5.7
	3	6.7	6.6
	4	6.3	7
		(6.1 + 6 + 6.7 + 6.3) ÷ 4	(5.2 + 5.7 + 6.6 + 7) ÷ 4
Means		6.28	6.13

Figure 12.45 from Table 12.49 - Means for EST3 Groups by GCSE Geography and Sex - Study 3



The results of this show that for GCSE subjects of Mathematics, Combined Science and Geography, the males achieved a higher overall outcome than did the females. However, this situation was reversed for the GCSE subjects of English Language and English Literature.

MANOVA – Tables for EST3 /SWT2, NSWT1, COIT – A, B, S (T was not computed), GPCT and School Subjects and GCSE Subjects.

From Table 12.50 Analysis of Variance – Tests of Significance for EST3: SEX is significant (F = 0.72; df 1,197; p = 0.01).

Table 12.50 Tests of Significance for EST3 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	6916.37	197	35.11		
Constant	94410.42	1	94410.42	2689.11	.000
SEX	25.45	1	25.45	.72	.396

Sense Word Test , Version Two(SWT2) – Non-Sense Word Test, Version 1 (NSWT1)
From Table 12.51 Analysis of Variance – Tests of Between – Subject Effects, it can be seen that the variables of EST3 and SEX are not significant (F = 4.70; df 3,191; p = 0.01) and (F = 12.22; df 1,191; p = 0.01) respectively, but that EST3 by SEX is significant (F = 0.77; df 3,191; p = 0.01)

Table 12.51 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	15471.06	191	81.00		
Constant	226226.33	1	226226.33	2792.91	.000
EST3	1143.06	3	381.02	4.70	.003
SEX	990.10	1	990.10	12.22	.001
EST3 by SEX	187.73	3	62.58	.77	.511

From Table 12.52Analysis of Variance- Test involving ‘Test Type’ Within – Subject Effect, it can be seen that Test Type is not significant (F = 35.75; df 1,191; p = 0.01), but that EST by Test Type; and SEX by Test Type; and EST by SEX by Test Type are significant (F = 0.56; df 3,191; p = 0.01), (F = 0.59; df `,191; p = 0.01) and (F = 1.45; df 3,191; p = 0.01) respectively.

Table 12.52 Tests involving 'Test Type' Within-Subject Effect
Tests of Significance for T2 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	6290.44	191	32.93		
Test Type	1177.32	1	1177.32	35.75	.000
EST3 by Test Type	55.43	3	18.48	.56	.641
SEX by Test Type	19.41	1	19.41	.59	.444
EST3 by SEX by Test Type	143.37	3	47.79	1.45	.229

Chronological Order Integration Test (COIT) (Categories A, B and S)

Table 12.53 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	1461.72	174	8.40		
Constant	5761.05	1	5761.05	685.78	.000
EST3	59.68	3	19.89	2.37	.072
SEX	8.05	1	8.05	.96	.329
EST3 by SEX	35.10	3	11.70	1.39	.247

From Table 12.53 Analysis of Variance – Tests of Between – Subject Effects, it can be seen that the variables of EST3; SEX; and EST3 by SEX are significant (F = 2.37; df 3,174; p = 0.01), (F = 0.96; df 1,174; p = 0.01), and (F = 1.39; df 3,174; p = 0.01 respectively.

From Table 12.54 Analysis of Variance involving 'Test Type' Within – Subject Effect, it can be seen that Test Type is not significant (F = 30.70; df 1,174; p = 0.01), but that EST3 by Test Type; SEX by Test Type; and EST3 by SEX by Test Type are significant (F = 3.13; df 3,174; p=0.01), (F = 0.02; df 1,174; p = 0.01) and (F = 2.12, df 3,174; p = 0.01) respectively.

Table 12.54 Tests involving 'Test Type' Within-Subject Effect
Tests of Significance for T2 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	621.13	174	3.57		
Test Type	109.58	1	109.58	30.70	.000
EST3 by Test Type	33.55	3	11.18	3.13	.027
SEX by Test Type	.06	1	.06	.02	.895
EST3 by SEX by Test Type	22.75	3	7.58	2.12	.099

From Table 12.55 Analysis of Variance – Tests of Significance for EST3; SEX; and EST3 by SEX are significant (F = 0.84; df 3,174; p = 0.01), (F = 2.81; df 1,174; p = 0.01), and (F = 2.77; df 3,174, p = 0.01) respectively.

Table 12.55 Tests of Significance for Chronological Order Integration Test (COIT) using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	986.03	174	5.67		
Constant	2189.83	1	2189.83	386.43	.000
EST3	14.20	3	4.73	.84	.476
SEX	15.90	1	15.90	2.81	.096
EST3 by SEX	47.07	3	15.69	2.77	.043

Gestalt Picture Completion Test (GPCT)

From Table 12.56 Analysis of Variance – Test of Significance for Gestalt Picture Completion Test (GPCT), EST3, SEX and EST3 by SEX are significant ($F = 3.02$; df 3,181; $p = 0.01$), ($F = 0.07$; df 1,181; $p = 0.01$), and ($F = 0.16$; df = 3.181; $p=0.01$) respectively.

Table 12.56 Tests of Significance for Gestalt Picture Completion Test (GPCT) using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	464.86	181	2.57		
Constant	10633.26	1	10633.26	4140.22	.000
EST3	23.25	3	7.75	3.02	.031
SEX	.18	1	.18	.07	.792
EST3 by SEX	1.21	3	.40	.16	.925

School Subjects

From Table12.57 Analysis of Variance – Tests of Between – Subjects Effects, it can be seen that EST3 and SEX are not significant ($F = 9.34$; df 3,145; $p = 0.01$) and ($F = 9.67$; df 1,145; $p = 0.01$) respectively, but EST3 by SEX is significant ($F = 0.56$; df 3,145; $p = 0.01$).

Table 12.57 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	394.46	145	2.72		
Constant	21023.55	1	21023.55	7728.06	.000
EST3	76.27	3	25.42	9.34	.000
SEX	26.31	1	26.31	9.67	.002
EST3 by SEX	4.55	3	1.52	.56	.644

From Table 12.58 Analysis of Variance Test involving ‘Subject’ Within – Subject Effect, it can be seen that Subject and SEX by Subject are not significant (F = 2.46; df 10,1450; p = 0.01) and (p = 2.33; df 10,1450; p = 0.01) respectively, but EST3 by subject and EST3 by SEX by Subject are significant (F = 1.25; df 30,1450; p = 0.01) and (F = 1.12; df 30,1450; p = 0.01) respectively.

Table 12.58 Tests involving 'SUBJECT' Within-Subject Effect AVERAGED Tests of Significance for SUB using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	723.36	1450	.50		
Subject	12.29	10	1.23	2.46	.006
EST3 by Subject	18.76	30	.63	1.25	.163
SEX by Subject	11.60	10	1.16	2.33	.010
EST3 by SEX by Subject	16.79	30	.56	1.12	.297

GCSE Subjects

From Table 12.59 Analysis of Variance – Tests of Between Subjects Effects, it can be seen that EST3, SEX and EST3 by SEX is significant (F = 3.56; df 3, 85; p = 0.01), (p = 0.00; df 1,85; p = 0.01) and (F = 1.70; df 3,85; p = 0.01) respectively.

Table 12.59 Tests of Between-Subjects Effects Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	465.99	85	5.48		
Constant	15498.26	1	15498.26	2826.98	.000
EST3	58.50	3	19.50	3.56	.018
SEX	.00	1	.00	.00	.980
EST by SEX	28.04	3	9.35	1.70	.172

From Table 12.60 Analysis of Variance – Tests involving 'Subject' Within – Subject Effect, it can be seen that Subject and SEX by Subject are not significant (F = 27.77; df 4, 340; p = 0.01) and (F = 3.60; df 4, 340; p = 0.01) respectively, but EST3 by subject and EST3 by SEX by Subject are significant (F = 1.06; df 12, 340; p = 0.01) and (F = 0.58; df 12, 340; p = 0.01) respectively.

Table 12.60 Tests involving 'SUBJECT' Within-Subject Effect AVERAGED Tests of Significance for GCSE using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	247.10	340	.73		
Subject	80.74	4	20.19	27.77	.000
EST3 by Subject	9.27	12	.77	1.06	.391
SEX by Subject	10.46	4	2.62	3.60	.007
EST3 by SEX by Subject	5.03	12	.42	.58	.861

Correlations A further analysis for Study Three involved the production of a correlation matrix / value for each of the variables involved, except COIT Category T, the first nine variables of which are shown in Table 12.61on the following page.

Table 12.61 Correlation Matrix for the first nine variables of Study 3

	SEX	EST3	SWT2	NSWT1	COIT A	COIT B	COIT S	COIT T	GPCT
SEX		.0183	* .2284	* .2071	.0550	.1387	.1494		- .0231
EST3			* .2214	** .2317	.1329	.1536	.1159		.1564
SWT2				** .4788	.0201	.0519	.0132		- .0171
NSWT1					- .0085	- .0349	- .0082		.0793
COIT A						** .4125	** .6797		.0173
COIT B							** .7153		- .0036
COIT S									- .0173
COIT T									
GPCT									

2 – tailed Signif: * -.01 ** - .001

Correlations for COIT Category T were not computed.

In terms of significance and level of significance, the correlations ‘r’ between EST3, SWT2 and NSWT1, COIT Categories and the other variables of School Subjects and GCSE Subjects, are shown in Table 12.62

Table 12.62 Significant correlations from Table 12.61 – Study 3

Variables	Correlations (r)	Significance (p)
EST3/SWT2	.2114*	< 0.01
EST3/NSWT1	.2317**	< 0.001
EST3/School Subject Mathematics	.1873*	< 0.01
EST3/School Subject Science (General)	.3704**	< 0.001
EST3/School Subject History	-.2253*	< 0.01
EST3/School Subject Geography	-.2502**	< 0.001
EST3/School Subject D and T (Product)	-.2478*	< 0.01
EST3/School Subject Religious Education	-.2059*	< 0.01
EST3/School Subject Art	-.1996*	< 0.01
EST3/School Subject Music	-.2633**	< 0.001
EST3/GCSE English (Language)	.3178**	< 0.001
EST3/GCSE English (Literature)	.2946**	< 0.001
EST3/GCSE Drama	.6309**	< 0.001
EST3/GCSE Mathematics	.3546**	< 0.001
EST3/GCSE Science (General)	.4350**	< 0.001
EST3/GCSE Geography	.3248**	< 0.001

EST3/GCSE D and T (Product)	.4179*	< 0.01
SWT2/SEX	.2284*	< 0.01
SWT2/NSWT1	.4788**	< 0.001
SWT2/School Subject History	-.1979*	< 0.01
SWT2/School Subject Geography	-.2010*	< 0.01
SWT2/School Subject Religious Education	-.2539**	< 0.001
SWT2/School Subject Music	-.2126*	< 0.01
SWT2/GCSE English (Language)	.2206*	< 0.01
NSWT1/SEX	.2021*	< 0.01
NSWT1/ School Subject Religious Education	-.2064*	< 0.01
NSWT1/ School Subject Music	-.1991*	< 0.01
NSWT1/GCSE English (Language)	.3045**	< 0.001
NSWT1/GCSE Mathematics	.2472**	< 0.001
NSWT1/GCSE Geography	.3131**	< 0.001
COIT A/COIT B	.4125**	< 0.001
COIT A/COIT S	.6797**	< 0.001
COIT A/School Subject Mathematics	-.2358*	< 0.01
COIT A/School Subject Science (General)	-.2040*	< 0.01
COIT A/School Subject History	-.2446**	< 0.001
COIT A/School Subject Art	-.1973*	< 0.01
COIT A/School Subject Music	-.2490**	< 0.001
COIT A/GCSE English (Language)	.2236*	< 0.01
COIT A/GCSE Mathematics	.2323*	< 0.01
COIT A/GCSE Science (General)	.2057*	< 0.01
COIT A/GCSE History	.3917**	< 0.001
COIT B/School Subject English (Lang - Lit)	-.2757**	< 0.001
COIT B/School Subject Mathematics	-.3072**	< 0.001
COIT B/School Subject Science (General)	-.2681**	< 0.001
COIT B/School Subject History	-.2631**	< 0.001
COIT B/School Subject D and T (Food)	-.2415**	< 0.001
COIT B/School Subject Music	-.2620**	< 0.001
COIT B/GCSE English (Language)	.2557**	< 0.001
COIT B/GCSE Mathematics	.2404*	< 0.01
COIT B/GCSE Science (General)	.2197*	< 0.01
COIT B/GCSE Geography	.3106**	< 0.001
COIT B/GCSE D and T (Product)	.4096*	< 0.01
COIT S/School Subject English (Lang - Lit)	-.1999*	< 0.01
COIT S/School Subject Mathematics	-.2589**	< 0.001
COIT S/School Subject Science (General)	-.1917*	< 0.01
COIT S/School Subject History	-.2127*	< 0.01
COIT S/School Subject Religious Education	-.1909*	< 0.01
COIT S/School Subject Music	-.2626**	< 0.001
COIT S/GCSE English (Language)	.2720**	< 0.001
COIT S/GCSE English (Literature)	.2276*	< 0.01
COIT S/GCSE Mathematics	.2078*	< 0.01
COIT S/GCSE Geography	.2714*	< 0.01

The correlations between EST3, SWT2 and NSWT1, although positive, are fairly low, at .2114 and .2317 respectively. However, the correlation between SWT2 and NSWT1 is not. Such results are not too surprising since the SWT2 and NSWT1 are of a similar construction when compared to the EST3 in terms of the modality of the tasks they present, i.e. letters and words in contrast to geometrical shapes.

The Gestalt Picture Completion Test (GPCT) correlations do not correspond with any of the other variables at the $p < .01$ or $p < .001$ levels of significance.

This is not too surprising, because the skills or style required to identify a picture from little information given is unlike those required for disembedding a piece of information from a lot of information given. This would give some confirmation that the two different tasks can be considered 'opposite' and therefore, require a different set of skills or style, to that of the global or articulated aspects of field dependence - field independence.

The Chronological Order Integration Test (COIT), Categories A, B and S show a number of positive correlations at both the $p <.01$ and $p <.001$ levels of significance with many of the other variables of School and GCSE Subjects, but not EST3, SWT2 or NSWT1.
There are two considerations that need to be made here. First, since the David Livingstone passages are a piece of text, the skills of absorbing the factual information, analysing, synthesising and remembering it, are similar to the activities of many School and GCSE Subjects. Therefore, the correlations should not be surprising. Secondly, the 'switch' component/data of the David Livingstone passages attempted to measure which elements had been retained by the testees from both passages, which would be an indication of field dependence or field independence. From such a hypothesis, one would have expected higher correlations between the COIT Categories A, B, and S; SWT2 and NSWT1, in particular, as well as EST3.

With regards to school and GCSE subjects, there are many correlations, both at the $p <.01$ and $p<.001$ levels of significance, which is not surprising because one is comparing 'like with like', when the school subject and the GCSE subject are the same.

ii) Conclusion

The lines of enquiry in this Study (Three) have consolidated and extended those of Studies One and Two, as follows:-

1. The use of Embedded Shapes Test, Version Three (EST3), Sense Word Test, Version Two (SWT2) and Non-Sense Word Test, Version 1 (NSWT1), with a larger sample;
2. The use of the Chronological Order Integration Test (COIT) to investigate the measurement of field dependence – field independence, in the context of a verbal modality that uses text as the operating medium;
3. The use of the Gestalt Picture Completion Test (GCPT) to explore perceptual and thinking mechanisms which appear to have opposite characteristics to those involved with measurements of field dependence – field independence, whether within the context of a spatial or verbal modality;
4. The use of a larger number and range of subjects within the high school curriculum to compare performance/attainment on these with those from all of the above 'tests'; and
5. The use of several GCSE subjects to investigate similar comparisons to those referred to in four above.

Also sex differences in level of performance in measurements of field dependence – field independence, using the EST3, SWT2, NSWT1 and COIT; as well as the use of the GPCT, has not been a primary objective of this Study (Three) and the preceding Studies (One and Two), however, comparisons have been made and referred to whenever they have occurred.

In general terms, the level of evidence of an association, albeit an opposite one, between the EST3 and the GPCT, i.e. characteristics of field dependency – field independency perception and thinking skills to produce disembedding or segregating outcomes, in the context of a spatial modality, as opposed to the apparent opposite characteristics and skills to produce assembling or integrating outcomes, again in the context of a spatial modality, necessary for the completion of the GPCT, were somewhat low in terms of the significant interactions and correlations achieved.

With regards to the measurement of field dependence – field independence, using the SWT2, NSWT1, and the COIT, in the context of a verbal modality, the evidence produced of interactions and/or correlations was not substantial. There are likely to be many reasons for this which could include the following:-

1. Each of the above ‘tests’ or instruments, are in their infancy and require further development and application, particularly in relation to the inherent differences between ‘words’ and ‘text’, when associated with the measurement of field dependence – field independence; and

2. The SWT2 when compared to the NSWT1 is different to the extent that it may be better to consider it as an instrument for the measurement of field dependence – field independence, in a spatial rather than a verbal modality because it displays collections of letters which appear as shapes and not words with their associated meaning. However, the interactions and correlations between the EST3 and the NSWT1 are .2317 at $p < 00.1$.

From a comparison of the various tables and figures, and their associated interactions and correlations of the Study (Three), it can be seen that the females performed at a higher level than the males in the majority of the four groups for the EST3, SWT2 and NSWT1; COIT Categories A, B and S; GPCT; School Subjects and GCSE Subjects. When the males did perform at a higher than the females the general skills involved appear to have been predominantly spatial, since the higher male outcomes occurred in GPCT, COIT Category S, and GCSE Mathematics, Geography and Art, but such a difference did not occur for all of the four groupings in each of these ‘tests’ and ‘subjects’.

The general comparison referred to above between the sexes and ‘tests’ or instruments and high school subjects (pre GCSE), perhaps brings into focus the nature of field dependence – field independence, in terms of the spatial characteristics and the analytical properties inherent in the concept of it, when it is measured by an instrument like the EST3. This in turn poses a number of questions which include considerations of a range of abilities within the individual, male and/or female.

Chapter 13

Study Four

13.1 Introduction

The purpose of this Study (Four) was:-
1 To continue to investigate the use of the three field dependence – field independence instruments, i.e. Embedded Shapes Test, Version Three (EST3); Sense Words Test, Version Two (SWT2); and Non-Sense Words Test, Version One (NSWT1);
2 To investigate associated and related psychological and cognitive mechanisms/ attributes to the construct of field dependence – field independence and its measurement by using:-
The Gestalt Picture Completion Test (GPCT) (Street, 1931)
An Intelligence Quotient Assessment (British Ability Scales (BAS) Short Form), and
Cognitive Styles Analysis (CSA) (Riding, 1991, 2000) - a computer administered procedure for the measurement of cognitive style dimensions, defined by the CSA.
3 To provide a comparison between the results achieved on the above instruments and those achieved on a range of school subjects, by the members of the sample used in this Study (Four); and
4 To investigate possible relationships between all of the above measures/'tests', and school subject performance/achievements used, on a statistical basis.

13.2 Method

i) Sample

The sample consisted of one hundred and twenty-eight Year 8 students, from a Middle School situated in a semi-rural town, within an English County. There were six forms in Year 8, of which four were used for the sample. Each form in Year 8, consisted of mixed ability pupils, so consequently, a wide range of ability was automatically included in the sample, and there was no need for selection considerations to be made, either in terms of forms or individuals.

The composition of each form used in the sample in terms of the males and females, and the total number of sample members is shown in Table 13.1.

Table 13.1 Composition of the Overall Sample into Forms, Males and Females

Form	Males	Females	Total
1	18	14	32
2	19	13	32
3	17	15	32
4	18	14	32
Sample Totals	72	56	128

ii) Materials

a) Embedded Shapes Test, Version Three (EST3)

b) Sense Words Test, Version Two (SWT2)

c) Non-Sense Words Test, Version One (NSWT1)

A full description of each of these tests/versions has already been given in terms of their initial and modified forms, in Chapter 9 (Pilot Studies One and Two) and Chapter 10 (Study One). In this Study (Four) as in Chapter 11 (Study Two) and Chapter12 (Study Three) they were used in exactly the same way as Chapter 10 (Study One) in terms of their format and the procedure followed.

d) The Gestalt Picture Completion Test (GPCT)

A test items/questions response sheet for each testee was formulated by the researcher of this thesis to enable the above test to be administered on a group basis.
The theoretical basis of the GPCT was given in Chapter 8 (Further Developments) Section 8.3; and its description given in Chapter 12 (Study Three) Section 13.2 , Sub-section ii) Materials.

In this Study (Four) as in Chapter 12 (Study Three), the GPCT was used in exactly the same way in terms of its format and the procedure followed.

e) The British Ability Scales (BASI)/Short Form Intelligence Quotient

Scales used for the Short Form Intelligence Quotient
This consisted of four sub-scales, with a particular ‘ability’ being measured by each of them. Published materials, two booklets, i.e. Matrices and Speed of Information Processing, and one form, i.e. Similarities, were used with three of the scales, and a test items/questions response

sheet formulated by the researcher, for the fourth scale, i.e. Recall of Digits (Forwards) to enable it to be administered on a group basis.
All of the above were reproduced to form one composite Questions and Answer Booklet, i.e. for each of the four sub-scales, to enable all of them to be used on a group basis (see Appendix H).

Physical Materials Used with each of the Scales/Tests.
General-Scales/Questions and Answer Booklet used in this Study (Four)
The four Scales/Tests (Recall of Digits, Similarities, Matrices and Speed of Information Processing) used in this Study (Four) in their modified form were presented to the testees in one (composite) booklet. At the front of the booklet, and at the top of the Recall of Digits Scale/Test pro forma, was located the testee's personal information section. This consisted of name; date of birth; male/female; date of test and class code.

Since the Recall of Digits Scale/Test was the first to be administered out of the four BASI Scales/Tests used in this Study (Four), and because of its characteristics, i.e. it required less space on an A4 sized page or sheet than the Similarities Scale/Test or parts of the Matrices Scale/Test or Speed of Information Processing Scale/Test, at the top of its pro forma was placed the testee's personal information section to the test booklet containing all of the above Scales/Tests.

The four Scales/Tests used in the Short Form Intelligence Quotient measure of the BASI used in this Study (Four), each have their own standard task presentation/recording booklet or sheet, which are usually used on an individual basis.
Since each of the Scales/Tests used in this study were administered on a group basis, it was necessary to modify, to varying degrees, the means of presenting the Scales/Tests tasks to the testees for a variety of administrative reasons.
Although the modifications to the materials used resulted in very small changes in the British Ability Scales (BAS) prescribed procedures, more so with some scales/tests than others, i.e. Speed of Information Processing, Recall of Digits, Similarities and Matrices, in descending order, such changes were kept to a minimum.

See Appendix M for the Questions and Answer Booklet of materials, relating to Scales/Tests used.

1) Recall of Digits Scale, Test 'B'

The particular test used for this scale consisted of fifteen sets of digits as designated by this particular BASI Scales/Test, out of a possible total of thirty-six sets of digits. The digit 'sets' were ranged from two to nine digits as follows:-
two sets of two digits, two sets of three digits, two sets of four digits, two sets of five digits, two sets of six digits, two sets of seven digits, two sets of eight digits, and one set of nine digits.

A pro forma was produced, on an A4 sized page, which had more space for the recording of responses than the one produced as part of the BASI recording materials, because the testees and not the administrator were to record their own responses since this Scale/Test was administered on a group and not an individual basis.

The above pro forma in fact was arranged to accommodate all thirty-six sets of digits. The reason for this was to have a way of recording the complete Scale/Tests, i.e. Test 'A', which includes Test 'B' and 'C', if it became necessary, as this scale began to be used, as part of the present Study (Four), because of the possible difficulties involved in using this scale on a group basis, i.e. all of the testees hearing simultaneously the sets of digits as they were read out, to avoid having to re-administer this scale using Test 'C' which had different sets of digits but followed the same pattern of digits as Test 'B' in terms of their size and number. However, it did not become necessary to use more than Test 'B' in the use of the Recall of Digits Scale.

There appeared to be no apparent adverse outcomes as a result of administrating this Scale/Test on a group basis in spite of the potential difficulties.

2) Similarities Scale, Test 'A'

The test used for this scale—Similarities, was Test 'A', which included all twenty-one, in increasing level of difficulty, Similarities test items in the BASI Scale/Test.
The actual BASI Similarities pro forma, the way of presenting the tasks and recording the responses, was used, i.e. an A4 single page.
In the context of this Study (Four) the essential difference between this and the usual use of the Similarities Scale/Test(s) was in the procedure used to administer it, i.e. the testees read the task questions or statements and wrote their own responses instead of this being done by

the administrator, which is usually the case, because it was administered on a group and not an individual basis.

This change in procedure does not appear to have adversely or indeed affected in any way the outcomes produced.

3) Matrices Scale, Test 'F'.

The particular test used for this scale—Matrices, Test 'F', is a comprehensive test in that it covers the full range of Matrices items, in terms of level of difficulty, from the full Matrices range of this particular BASI scale.

It consists of eleven 'test' items, no practice items, some of a 2 x 2 matrix and others of a 3 x 3 matrix.

For the purposes of this Study (Four), four, four, and three 'test' items were arranged, respectively, on A4 sized paper. The first page was composed of three 2 x 2 matrices and one 3 x 3 matrix being placed as 'test' item number four; the second page was composed of different sized matrices as the first page, with the 3 x 3 matrix being placed as 'test' item number eight; and the third page was composed of three 3 x 3 matrices.

The sequence of matrices, whether 2 x 2 or 3 x 3 was the same in this new presentation as the presentation that formed part of the BASI Scales/Tests (usually the overall test is presented in a booklet with one 'test' item per page, with the 'test' being administered on an individual basis).

In each of the matrices, whether 2 x 2 or 3 x 3, the blank square, to be filled in to complete the 'pattern' of the matrix, was situated in the bottom right hand corner of the overall matrix. To complete the overall matrix pattern it was necessary for the subject(s) to examine the contents of each of the squares of the matrix, horizontally, vertically and/or diagonally.

The above 'new' presentation generally assisted the administration of this scale/'test' on a group basis, and the 'new' presentation did not alter in any way the method by which the testees completed each matrix 'test' items. Thus, the validity of the outcomes would be expected to remain unaffected.

4) Speed of Information Processing Scale, Test 'D'

The particular test used for this Scale—Speed of Information Processing, Test 'D', included two practice items and ten 'test' items. Each item, practice and 'test' consisted of a series of random numbers arranged in five horizontal lines. The first practice item was composed of single digit numbers, the second practice item and the following five ‘test’ items were composed of double digit numbers, and the remaining five ‘test’ items were composed of triple digit numbers.

For the purposes of this Study (Four), the practice and ‘test’ items were arranged to include four items on A4 sized paper (usually the overall test is presented in a booklet with one item, practice and ‘test’, on each page, with the ‘test’ being administered on an individual basis). This allowed the two practice items and the first two ‘test’ items to be placed on the first page, and four ‘test’ items on the two other pages. The resulting arrangement gave a practice item composed of single digits, a practice item composed of double digits on the first page; three ‘test’ items composed of double digits and one ‘test’ item composed of triple digits on the second page; and four ‘test’ items composed of triple digits on the third page.

Since the objective or task of this Scale/Test is to indicate in some way, e.g. a circle around or a line through, the largest number in each line of numbers of each item, practice and ‘test’, at speed, i.e. within a time limit, the above arrangement assisted the general administration of this Scale/Test on a group basis, without any apparent invalidation of the outcomes.

f) The Cognitive Styles Analysis (CSA)

Theoretical basis of the Cognitive Styles Analysis (CSA) (See Chapter 4, Section 4.9)

The Cognitive Styles Analysis (CSA) is computer presented and measures an individual’s position on the Cognitive Style dimensions of Wholist-Analytic and Verbal-Imager by means of a calculated ratio, derived from the number of correct responses and the time taken by the testee, to provide a designated position on each pair of the cognitive style dimensions, via the following matrix:-

COGNITIVE STYLES ANALYSIS (Riding 2000)
DISTRIBUTION

WHOLIST-ANALYTIC DIMENSION

> 1.35	ANALYTIC VERBALIZER	ANALYTIC BIMODAL	ANALYTIC IMAGER
> 1.02 and < = 1.35	INTERMEDIATE VERBALIZER ●	INTERMEDIATE BIMODAL	INTERMEDIATE IMAGER ●●●●
< = 1.02	WHOLIST VERBALIZER	WHOLIST BIMODAL ●●●	WHOLIST IMAGER
	< = 0.98	> 0.98 and < = 1.09	> 1.09

VERBAL-IMAGERY DIMENSION

Two computer stations were used simultaneously for the CSA data collection.
A description of the theoretical basis of the CSA can be found in Chapter 4, Section 4.9.

g) School Subjects Performance/ Attainment Data

Information was requested, from the school, for each member of the sample on all school subjects in terms of test/examination results, and level of achievement. This meant that the performance/attainment levels for each school subject for each member of the sample at the end of the Summer Term/Academic Year of Year 8 were obtained.

The school subjects for which the above information was obtained were English (a combination of Language and Literature), Mathematics, Science (General), Humanities (History and Religious Education), Geography, Design and Technology (Product Design), Design and Technology (Food), Art, Music, Modern Language (French), Computer Studies, and Physical Education.

iii) Procedure

General Comments

Since the overall sample consisted of four forms or groups, each of mixed ability, each of the 'tests', except for the computer- presented CSA, was administered to one form at a time. However, all of the tests were not administered consecutively i.e. with one form at a time, because of time-table considerations. In the case of the computer-presented CSA, this was administered to two testees at a time, one on each side of a small room, because of the availability of suitable computer hard/software, i.e. it was not possible to 'network' to enable a form to be assessed as a whole at the same time. Each testee had an independent computer station.

Therefore, the pattern of administration for all of the 'tests', with each form, was as follows:-

1) EST3; SWT2; and NSWT1, administered in this order and consecutively;

2) GPCT

3) The British Scales (BASI)/Short Form Intelligence Quotient

The four Scales/Tests used were administered in the order of Recall of Digits; Similarities; Matrices; and Speed of Information Processing.

4) CSA

Within the time slots requested for each form, for the administration of all of the 'tests', it was possible to work through each of the tests at a steady pace, i.e. allowing sufficient time for general organisation, explanation and working time.

The situation was different for the administration of the CSA, because only two testees could be accommodated at any one time. Therefore, several half or quarter days, mornings and afternoons, were used for the administration of this assessment. These half or quarter days were inter-dispersed by sessions with a particular form, when the other tests were administered.

The overall administration of all of the tests took about five days, within one week, towards the end of the Summer Term, of Year 8 for the testees of the sample.

This arrangement not only gave more flexibility for the administration of the tests, as far as the school time-table was concerned, but it also meant that the school subject 'test' results and levels of achievement, which were recent, would be close in time to the 'test' results obtained from the 'tests' and 'scales/tests' administered as part of this Study (Four). Thus giving a snap-shot of level of functioning within a relatively short period of time, from both school and research outcomes.

With each form, the seating positions of the testees were arranged in a normal sized classroom in such a manner so as to maximise the space between each testee. There was no attempt made to separate males from females.

Each of the EST3, SWT2, and NSWT1 were given out, worked through, and collected in separately, in the above order. The answer sheet for the GPCT and the booklets and sheets for the BAS sub-scales/tests were arranged in a booklet in the order of GPCT, Recall of Digits, Similarities, Matrices, and Speed of Information Processing.

Prior to the beginning of each session of administering the tests with each of the four forms, every member of the form was given an HB pencil and a pencil eraser.
Throughout the administration of each test within each session, the need for standard test/examination conditions to be maintained at all times was emphasised.

a) Embedded Shapes Test, Version Three (EST3);
b) Sense Word Test, Version Two (SWT2); and
c) Non-Sense Word Test, Version One (NSWT1)

Each of the above 'tests' were administered in the order a), b), and c), consecutively.
The procedure for the administration of each of the above three 'tests' was exactly as that described in Study One, Chapter 10, Section 10.2 iii) a) b) c)

d) The Gestalt Picture Completion Test (GPCT)

The procedure for the administration of this test, was exactly as that described in Study Three, Chapter 12, Section 12.2 iii) e)

e) The British Ability Scales (BASI)/Short Form Intelligence Quotient

Once the composite booklet (see Section 2.2—sub-section v for details) had been given out to the testees within each of the forms, they were asked to complete the section relating to personal details. After this, the testees were requested not to 'look through' the composite booklet but to only turn to various parts of it when directed.

The order of the administration of the four scales/tests used to obtain an Intelligence Quotient for each testee of the forms/sample was as follows:-
Recall of Digits/Test 'B'; Similarities/Test 'A'; Matrices/Test 'F'; and Speed of Information Processing/Test 'D'.
The procedure for the administration of each of the above four tests was as directed by the Administration and Scoring Manual, of the British Ability Scales (BASI) (Elliot et al, 1983).

However, some minor changes to the standard procedure were necessary because they were administered on a group and not an individual basis. Such changes did not invalidate the consequent performance and IQ calculation for the testees. These differences were as follows:-

1) Recall of Digits/Test 'B'

To administer this scale on a group basis the testees were required to write down their responses. To meet this requirement, a pro forma was produced, which was included in the test booklet for all four Scales/Tests.
Therefore, the administrator read out each number forming each set of digits, to the form and each testee wrote down, on their individual pro forma, the numbers forming each set of digits as they remembered them. Sufficient time was allowed between each set of digits for all of the testees to write down as much as they could remember.

Although the actual presentation of each set of digits was not different from that given on an individual basis, it was obviously important that all of the testees in each group were able to hear clearly each number to each set of digits as they were being said by the administrator. With this in mind the administrator was careful to place himself in an optimum position in relation to each testee within each form, and to ensure that no-one had any hearing difficulties in relation to being able to hear the numbers.

Before each set of digits were given to the testees, in each form, they were told the 'Question Number' as indicated on the pro forma and asked to try to write the number to each set of digits neatly, and by the side of the corresponding 'Question Number'.
Also, before the commencement of the administration of this Scale/Test, a general explanation was given to each form with regard to what they were going to be asked to do, which incorporated many of the above points.

Since the pro forma used for this scale formed the first page of the composite booklet, the personal details being placed above it, the subjects were asked to turn the booklet over once they had completed the last question, thus reducing the possibility of ‘copying’.

2) Similarities/Test ‘A’

Again, as with the Recall of Digits Scale, the Similarities Scale is administered individually, for the same reasons, with the responses given by the subject, to the question asked, and then written down by the administrator. By administrating this Scale/Test on a form basis, although the published pro forma was used, the subjects of each group wrote down their own answer in response to the questions, as they read them to themselves and not as a consequence of being asked by the administrator.

Therefore, after the Scale/Test had been introduced to the subjects in each group, and the example at the beginning of the Scale worked through orally, the administrator satisfying himself that everyone understood what they had to, the subjects were allowed to work through as many questions as they could manage, at their own pace, without a set time for completion. Once the subjects had completed as many questions as they could, they were asked, by the administrator, to close and turn over their composite booklets, again to reduce the possibility of ‘copying’, and wait for further instructions.

Throughout, the administration of this Scale/Test the subjects were closely monitored by the administrator who was also ready to answer any questions in relation to the nature of the questions the subjects were being asked to answer.

Very few questions were asked in relation to this scale from the sample as a whole, the vast majority of subjects appeared to readily understand what they had to do and how to do it after the explanation and example had been given.

3) Matrices/Test ‘F’

The administration for this Scale/Test was modified slightly in terms of the use of examples and the presentation of the questions, when used on a group as opposed to an individual basis for which it was primarily intended.

No examples were used, and the questions that constitute the test were arranged four to a page for two A4 sized pages, with the remaining three questions being placed on a third page.

Therefore, a careful explanation was given by the administrator, with regard to the technique of looking closely at the presented incomplete pattern of shapes or figures, both horizontally and vertically, before attempting to complete the overall pattern, such a technique being applicable to both four and nine pattern questions.

The subjects were allowed to look at the first page, containing the first four matrices questions, three four pattern, and one nine pattern, while the above explanation of how to complete the overall pattern of each question was given.

The testees were requested to complete the matrices patterns using pencil and reference made to the need for a reasonable degree of accuracy and proportion when drawing in the missing shape or figure to complete the overall pattern of each question.
Once the administrator was assured that the testees understood what to do, they were allowed to complete the four matrices questions on the first page and then move on to the questions presented on the other two pages, at their own pace.

Also the testees were requested to close their composite booklets, once they had completed all of the matrices questions, again, to reduce the possibility of copying taking place.
Crossing out or rubbing out of initial answers was allowed if the testees felt they had made a mistake, which was facilitated by the suggested use of pencil to complete the matrices questions.

These slightly modified approaches to the administration and completion of the Matrices Scale/Test did not appear to cause any concerns, the vast majority of subjects being able to work successfully from the start, with very few having to alter their initial answers.

4) Speed of Information Processing/Test 'D'

The administration of the Speed of Information Processing Scale/Test was modified slightly, since it was administered on a group basis as opposed to an individual basis, which is the usual procedure.

The modification made was in relation to the time of the overall test, in that the maximum time allocated for each question was allowed instead of each testee working through the questions at their own pace, as would be the case if they were completing this Scale/Test on an individual basis. This meant that the administrator started and stopped the working of each question by the testees in each group, working through all of the questions of the Scale/Test, one at a time, until it was complete.

The testees were told, before the commencement of the 'scored' questions of the Scale/Test, that they must stop working when told to do so, and move to the next question when told to do so, immediately as they were directed through the questions.
Therefore, by allowing the maximum permitted time for each 'scored' question, each subject could legitimately score a point for each question they completed successfully, and the administration of the Scale/Test would not be invalidated.

Prior to the administration of the 'scored' questions as described above, the two practice questions allocated to this Scale/Test which were administered in a similar manner.
Since the practice and scoring of questions were presented four to an A4 sized page, i.e. two practice and two scoring questions on the first page, followed by four scoring questions on each of the other two pages of the overall Scale/Test, the testees were asked to focus their attention on the question in hand, practise or scoring, as the questions were 'worked through'.

The testees were requested to complete the practice and scoring questions using pencil and reference made to the need for accuracy when 'crossing out' the numbers involved in each question, and speed of working, bearing in mind that there would not be time to erase mistakes. With regard to 'mistakes', testees were told to cross out the mistake rather than attempt to erase them.

After the time for the last question had elapsed, the subjects were requested to close their composite booklets immediately, to reduce the possibility of some candidates spending more time on the last question, and the general possibility of copying taking place.
In spite of the administrative and presentation modifications made, the overall administration appeared to be successful because the testees followed very closely the instructions given to them, i.e. starting and stopping to work at each of the scoring questions as directed, and focusing their attention on one question at a time.

5) Compilation of Intelligence Quotient

From the raw score obtained from each of the four Scales/Tests for each testee of the sample, a Mean 'T-score' was obtained and then an Intelligence Quotient (I.Q.) was derived for each testee.

The above procedure followed that as specified in the British Ability Scales (BASI), Manual, Administration and Scoring (Elliott et al, 1983), for the estimation of an Intelligence Quotient (Short Form).

Reasons for the order of administration of the Scales/Test used

Although the sequence of administration of the Scales/Tests used for the estimation of Intelligence Quotient is not specified in the procedure as outlined in the British Ability Scales (BAS), Manual, Administration and Scoring, the sequence of Recall of Digits, Similarities, Matrices and Speed of Information was used.

The reasons for this were as follows:-

First, Recall of Digits, because this required listening skills to be used by the testees which meant that they would need to settle down quickly, having their attention focused on the first and subsequent tasks immediately and publicly;

Secondly, Similarities, the tasks involved in this Scale/Test allowed the subjects to work on their own once the example had been worked through together/publicly, which was in contrast to the first Scale/Test used, and the type of task was different;

Thirdly, Matrices, although the method of working through this Scale/Test was similar to that of Similarities, i.e. the testees working on their own, once they understood what they had to do, the type of task was, again, different to the tasks in the previous scale/test, i.e. Similarities; and,

Fourthly, Speed of Information Processing required the testees to listen to the 'Start' and 'Stop' instructions, which were public, while working on the particular types of tasks for this Scale/Test in between and on their own.

Therefore, apart from the inherent differences in each of the four Scales/Test used, by arranging the administration of them in the particular sequence that was used, the form of the administration, which required particular skills to be used by the testees, in addition to those for the type of tasks included in each Scale/Test, gave a lot of variation, in an attempt to maximise the attention and interest of the testees, throughout the administration of the four scales/tests consecutively. This was considered important, especially since the Scales/Tests were administered on a group basis and not an individual basis.

In spite of these modifications, which will be described in this sub-section, the outcomes from each scale/test and the resulting Intelligence Quotient measure does not appear to have been invalidated when considered in relation to other measures of cognitive and scholastic functioning associated with the subjects as part of this overall Study (Four)/Thesis.

f) Cognitive Styles Analysis (CSA)

The administration of "The Cognitive Styles Analysis" (CSA) was carried out in groups of two, each subject having their own computer station, i.e. keyboard and computer monitor, both of which were situated, for the purpose of this Study (Four), in a small room.
Each computer station was placed opposite to the other, at the maximum distance permitted by the size of the room, so that each testee could not see what the other was doing, i.e. the answers being given to the questions posed, and to minimise the influence of one testee onto the other, i.e. the presence of the other in the same small room.

Before the computer presentation of the CSA was started by each testee, the administrator briefly explained to them what they were about to do and how to do it using the computer. This involved explaining the type of questions that were about to be presented; the number of each type of question; the type of information they would be given to each type of question, what they were to do with it and how they were to respond to it, using the keyboard, to give their answer; and how they were to procedure through the overall presentation, from one set of questions to the next, again using the computer keyboard.

Before the commencement of the first set of questions, the testees were asked to 'type' into the computer, using the keyboard, their personal details, i.e. their full name; sex; and age in years. Also, the testees were told how to finish their 'computer session', leaving their computer station ready for the next testee to attempt the CSA.

Since the last information the testee receives on the computer monitor, after completing the CSA, is their position on the two dimensions that the CSA is measuring (for details see Section 2.2, sub-section (vi)); they were asked to look at this and wait until the administrator (briefly and simply) explained this to them, (separately and privately with each pair of testees); before settling the programme/computer monitor to the start of the CSA for the next testee.

After the above procedure had been completed for each pair of testees, they were allowed to go back to their class/group, and the above procedure repeated for the next pair of testees. In this way, it was possible to work through the CSA with many pairs of testees on a continual basis within the time slots arranged, but not necessarily a complete class/group, in relation to the administration of the other ‘tests’ and the school time-table.

With each pair of testees/sessions when the CSA was in use, the administrator was present in the room. This enabled the administrator to:-
ensure that each testee was able to move through the presented questions smoothly, e.g. able to read the information; know what to do and how to move from one question/section to another; ensure that the answers provided by each testee were their own; and to be generally supportive to the testees should they wish to seek any further help or advice.

All of the subjects appeared to have well developed computer keyboard skills, and able to read the information presented on the television monitor well/well enough to enable them to complete the CSA.

g) School Subjects

Performance/Attainment Grades/Codings for the subjects of the curriculum were obtained from school.

13.3 Results and Analysis

i) Results

General Comments
The general response of the sample members was positive in that the majority appeared to readily understand the tasks they were required to do in each of the ‘tests’ used, i.e. EST3; SWT2; NSWT1; GPCT; BAS I, Scales/Tests; and CSA.

As with the previous three studies, the response of the sample members to the Practice Section of the EST3 was similar in that a few (eleven) sample members failed to score any points.

Again, for the purposes of analysis used in this study, as with the previous three studies, only the raw scores from the Response Section (C) of the EST3 were used for the same reason, i.e. to give a degree of compatibility with the SWT2 and NSWT1, since these two tests did not have a Practice Section.
The outcomes of the GPCT practice items were better than those for the practice items of the EST3, in that all sample members achieved a maximum score.

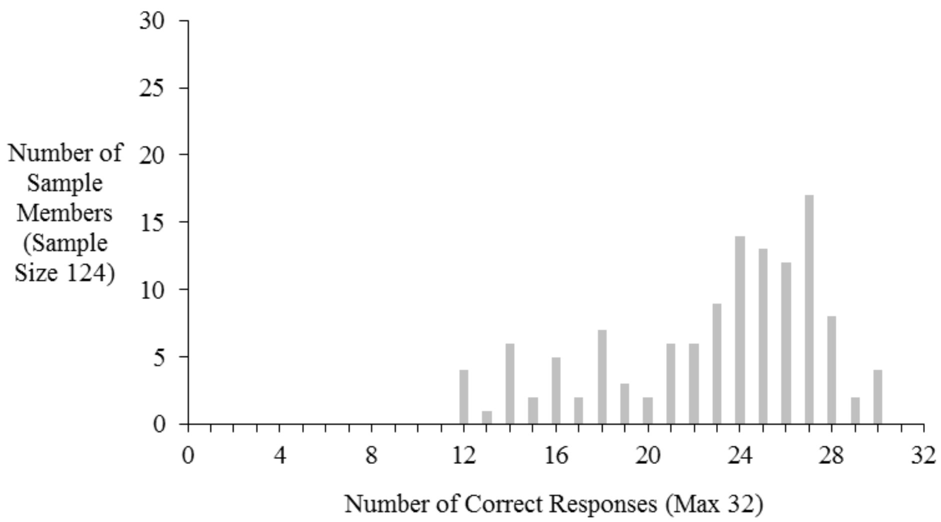
The outcomes for each of the BASI, Scales/Tests, i.e. Recall of Digits, Similarities, Matrices and Speed of Information Processing, were positive in relation to all of the sample members achieving a score, which enabled their ability/skill level to be measured on each of the scales. In turn, a viable Intelligence Quotient (IQ) measure was determined from such scores, i.e. via the summation of each Scale/Test score.

The sample members readily adapted to the CSA in terms of the presentation of tasks and the recording of their responses, i.e. a computer station rather than paper and pencil.

a) Embedded Shapes Test, Version Three (EST3)

The range of raw scores for the Response Section (C) of the EST3 was wide with the majority of them being high, i.e. between twenty-two and twenty-eight.
In terms of males and females, the range of raw scores was from thirteen to twenty-nine, and twelve to twenty-eight respectively.

Figure 13.1 Frequency Distribution of Correct Responses (C) (raw scores) for the Embedded Shapes Test, Version Three (EST3) - Study 4



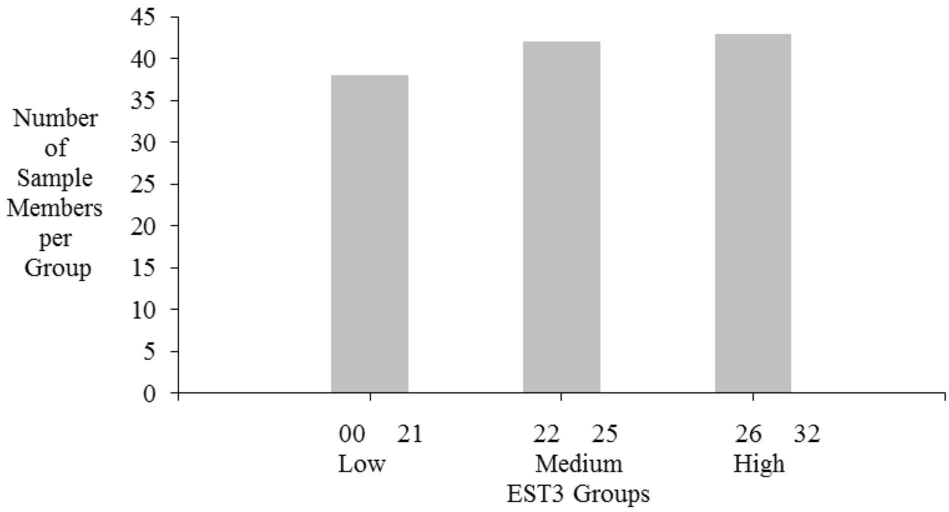
For the overall sample the range of raw scores on this test was from twelve to thirty.
The raw scores from the EST3 were arranged into three groups. The range of raw scores within each of these groups is shown in Table 13.2.

Table 13.2 Range of Raw Scores for EST3 - Low, Medium and High – Study 4

Group 1 (Low)	0 – 21	(39 sample members)
2 (Medium)	22 – 25	(42 sample members)
3 (High)	26 - 32	(43 sample members)

The distribution of scores within each of the three groups is shown in Figure 13.2.

Figure 13.2 Correct Responses from Response Section (C) (raw scores) arranged into three groups of Low, Medium and High for the Embedded Shapes Test, Version Three (EST3) - Study 4



The number of correct responses to the test items/questions of the Response Section (C) did not differ very much from the number of test items attempted for the majority of the sample members.

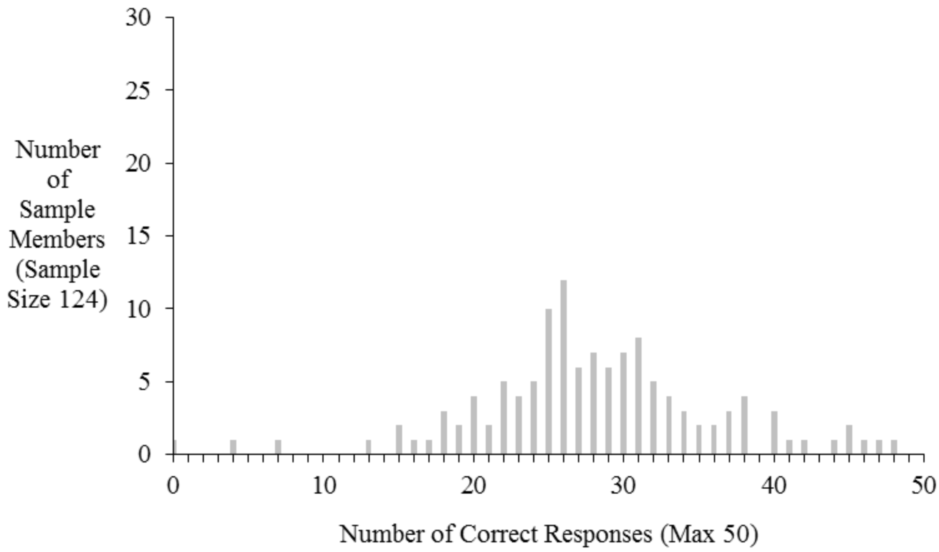
Also, most sample members attempted the majority of the items presented in the Response Section (C).

b) Sense Word Test, Version Two (SWT2)

The range of raw scores from the overall sample for the SWT2 was from 0 to 48, with most of the scores occurring between 22 and 32.

In terms of males and females, the range was from 4 to 48, and 0 to 47, respectively.

Figure 13.3 Frequency Distribution of Correct Responses (raw scores) for the SenseWord Test, Version Two (SWT2) - Study 4



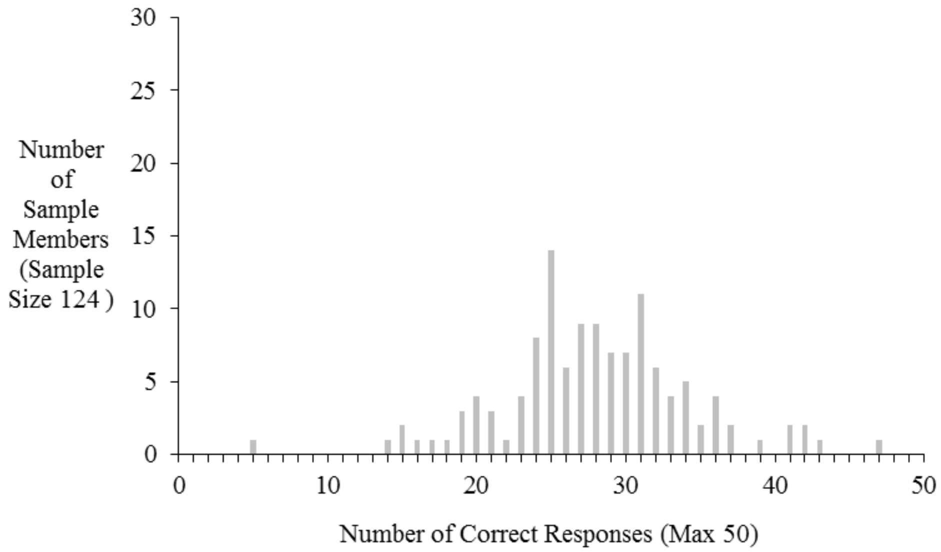
The number of correct responses to the test items/questions presented differed very little from the number of test items/questions attempted for the majority of the sample members.

As in Study 3 for SWT2, most of the sample members attempted approximately thirty of the test items/questions presented, within the allocated time for the completion of the 'test'.

c) Non-Sense Word Test, Version Two (NSWT1)

The range of raw scores for the NSWT1 was less than that of the SWT2, i.e. the highest raw score achieved was forty-three as compared to forty-eight, and five as compared to zero.
The overall sample the range of raw scores on the Non-Sense Word Test was from five to forty-three.
In terms of males and females, the range of raw scores was from five to forty-one, and fifteen to forty-three respectively.

Figure 13.4 Frequency Distribution of Correct Responses (raw scores) for the Non-Sense Word Test, Version 1 (NSWT1) - Study 4

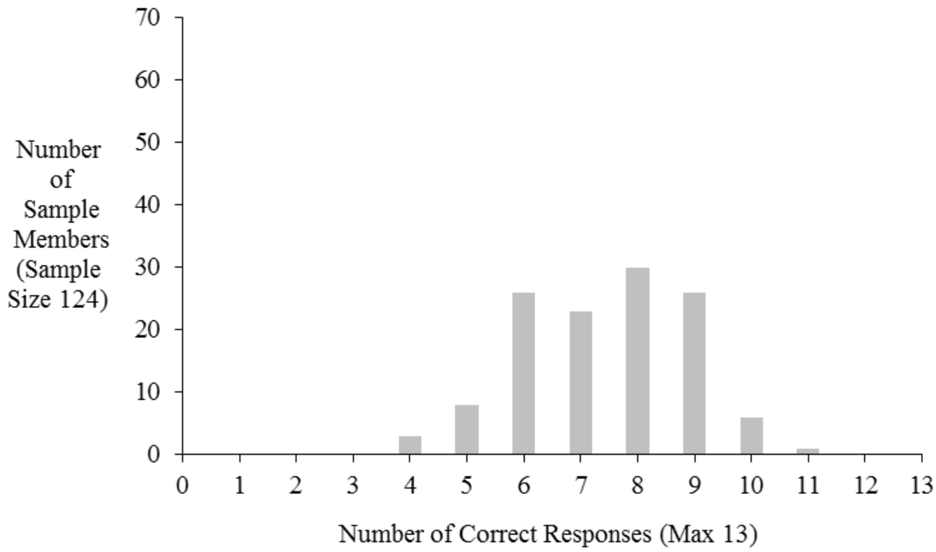


The number of correct responses to the test items/questions achieved differed very little from the number of test items/questions attempted by the majority of the testees.
As in Study 3, for the NSWT1, most of the sample members only attempted approximately thirty of the test items/questions presented, within the allocated time for the completion of the 'test'.

d) The Gestalt Picture Completion Test (GPCT)

The range of raw scores obtained for the GPCT was from 4 to 11, with the overall sample scores providing a well-defined frequency distribution (See Figure 13.5).
In terms of males and females, the range was from 4 to 11, and 4 to 10 respectively.

Figure 13.5 Frequency Distribution of Correct Responses (raw scores) for the Gestalt Picture Completion Test (GPCT) - Study 4



The number of correct responses to the test items/questions achieved, compared to the number of test items attempted, differed by about fifty percent (similar to Study 3) for approximately fifty percent of the sample members.
Approximately half of the sample members attempted all of the test items/questions presented.

e) British Ability Scales (BASI)

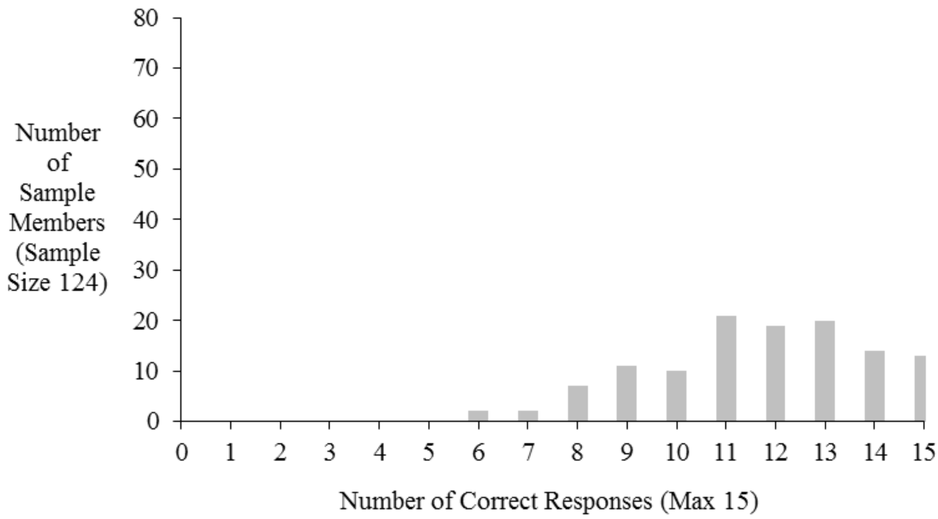
General Comments

Although with each of the British Ability Scales/Tests used, a distribution of scores was obtained from the sample, the distribution, in each case, did not span the range of possible scores, giving a skewed distribution that included the higher parts of the score range.
This in turn produced a similar I.Q. distribution for the sample, since the I.Q. score for each member of the sample was calculated by taking the average of the sum of the four scores achieved from each Scale/Test used.

i) Recall of Digits Scale, Test 'B'.

The range of raw scores obtained for the Recall of Digits Scale/Test 'B' was from six to fifteen (score range zero to fifteen), giving a distribution skewed toward high scores (See Figure 13.6).

Figure 13.6 Frequency Distribution of Correct Responses (raw scores) for the British Ability Scales (BAS I) - Recall of Digits Scale/Test B - Study 4

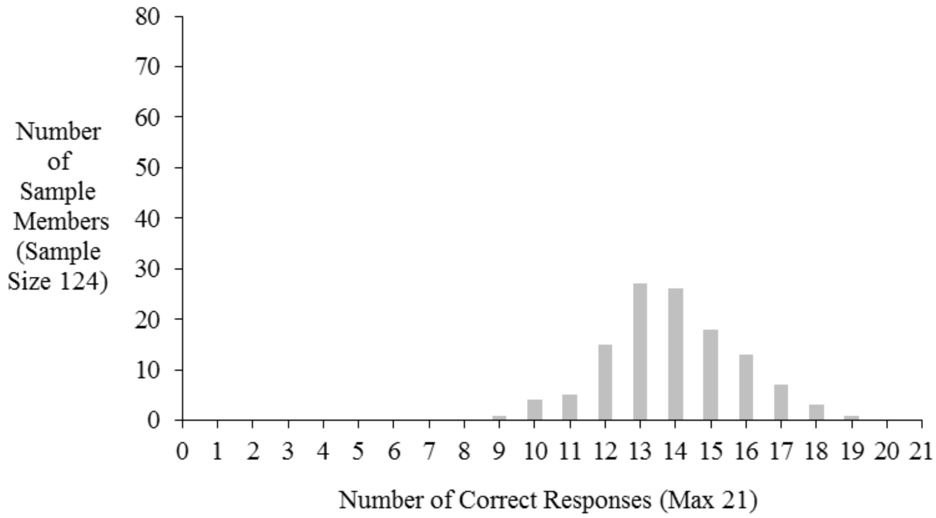


In terms of males and females, the range of correct responses was from six to fifteen, and seven to fifteen respectively.
All of the sample members attempted all the test items presented, with the majority achieving a number of correct responses of between eleven and fifteen.

ii) Similarities Scale, Test ‘A’

The range of raw scores obtained for the Similarities Scale/Test ‘A’ was from nine to nineteen (score range zero to twenty-one) giving a distribution of high scores, i.e. 9 and above. (See Figure 13.7).

Figure 13.7 Frequency Distribution of Correct Responses (raw scores) for the British Ability Scales (BAS I) - Similarities Scale/ Test A - Study 4



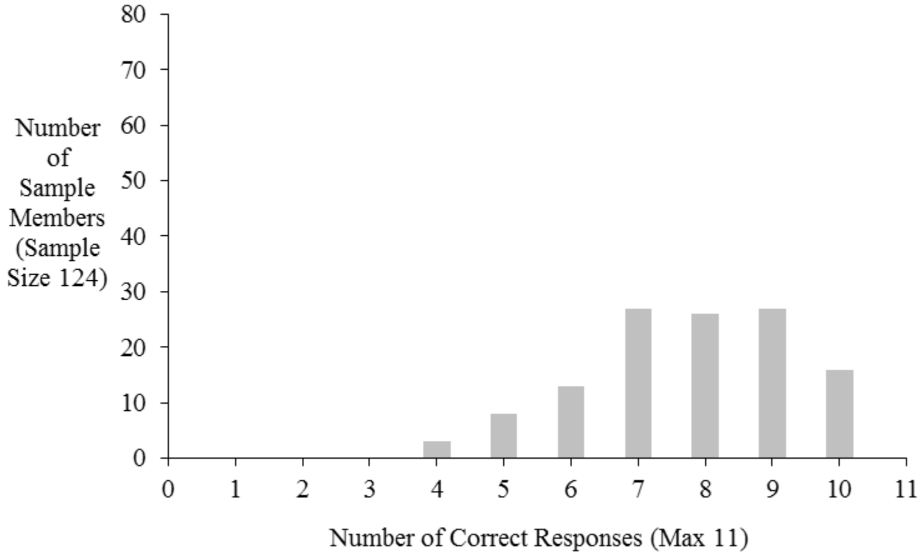
In terms of males and females, the range of correct responses was from nine to nineteen, and ten to eighteen respectively.

All of the sample members attempted all the test items presented, with the majority achieving a number of correct responses of between twelve and sixteen.

iii) Matrices Scales, Test ‘F’

The range of raw scores obtained for the Matrices Scale/Test ‘F’ was from four to ten (score range zero to eleven) giving a distribution skewed towards high scores. (See Figure 13.8)

Figure 13.8 Frequency Distribution of Correct Responses (raw scores) for the British Ability Scales (BAS I) - Matrices Scale/ Test F - Study 4



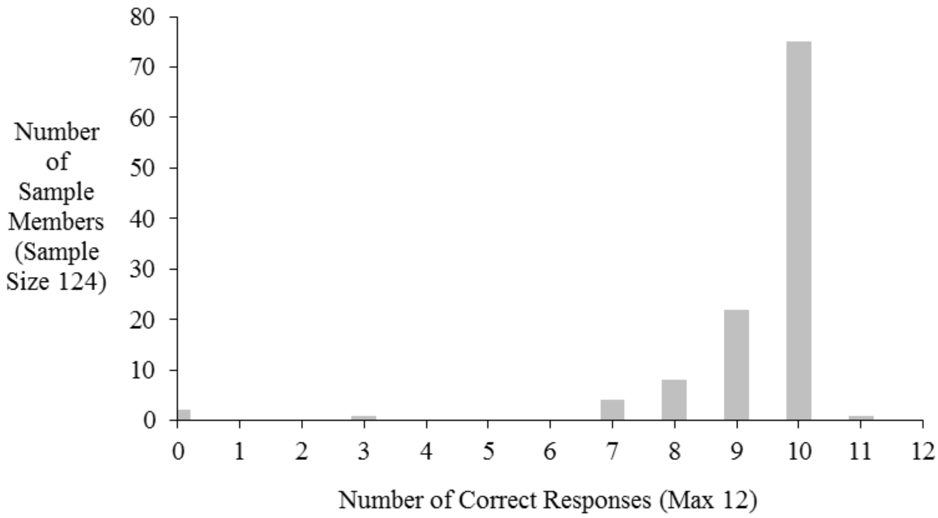
In terms of males and females, the range of correct responses was from four to ten, and five to ten, respectively.

All of the sample members attempted all the test items presented, with the majority achieving a number of correct responses of between seven and nine.

iv) Speed of Information Processing Scale, Test ‘D’

The range of raw scores obtained for the Speed of Information Processing Scale/Test ‘D’ was from zero to eleven (score range zero to twelve) giving a distribution very skewed with high scores towards the maximum score possible (see Figure 13.9).

Figure 13.9 Frequency Distribution of Correct Responses (raw scores) for the British Ability Scales (BAS I) - Speed of Information Processing Scale/ Test D - Study 4

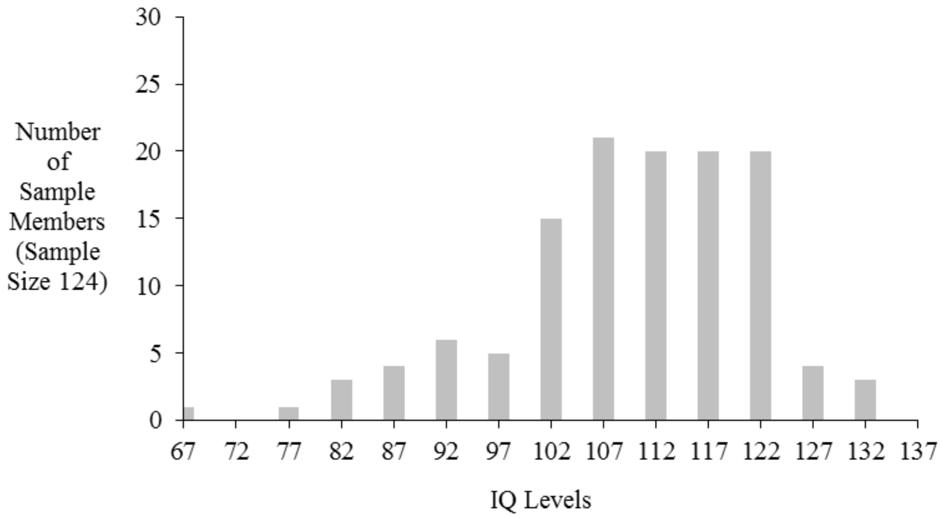


In terms of males and females, the range of correct responses was from three to ten, and zero to eleven, respectively.
All of the sample members attempted all the test items presented, with the majority achieving the maximum number of correct responses.

v) Intelligence Quotient (IQ)

The range of I.Q. scores obtained from the sample gave a distribution with approximately five sixths of the sample achieving higher than average, i.e. a score above one hundred.
By taking a fifteen point interval (one standard deviation), above or below the distribution mean, approximately two thirds of the sample members are above and one third below the distribution mean for IQ (See Figure 13.10)

Figure 13.10 Frequency Distribution of Intelligence Quotients from the British Ability Scales (BAS I) - Short Form Version - Study 4



f)The Cognitive Styles Analysis (CSA)

General Comments

Ratios for both the Wholistic-Analytic and Verbal-Imager dimensions were obtained for each of the sample members.

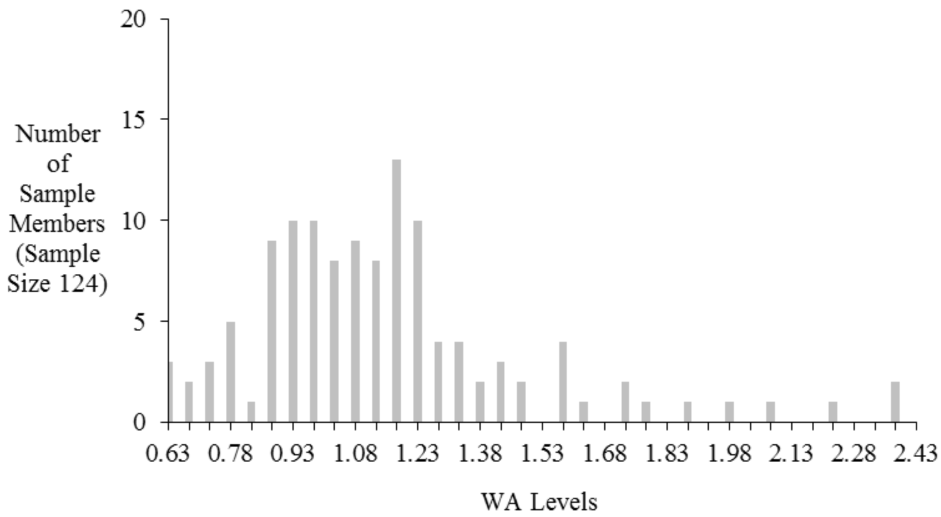
i) Wholistic-Analytic Dimension

The range of ratios obtained for the Wholistic-Analytic Dimension was from 0.61 - 0.65 to 2.36 - 2.40.

The majority of the sample members achieved a Wholistic-Analytic ratio of between 0.86 - 0.90 and 1.21 - 1.25.

Also, the distribution of the Wholistic-Analytic ratios for the sample members were skewed towards the lower value ratios of the overall ratio range, i.e. less than 1.56 - 1.60. (See Figure 13.11).

Figure 13.11 Frequency Distribution from the Cognitive Styles Analysis (CSA) of the Wholistic - Analytic Dimension (WA) Ratios - Study 4



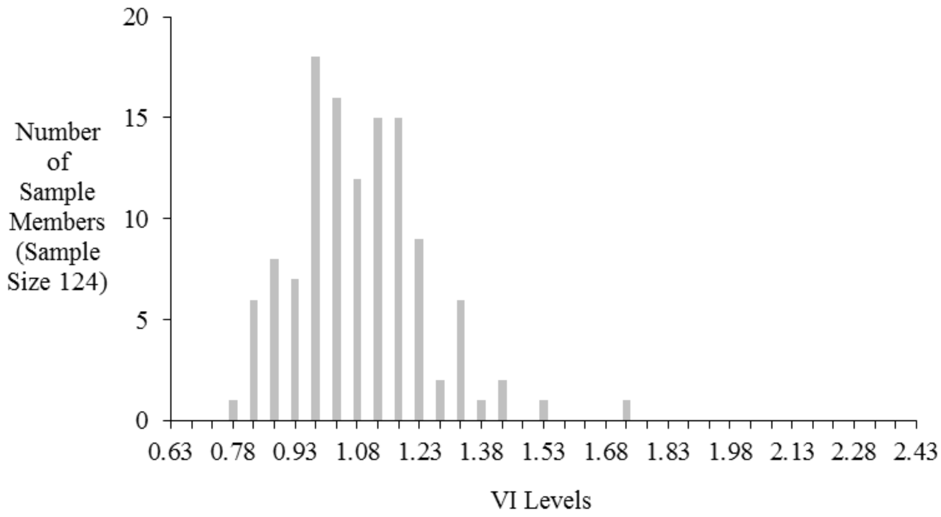
ii)Verbaliser-Imager Dimension

The range of ratios obtained for the Verbaliser-Imager Dimension was from 0.26 - 0.80 to 1.71 - 1.75.

The majority of the sample members achieved a Verbaliser-Imager ratio of between 0.81 - 0.85 to 1.31 - 1.35.

Also, the distribution of the Verbaliser–Imager ratios for all of the sample members were skewed towards the lower value ratios of the overall ratio range, i.e. less than 1.41 – 1.45.

Figure 13.12 Frequency Distribution from the Cognitive Styles Analysis (CSA) of the Verbal - Imager Dimension (VI) Ratios - Study 4



iii) Categorising each of the sample members into cognitive style types by considering combinations of the component parts of the Wholistic–Analytic and Verbaliser-Imager dimensions.

For the Wholistic - Analytic ratios, values of 0.99 or less were designated Wholistic; and values of 1.00 or more were designated Analytic.

For the Verbaliser-Imager ratio, values of 0.94 or less were designated Verbaliser; values of 1.06 or more were designated Imager; and values of 0.95 to 1.05 were designated Intermediate or Bimodal.

By using the above technique of matching ratio values to the two cognitive style dimensions, the sample members were allocated to one of the following combinations:-

Analytic Verbaliser	Analytic Bimodal	Analytic Imager
Intermediate Verbaliser	Intermediate Bimodal	Intermediate Imager
Wholistic Verbaliser	Wholistic Bimodal	Wholistic Imager

(See Chapter 4, Section 4.9; and Riding, 1991 and 2000 for further details.)

Table 13.3 shows the distribution of the overall sample, and in terms of male and female, for six of the above combinations of the two cognitive style dimensions.

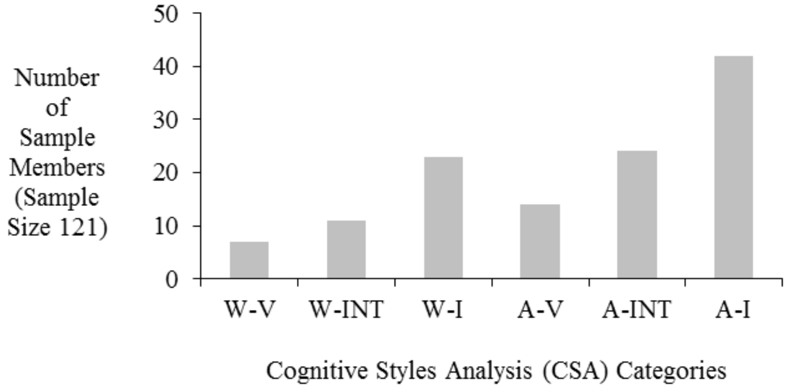
Table 13.3 Cognitive Styles Analysis (CSA) Categories for Males and Females – Study 4

	W-V	W-INT	W-I	A-V	A-INT	A-I
Males	3	5	14	8	15	23
Females	4	6	9	6	9	19
Total	7	11	23	14	24	42

It can be seen from Table 13.3 that most of the males and females, and therefore the overall sample members, are designated as having a predominant cognitive style that has an analytic and imager component.

Figure 13.13, shows the cognitive style frequency distributions for the total sample.

Figure 13.13 from Table 13.3 Frequency Distribution for Cognitive Styles Analysis (CSA) Categories Categories for the Total Sample - Study 4



Figures 13.14 and 13.15 show the cognitive style frequency distributions for the males and females, respectively.

Figure 13.14 from Table 13.3 Frequency Distribution for Cognitive Styles Analysis (CSA) Categories for Males - Study 4

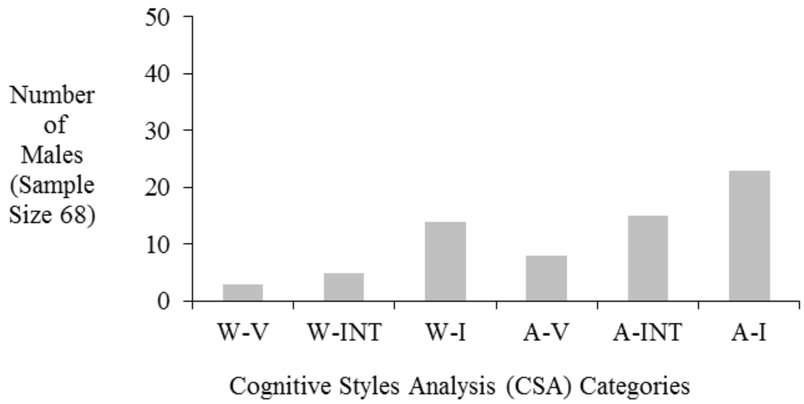
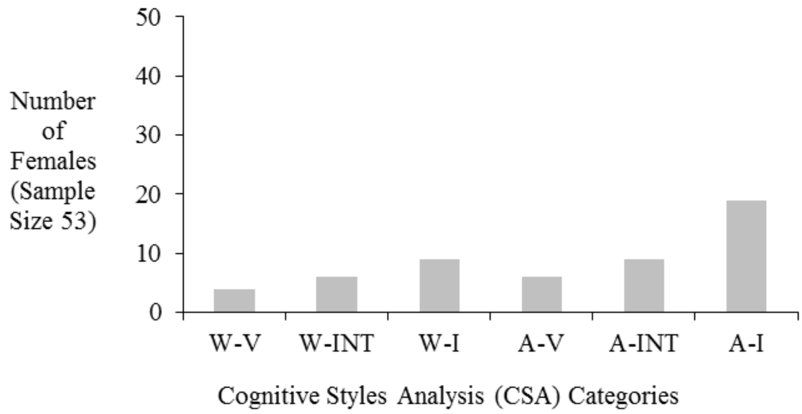


Figure 13.15 from Table 13.3 Frequency Distribution for Cognitive Styles Analysis (CSA) Categories for Females - Study 4



With two of the cognitive styles categories, i.e. Wholistic–Imagery and Analytic–Intermediate, there are approximately twice as many males as females. For three other cognitive style categories, i.e. Wholistic–Verbaliser, Wholistic–Intermediate, and Analytic–Verbaliser, the difference in the number of males and females is very small, and that these three latter categories represent between them the minority of the overall sample.

g) School Subjects Performance/Attainment Data.

Performance/attainment data was processed for the school subjects of English (Literature and Language), Mathematics, Science (General), History, Geography and Modern Language - French.

Although performance/attainment data was also available for Design and Technology (Product and Food), Art, Music and Computer Studies, there were not enough sample members, for whom data was available, for these school subjects, to validate their inclusion within the analysis (MANOVA) of all of the data, from the other variables, for the overall sample.

The raw scores for the school subjects performance/attainment consisted of attainment rankings related to a three point scale used by the school, i.e. U (Upper) = 3, M (Middle) = 2 and L (Lower) = 1.

ii) Analysis

As with the previous three studies, when discussing the results/analysis of this Study (Four), the following key will be employed.
Test Variables:-
Embedded Shapes Test (EST3) Groups 1, 2 and 3; Sense Word Test (SWT2); Non-Sense Word Test (NSWT1); Gestalt Picture Completion Test (GPCT); British Ability Scales (BASI); Recall of Digits (no key); Similarities (no key); Matrices (no key);Speed of Information Processing (Sp of Info Proc); I.Q. (no key); Cognitive Styles Analysis (CSA); Wholistic-Analytic Dimension (WA); Verbaliser-Imager Dimension (VI);Wholistic Style (W); Analytic Style (A); Verbaliser Style (V); Imager Style (I); CSA Speed (no key);CSA WA Speed (no key); CSA VI Speed (no key).
School Subjects:-
No key was required for the School Subjects, which were as follows:-
English (Language and Literature); Mathematics; Science (General); History; Geography; Design and Technology (Product and Food); Art; Music; Modern Language (French); Physical Education and Computer Studies; Sex (Male) and Sex (Female).

The means and standard deviations for each of the variables (overall sample) of this Study (Four) are shown in Table 13.4.

Table 13.4 Means and Standard Deviations for each of the Variables and Overall Sample for Study 4

Variable	Cases	Mean	Std Dev
SEX	124	1.4597	0.5004
EST3	123	22.8537	4.7021
SWT2	123	28.0650	8.0610
NSWT1	123	27.9512	6.3760
GPCT	123	7.4309	1.4770
BAS I / Recall of Digits	123	11.7317	2.2473
BAS I / Similarities	123	13.9350	18936
BAS I / Matrices	123	7.8537	1.7865
BAS I / Speed of Info. Pro	123	9.3902	1.5504
BAS I / IQ	123	109.6179	12.0549
CSA / WA	120	1.1542	0.3357
CSA / VI	120	1.0863	0.1553
CSA / W	120	226.9912	81.4951
CSA / A	120	200.8750	60.2391
CSA / V	120	358.9500	92.0481
CSA / I	120	350.8083	78.2644
CSA / Speed	124	3.8816	1.1474
CSA / WA Speed	124	4.9052	1.6663
CSA / VI Speed	124	2.8579	0.8360
Sub 1 English (Lang and Lit)	124	1.9597	0.7031
Sub 2 Mathematics	124	2.0081	0.7597
Sub 3 Science (General)	124	1.9274	0.7981
Sub 4 History	124	1.9355	0.7184
Sub 5 Geography	124	1.9032	0.7589
Sub 6 Mod Lang (French)	124	1.9839	0.8063

A multi-variable Analysis of Variance (MANOVA) was used first with EST3 (Groups 1, 2 and 3) and Sex (Male and Female) designated as ‘factors’ and SWT2, NSWT1, GPCT, Recall of Digits, Similarities, Matrices, Sp of Info Proc, I.Q., WA, VI, W, A, V, I, , CSA Speed, CSA WA Speed, CSA VI Speed, designated as variables.
(The variables of W,A,V and I; and CSA/Speed; CSA/VA Speed; and CSA/VI Speed, are not included in the Thesis since the variables of WA and VI are included as a combined entity, and Speed is relative, with the level of functioning, arguably, a more important variable to discuss.)

The EST3 factor was divided into three groupings. These were derived from the EST3 raw scores for the overall sample in terms of males and females, which were allocated into a 'high', 'medium' or low group (3, 2 and 1, respectively) for both males and females in relation to level of field dependence - field independence.

The EST3, three groupings, for both males and females, were then analysed in relation to the variables SWT2 and NSWT1 in terms of Sex (Male and Female) and the overall sample.

Also, the analysis (MANOVA) for the EST3, three groupings for both Male and Female, in relation to the school subject variables of English (Language and Literature), Mathematics, Science (General), History, Geography and Modern language (French) was investigated in terms of a comparison between school subject performance/attainment and level of field dependence - field independence.
(It was not possible to perform a MANOVA for all of the school subjects for which data was obtained, for statistical reasons i.e. the size of the sample for the cells in the MANOVA process.)

A further analysis for Study 4 involved the production of a correlation matrix for each of the variables involved.

13.4 Discussion and Conclusion

i) Discussion

The terminology 'Main Effect' as utilised by Kepple, G. and Saufley, W.H., Jr., (1980, pp212-218), is used in the MANOVA Tables and Figures throughout Study 4.

General Comments
Overall, the MANOVA revealed some interactions with several significant 'F-ratio' values between the different variables used in this Study (Four).

The MANOVA analysis produced the following Tables and Figures, which will now be discussed.

Table 13.5 and Figure 13.16 show that the mean values for the SWT2 variable were higher for females than for males in each of the three EST3 groups.

Also, the mean value for both females and males increases with successive EST3 Groups, indicating an increasing level of field independence since EST3 Group 1 is designated low field independence and EST3 Group 3 high field independence for the sample.

There was no interaction between the 'female line' and the 'male line', with the 'main effect line' occurring between the two (Figure 13.16).

Table 13.5 Means for Male, Female and Main Effect for Sense Word Test, Version Two (SWT2) – Study 4

EST3 Group	1	2	3
Male	24.5	27.3	30.2
Female	25.2	27.8	32.5
	(24.5 + 25.2) ÷ 2	(27.3 + 27.8) ÷ 2	(30.2 + 32.5) ÷ 2
Main Effect	24.85	27.55	31.35

Figure 13.16 from Table 13.5 for Sense Word Test, Version Two (SWT2) - Study 4

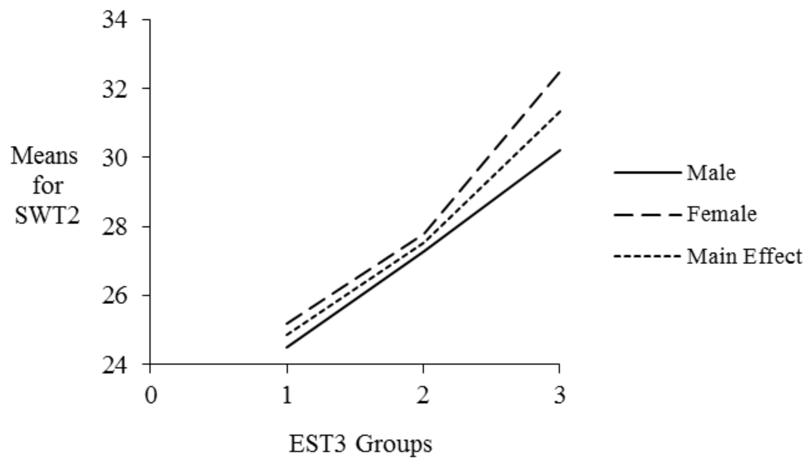
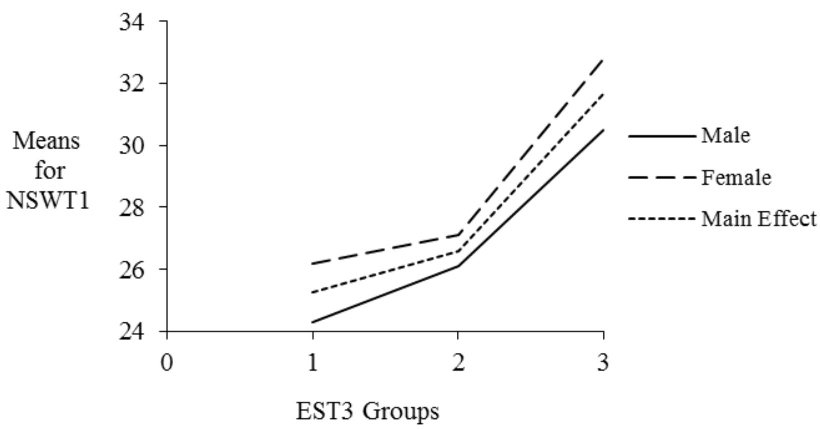


Table 13.6 and Figure 13.17 show that the mean values for the NSWT1 variable were higher for the females than for the males in each of the three EST3 Groups.
Also, (as with the SWT2 outcome above) the mean value for both females and males increases with successive EST3 Groups, indicating an increasing level of field independence since EST3 Group 1 is designated low field independence and EST3 Group 3 high field independence for the sample.
There was no interaction between the ‘female line’ and the ‘male line’, with the ‘main effect line’ occurring between the two (Figure 13.17).

Table 13.6 Means for Male, Female and Main Effect for Non-Sense Word Test, Version One (NSWT1) – Study 4

EST3 Group	1	2	3
Male	24.3	26.1	30.5
Female	26.2	27.1	32.8
	(24.3 + 26.2) ÷ 2	(26.1 + 27.1) ÷ 2	(30.5 + 32.8) ÷ 2
Main Effect	25.25	26.6	31.65

Figure 13.17 from Table 13.6 for Non-Sense Word Test, Version One (NSWT1) - Study 4



Tables13.7 and 13.8, and Figure 13.18 show that the combined mean values for the SWT2 and NSWT1 variables for both male and female, which were obtained for each of the three groupings of the EST3 factor, and plotted against male and female. It can be seen from Figure 13.18 that the females achieved a higher outcome than the males for both the SWT2 and the NSWT1 measure of field dependence - field independence. Also, the male combined SWT2 mean was higher than that for the combined NSWT1 mean, while for the females the combined SWT2 mean was lower than that for the combined NSWT1 mean.

Table 13.7 Means for EST3 by Sense Word Test, Version Two (SWT2) and Sex – Study 4

		Male	Female
EST3 Group	1	24.5	25.2
	2	27.3	27.8
	3	30.2	32.5
		(24.5 + 27.3 + 30.2) ÷ 3	(25.2 + 27.8 + 32.5) ÷ 3
Means		27.33	28.50

Table 13.8 Means for EST3 by Non-Sense Word Test, Version One (NSWT1) and Sex – Study 4

		Male	Female
EST3 Group	1	24.3	26.2
	2	26.1	27.1
	3	30.5	32.8
		(24.3 + 26.1 + 30.5) ÷ 3	(26.2 + 27.1 + 32.8) ÷ 3
Means		26.97	28.70

Figure 13.18 from Tables 13.7 and 13.8 - Means for EST3 Groups by SWT2 and NSWT1 and Sex - Study 4

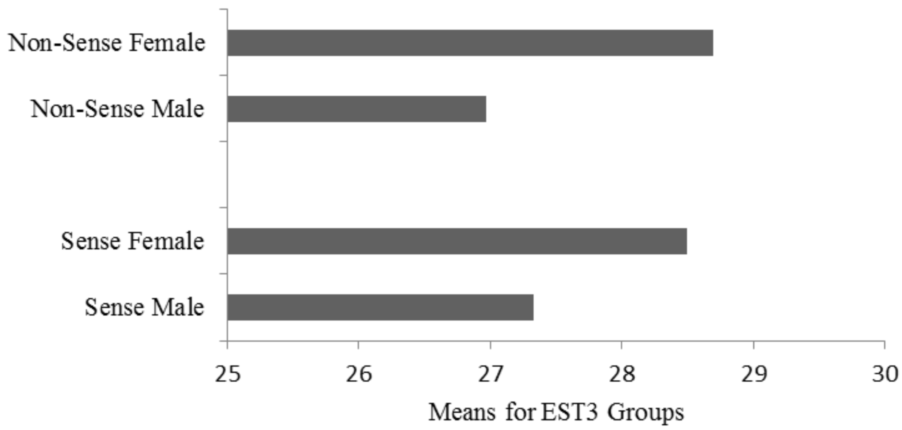


Table 13.9 and Figure 13.19 show the EST3 Groups mean values for the GPCT variable.
It can be seen from Figure 13.19 that the males scored higher in each of the three EST3 Groups than did the females. Also, the scores increased with increasing EST3 factor, Group number, for both males and females.
Consequently, the 'main effect line' is positioned between the male and female lines, showing no interaction.

Table 13.9 Means for Male, Female and Main Effect for Gestalt Picture Completion Test (GPCT) – Study 4

EST3 Group	1	2	3
Male	7.2	7.3	8.1
Female	6.9	7	7.6
	(7.2 + 6.9) ÷ 2	(7 + 7.3) ÷ 2	(8.1 + 7.6) ÷ 2
Main Effect	7.05	7.15	7.85

Figure 13.19 from Table 13.9 - Means for Gestalt Picture Completion Test (GPCT) - Study - 4

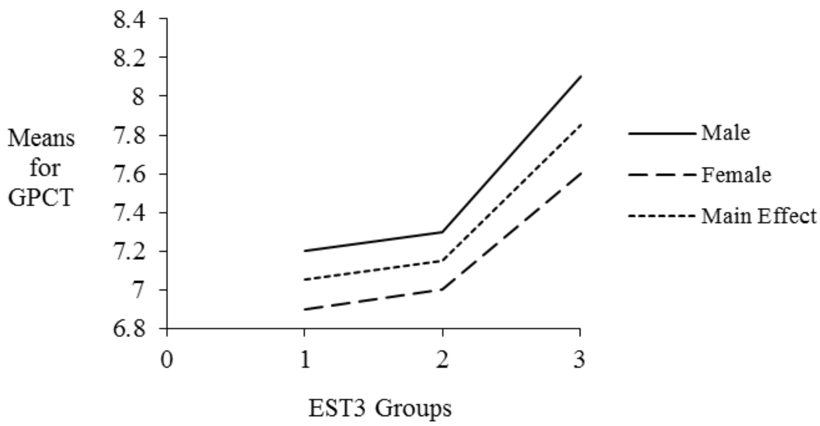
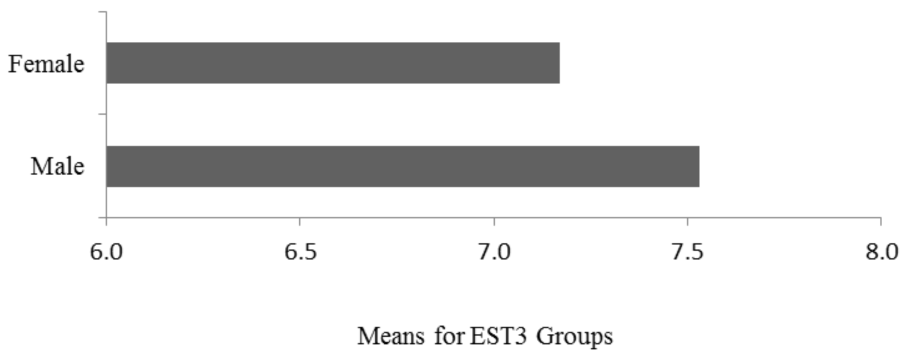


Table 13.10 and Figure 13.20 show that the combined mean values for the GPCT variable for both male and female, which were obtained from each of the three groupings of the EST3 factor, and plotted against male and female.
This gave the result of the males achieving a higher score than the females, i.e. a ‘summative mean’ score of 7.53 and 7.13, respectively.

Table 13.10 Means for EST3 by Gestalt Picture Completion Test (GPCT) and Sex – Study 4

		Male	Female
EST3 Group	1	7.2	6.9
	2	7.3	7
	3	8.1	7.6
		(7.2 + 7.3 + 8.1) ÷ 3	(6.9 + 7 + 7.6) ÷ 3
Means		7.53	7.17

Figure 13.20 from Table 13.10 - Means for EST3 Groups for Gestalt Picture Completion Test (GPCT) and Sex - Study 4



British Ability Scales (BASI)/Short Form Intelligence Quotient

The following Tables (13.11 to 13.20) and Figures (13.21 to 13.28) represent the outcomes for each of the BASI Scales/Tests of Recall of Digits, Similarities, Matrices and Speed of Information Processing, used to obtain an I.Q, measure for the members of the samples.

Table 13.11 and Figure 13.21 show the mean values for the Recall of Digits Scale were higher for the females than for the males in each of the EST3 Groups. Also, there was an increase in the mean value in each of the successive EST3 Groups for the females, but not for the males, where EST3 Group 3 mean was less than that for group 2, i.e. 11.7 and 11.5 respectively. The 'main effect line' showed no interaction although its value did coincide with the female and male line at EST3 Group 1.

Table 13.11 Means for Male, Female and Main Effect for BASI - Recall of Digits Scale/Test B – Study 4

EST3 Group	1	2	3
Male	11	11.7	11.5
Female	11	12.2	12.6
	(11 + 11) ÷ 2	(11.7 + 12.2) ÷ 2	(11.5 + 12.6) ÷ 2
Main Effect	11	11.95	12.05

Figure 13.21 from Table 13.11 for BASI - Recall of Digits Scale/Test B - Study 4

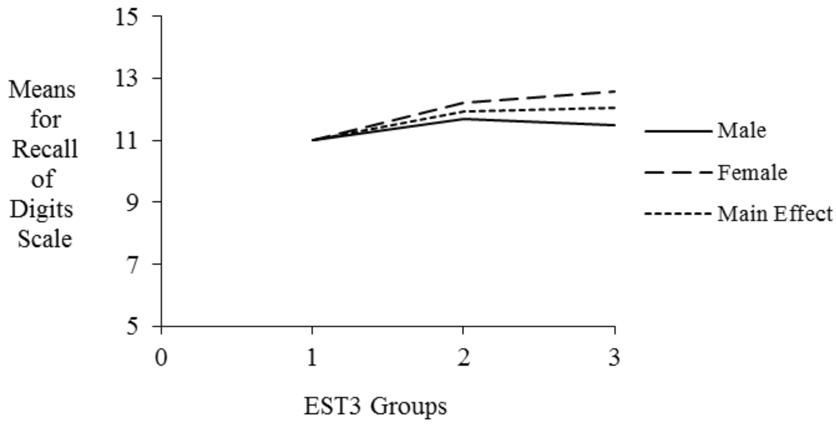


Table 13.12 and Figure 13.22 for the Similarities Scale, show that the females achieved a higher mean score than the males in EST3 Groups 1 and 2, but that the situation was reversed for EST3 Group 3. However, although the male mean score increased in value with successive EST factor groups, this did not happen with the females from EST3 Group 2 to 3. The 'main effect line' shows an interaction between EST3 3 Group 2 and 3.

Table 13.12 Means for Male, Female and Main Effect for BASI - Similarities Scale/Test A– Study 4

EST3 Group	1	2	3
Male	12.7	13.9	14.6
Female	13.2	14.5	14.3
	(12.7 + 13.2) ÷ 2	(13.9 + 14.5) ÷ 2	(14.6 + 14.3) ÷ 2
Main Effect	12.95	14.2	14.45

Figure 13.22 from Table 13.12 for BASI - Similarities Scale/ Test A - Study 4

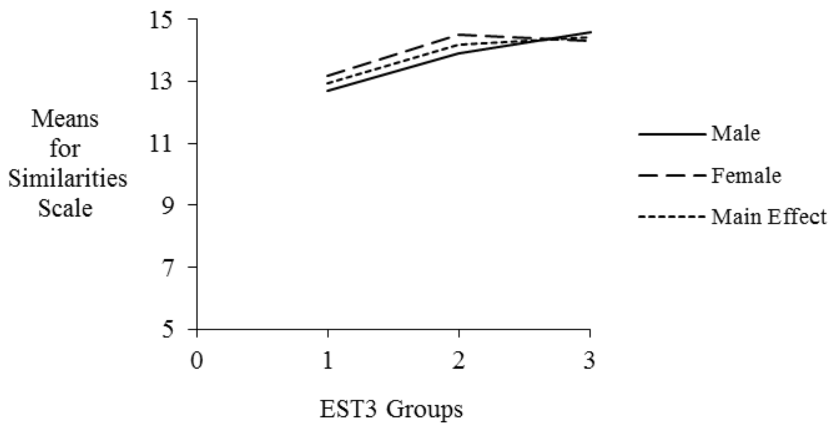


Table 13.13 and Figure 13.23 for the Matrices Scale, shows that the males in EST3 Groups 1 and 2 achieved a higher mean value than the females, but that this situation was reversed for EST3 Group 3. However, whereas the female mean score increased in value with successive EST3 Groups, the same did not happen for the males between EST3 Groups 2 and 3. The ‘main effect line’ shows an interaction between EST3 Groups 2 and 3.

Table 13.13 Means for Male, Female and Main Effect for BASI – Matrices Scale/Test F – Study 4

EST3 Group	1	2	3
Male	6.6	8.2	8.2
Female	6.8	7.6	9.1
	(6.6 + 6.8) ÷ 2	(8.2 + 7.6) ÷ 2	(8.2 + 9.1) ÷ 2
Main Effect	6.7	7.9	8.65

Figure 13.23 from Table 13.13 for BASI - Matrices Scale/ Test F - Study 4

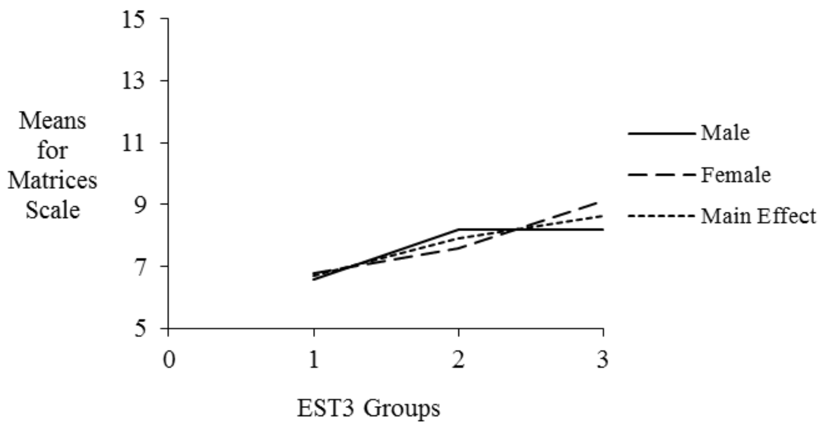
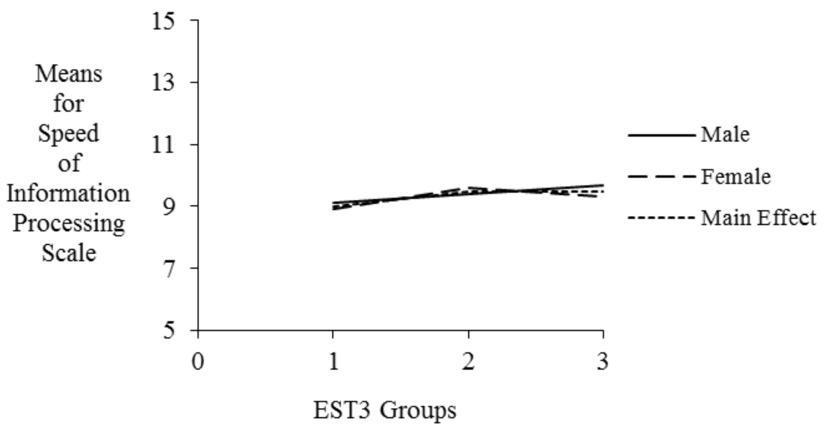


Table 13.14 and Figure 13.24, for the Speed of Information Processing Scale, shows that the males achieved a higher mean score in EST3 Groups 1 and 3 than did the females, with this situation reversed for EST3 Group 2. Also, the male mean scores increased with successive EST3 Groups, whereas this did not happen with the females from EST3 Groups 2 and 3. The 'main effect line' shows an interaction between EST3 Groups 1 and 2; and Groups 2 and 3.

Table 13.14 Means for Male, Female and Main Effect for BASI – Speed of Information Processing/Test D – Study 4

EST3 Group	1	2	3
Male	9.1	9.4	9.7
Female	8.9	9.6	9.3
	(9.1 + 8.9) ÷ 2	(9.4 + 9.6) ÷ 2	(9.7 + 9.3) ÷ 2
Main Effect	9	9.5	9.5

Figure 13.24 from Table 13.14 for BASI - Speed of Information Processing Scale/Test D - Study 4



Tables 13.15, 13.16,13.17 and 13.18 and Figures 13.25 and 13.26 show the combined mean scores for each of the four Scales for both male and female, obtained from each of the three EST3 groupings, and plotted against male and female. The results of this show, that for the Scales of Matrices, Similarities and Recall of Digits, the females achieved higher 'summative means', whereas for the Scale of Speed of Information Processing, the males achieved a higher 'summative mean' than the females.

Table 13.15 Means for EST3 by BASI - Recall of Digits Scale/Test B and Sex – Study 4

		Male	Female
EST3 Group	1	11	11
	2	11.7	12.2
	3	11.5	12.6
		(11 + 11.7 + 11.5) ÷ 3	(11 + 12.2 + 12.6) ÷ 3
Means		11.40	11.93

Table 13.16 Means for EST3 by BASI - Similarities Scale/ Test A and Sex – Study 4

		Male	Female
EST3 Group	1	12.7	13.2
	2	13.9	14.5
	3	14.6	14.3
		(12.7 + 13.9 + 14.6) ÷ 3	(13.2 + 14.5 + 14.3) ÷ 3
Means		13.73	14.00

Figure 13.25 from Tables 13.15 and 13.16 - Means for EST3 Groups by BAS I - Recall of Digits/Test B and BAS I - Similariries Scale/Test A - Study 4

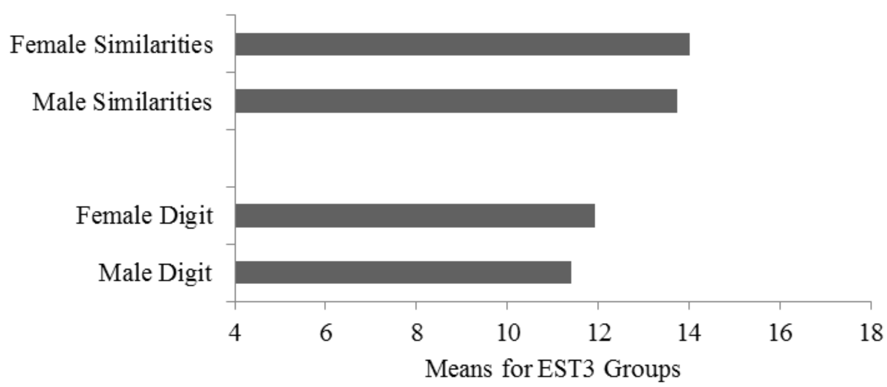


Table 13.17 Means for EST3 by BASI - Matrices Scale/ Test F and Sex – Study 4

		Male	Female
EST3 Group	1	6.6	6.8
	2	8.2	7.6
	3	8.2	9.1
		(6.6 + 8.2 + 8.2) ÷ 3	(6.8 + 7.6 + 9.1) ÷ 3
Means		7.67	7.83

Table 13.18 Means for EST3 by BASI - Speed of Information Processing Scale/ Test D and Sex – Study 4

		Male	Female
EST3 Group	1	9.1	8.9
	2	9.4	9.6
	3	9.7	9.3
		(9.1 + 9.4 + 9.7) ÷ 3	(8.9 + 9.6 + 9.3) ÷ 3
Means		9.40	9.27

Figure 13.26 from Tables 13.17 and 13.18 - Means for EST3 Groups by BAS I - matrices Scale/Test F and BAS I - Speed of Information Processing Scale /Test D and Sex - Study 4

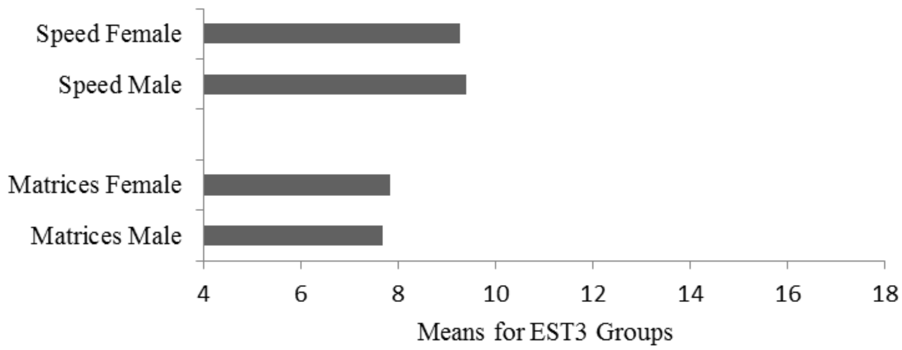


Table 13.19 and Figure 13.27, for I.Q. score, derived from the BASI Scales/Tests (mean scores) already referred to, shows that the females achieved a higher score in EST3 Groups 2 and 3 than did the males, but that the males achieved a higher score for EST3 Group 1. However, with both males and females the mean scores increased with successive EST3 Groups. The 'main effect line' shows an interaction between EST3 Groups 1 and 2.

Table 13.19 Means for Male, Female and Main Effect for BASI – Short Form IQ – Study 4

EST3 Group	1	2	3
Male	1.7	1.9	2.2
Female	1.6	2.1	2.5
	(1.7 + 1.6) ÷ 2	(1.9 + 2.1) ÷ 2	(2.2 + 2.5) ÷ 2
Main Effect	1.65	2	2.35

Figure 13.27 from Table 13.19 for BASI - Short Form IQ - Study 4

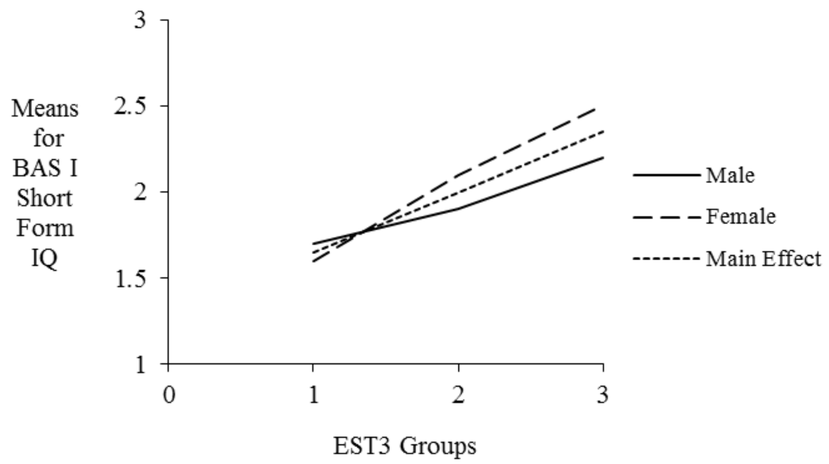
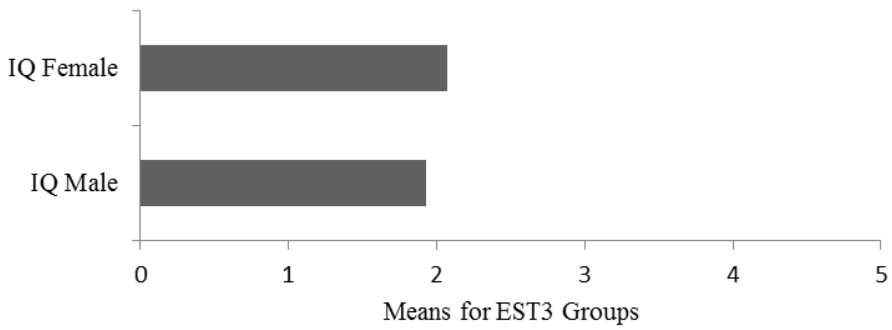


Table 13.20 and Figure 13.28 show the combined mean scores for IQ for both male and female, obtained from each of the three EST3 groupings, and plotted against male and female. This result shows that for I.Q. the females achieved a higher 'summative mean' than the males.

Table 13.20 Means for EST3 by BASI – Short Form IQ and Sex – Study 4

		Male	Female
EST3 Group	1	1.7	1.6
	2	1.9	2.1
	3	2.2	2.5
		(1.7 + 1.9 + 2.2) ÷ 3	(1.6 + 2.1 + 2.5) ÷ 3
Means		1.93	2.07

Figure 13.28 from Table 13.20 - Means for EST3 Groups by BAS I Short Form IQ and Sex - Study 4



Cognitive Styles Analysis (CSA) – Tables 13.21 to 13.24 and Figures 13.29 to 13.31.

Table 13.21 and Figure 13.29 for the Wholistic-Analytic (WA) dimension of the CSA, shows that the males achieved a higher mean score than the females in EST3 Groups 1 and 2, but that this situation was reversed for EST3 Group 3. However, with both males and females, there was a decrease in the magnitude of the mean score from EST3 Groups 1 to 2, and an increase from EST3 Groups 2 to 3.
The 'main effect line' shows an interaction between EST3 Groups 2 and 3.

Table 13.21 Ratio Means for Male, Female and Main Effect for Cognitive Styles Analysis (CSA)/ Wholistic – Analytic Dimension (WA) – Study 4

EST3 Group	1	2	3
Male	1.22	1.09	1.17
Female	1.17	1.02	1.22
	(1.22 + 1.17) ÷ 2	(1.09 + 1.02) ÷ 2	(1.17 + 1.22) ÷ 2
Main Effect	1.195	1.055	1.195

Figure 13.29 from Table 13.21 for Cognitive Styles Analysis (CSA)/ Wholistic - Analytic Dimension (WA) - Study 4

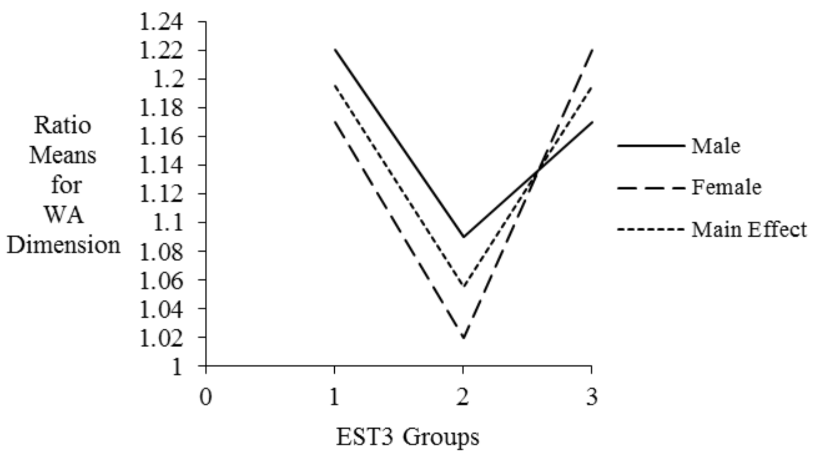


Table 13.22 and Figure 13.30 for the Verbaliser-Imager (VI) dimension of the CSA, shows that the males achieved a higher mean score than the females in each of the EST3 Groups. With the males there was a decrease in the magnitude of the mean score for each successive EST3 Groups, but with the females, this pattern changed from EST3 Groups 2 to 3 because of an increase in the magnitude of the mean score. The 'main effect line' showed no interaction although its value did coincide with the female line at EST3 Group 1, and with the male line at EST3 Group 3.

Table 13.22 Ratio Means for Male, Female and Main Effect for Cognitive Styles Analysis (CSA)/ Verbaliser - Imager Dimension (VI) – Study 4

EST3 Group	1	2	3
Male	1.1	1.09	1.07
Female	1.09	1.06	1.07
	(1.1 + 1.09) ÷ 2	(1.09 + 1.06) ÷ 2	(1.07 + 1.07) ÷ 2
Main Effect	1.095	1.075	1.07

Figure 13.30 from Table 13.22 for Cognitive Styles Analysis (CSA)/ Verbaliser - Imager Dimension (VI) - Study 4

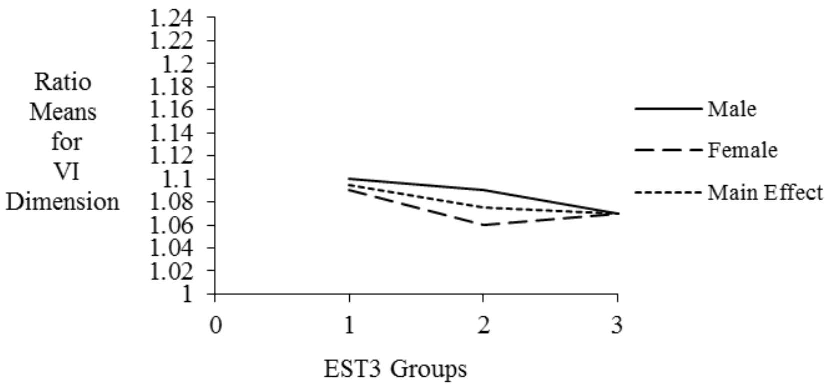


Table 13.23 and Figure 13.31

The combined mean scores for the Wholistic-Analytic (WA) dimension of the CSA, for both male and female, were obtained from each of the three EST3 groupings, and plotted against male and female. The results of this show that the males achieved a slightly higher score than the females, i.e. a 'summative mean' score of 1.16 compared to 1.13, respectively.

Table 13.24 and Figure 13.31

The combined mean scores for the Verbaliser-Imager (VI) dimension of the CSA, for both male and female were obtained from each of the three EST3 groupings, and plotted against male and female. The results of this show that the males achieved a slightly higher score than the females, i.e. a 'summative mean' score of 1.08 compared to 1.07, respectively.

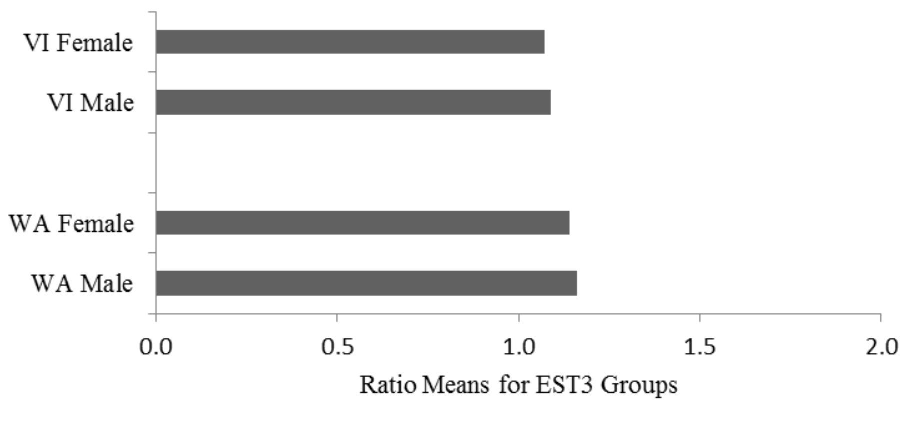
Table 13.23 Ratio Means for EST3 Groups by Cognitive Styles Analysis (CSA)/ Wholistic – Analytic Dimension (WA) and Sex – Study 4

		Male	Female
EST3 Group	1	1.22	1.17
	2	1.09	1.02
	3	1.17	1.22
		(1.22 + 1.09 + 1.17) ÷ 3	(1.17 + 1.02 + 1.22) ÷ 3
Means		1.16	1.14

Table 13.24 Ratio Means for EST3 Groups by Cognitive Styles Analysis (CSA)/ Verbaliser – Imager Dimension (VI) and Sex – Study 4

		Male	Female
EST3 Group	1	1.1	1.09
	2	1.09	1.06
	3	1.07	1.07
		(1.1 + 1.09 + 1.07) ÷ 3	(1.09 + 1.06 + 1.07) ÷ 3
Means		1.09	1.07

Figure 13.31 from Tables 13.23 and 13.24 - Ratio Means for EST3 Groups by Cognitive Styles Analysis (CSA) Dimensions WA and VI and Sex - Study 4



School Subjects – Tables 13.25 to 13. 36 and Figures 13.32 to 13.40

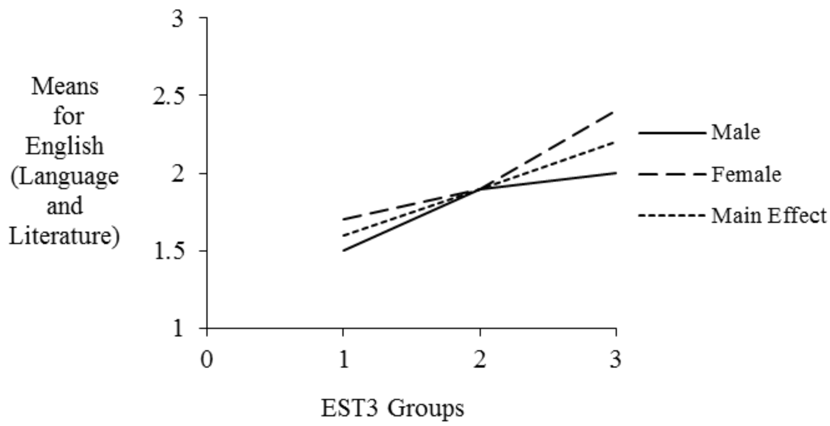
The following Tables and Figures show the means from the raw scores, in terms of performance/attainment, for five school subjects, i.e. English (Language and Literature), Mathematics, Science (General), History, Geography and Modern Language - French.

Table 13.25 and Figure 13.32 - English (Language and Literature)

Table 13.25 Means for Male, Female and Main Effect for English (Language and Literature) – Study 4

EST3 Group	1	2	3
Male	1.5	1.9	2
Female	1.7	1.9	2.4
	(1.5 + 1.7) ÷ 2	(1.9 + 1.9) ÷ 2	(2 + 2.4) ÷ 2
Main Effect	1.6	1.9	2.2

Figure 13.32 from Table 13.25 for English (Language and Literature) - Study 4



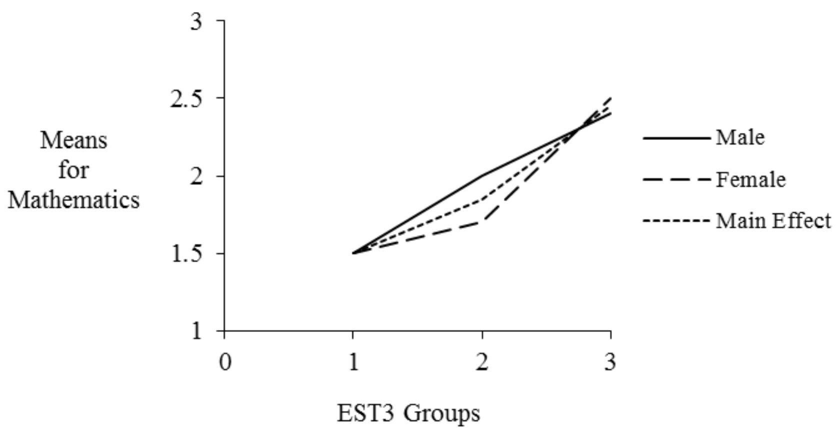
The females scored higher than the males in each of the three groups of the EST3, with the greatest difference occurring within EST3 Group 3. However, there was little difference between the male and female means for Group 2, i.e. 1.91 and 1.94, respectively. The 'main effect line' coincides at EST3 Group 2 with both the male and female lines to a very close degree, i.e. 1.9, but showed no other interaction within EST3 Groups 1 or 3.

Table 13.26 and Figure 13.33 – Mathematics

Table 13.26 Means for Male, Female and Main Effect for Mathematics – Study 4

EST3 Group	1	2	3
Male	1.5	2	2.4
Female	1.5	1.7	2.5
	(1.5 + 1.5) ÷ 2	(2 + 1.7) ÷ 2	(2.4 + 2.5) ÷ 2
Main Effect	1.5	1.85	2.45

Figure 13.33 from Table 13.26 for Mathematics - Study 4



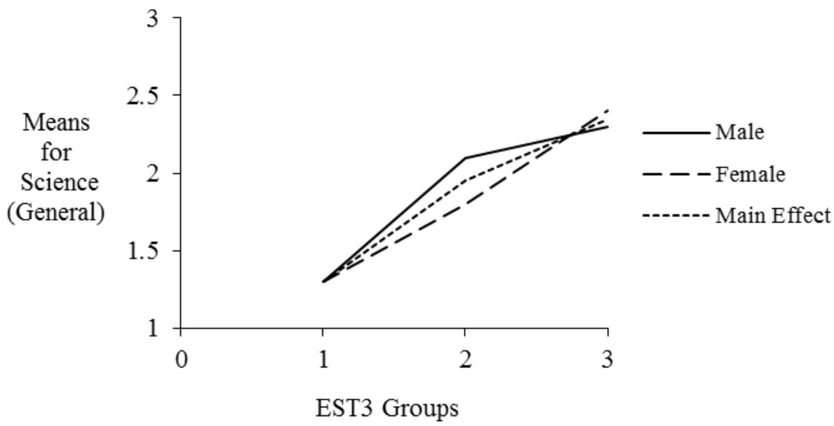
Both males and females achieved approximately the same mean score within EST3 Group 1, i.e. 1.55 and 1.50 respectively, but the males achieved a higher score than the females within EST3 Group 2, with the situation being reversed within EST3 Group 3. The ‘main effect line’ which coincides at Group 1 with both the male and female lines to a very close degree, i.e. 1.5, showed no interaction within EST3 Group 2, but some interaction from EST3 Groups 2 to 3.

Table 13.27 and Figure 13.34 - Science (General)

Table 13.27 Means for Male, Female and Main Effect for Science (General) – Study 4

EST3 Group	1	2	3
Male	1.3	2.1	2.3
Female	1.3	1.8	2.4
	(1.3 + 1.3) ÷ 2	(2.1 + 1.8) ÷ 2	(2.3 + 2.4) ÷ 2
Main Effect	1.3	1.95	2.35

Figure 13.34 from Table 13.27 for Science (General) - Study 4



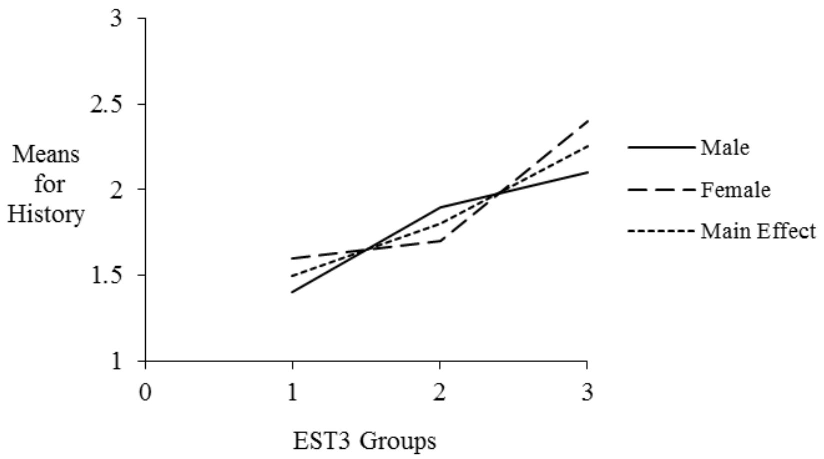
Both males and females achieved approximately the same mean score with EST3 Group 1, i.e. 1.35 and 1.38 respectively, but the males achieved a higher score than the females within EST3 Group 2, with this situation being reversed within EST3 Group 3. The ‘main effect line’ coincides at Group 1 to a very close degree, i.e. 1.3, and at Group 2 to a close degree, i.e. 1.8, matching the female line mean value. However, some interaction is indicated from EST3 Group 2 to Group 3.

Table 13.28 and Figure 13.35 – History

Table 13.28 Means for Male, Female and Main Effect for History – Study 4

EST3 Group	1	2	3
Male	1.4	1.9	2.1
Female	1.6	1.7	2.4
	(1.4 + 1.6) ÷ 2	(1.9 + 1.7) ÷ 2	(2.1 + 2.4) ÷ 2
Main Effect	1.5	1.8	2.25

Figure 13.35 from Table 13.28 for History - Study 4



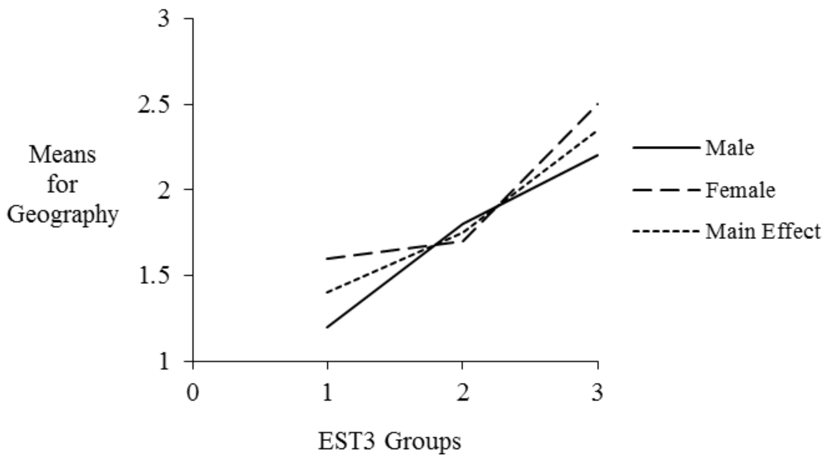
The females scored higher than the males in EST3 Groups 1 and 3, with the greatest difference occurring within EST3 Group 3. The 'main effect line' showed some interaction within EST3 Groups 2 and 3.

Table 13.29/Figure 13.36 Geography

Table 13.29 Means for Male, Female and Main Effect for Geography – Study 4

EST3 Group	1	2	3
Male	1.2	1.8	2.2
Female	1.6	1.7	2.5
	(1.2 + 1.6) ÷ 2	(1.8 + 1.7) ÷ 2	(2.2 + 2.5) ÷ 2
Main Effect	1.4	1.75	2.35

Figure 13.36 from Table 13.29 for Geography - Study 4



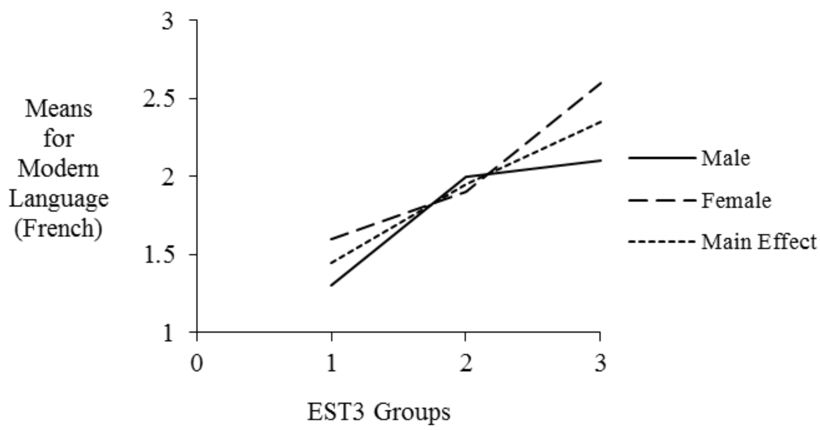
The females scores higher than the males in EST3 Groups 1 and 3, with the greatest difference occurring within EST3 Group 1. The ‘main effect line’ showed some interaction within EST3 Groups 2 and 3.

Table 13.30/Figure 13.37 Modern Language (French)

Table 13.30 Means for Male, Female and Main Effect for Modern Language (French) – Study 4

EST3 Group	1	2	3
Male	1.3	2	2.1
Female	1.6	1.9	2.6
	(1.3 + 1.6) ÷ 2	(2 + 1.9) ÷ 2	(2.1 + 2.6) ÷ 2
Main Effect	1.45	1.95	2.35

Figure 13.37 from Table 13.30 for Modern Language (French) - Study 4



The females scored higher than the males in EST3 Groups 1 and 3, with the greatest difference occurring within EST3 Group 3. The ‘main effect line’ showed some interaction within EST3 Groups 2 and 3.

School Subjects – Combined Tables and Figures.

The combined mean values for each of the school subject (variables) for both male and female, were obtained from each of the three groupings of the EST3, and plotted against male and female.

Tables 13.31 and 13.32 and Figure 13.38

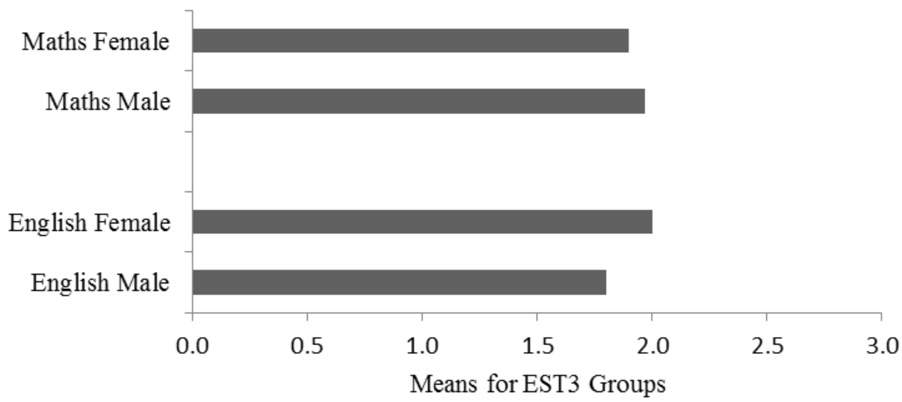
Table 13.31 Means for EST3 Groups by English (Language and Literature) and Sex – Study 4

		Male	Female
EST3 Group	1	1.5	1.7
	2	1.9	1.9
	3	2	2.4
		(1.5 + 1.9 + 2) ÷ 3	(1.7 + 1.9 + 2.4) ÷ 3
Means		1.80	2.00

Table 13.32 Means for EST3 Groups by Mathematics and Sex – Study 4

		Male	Female
EST3 Group	1	1.5	1.5
	2	2	1.7
	3	2.4	2.5
		(1.5 + 2 + 2.4) ÷ 3	(1.5 + 1.7 + 2.5) ÷ 3
Means		1.97	1.90

Figure 13.38 from Tables 13.31 and 13.32 for EST3 Groups by English(Language and Literature) and Mathematics and Sex - Study 4



Tables 13.33 and 13.34 and Figure 13.39

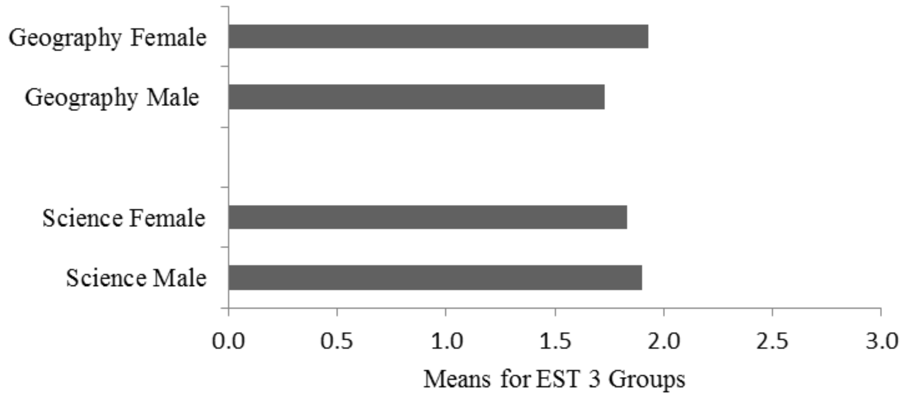
Table 13.33 Means for EST3 Groups by Science (General) and Sex – Study 4

		Male	Female
EST3 Group	1	1.3	1.3
	2	2.1	1.8
	3	2.3	2.4
		(1.3 + 2.1 + 2.3) ÷ 3	(1.3 + 1.8 + 2.4) ÷ 3
Means		1.90	1.83

Table 13.34 Means for EST3 Groups by Geography and Sex – Study 4

		Male	Female
EST3 Group	1	1.2	1.6
	2	1.8	1.7
	3	2.2	2.5
		(1.2 + 1.8 + 2.2) ÷ 3	(1.6 + 1.7 + 2.5) ÷ 3
Means		1.73	1.93

Figure 13.39 from Tables 13.33 and 13.34 - Means for EST3 Groups by Science (General) and Geography and Sex - Study 4



Tables 13.35 and 13.36 and Figure 13.40

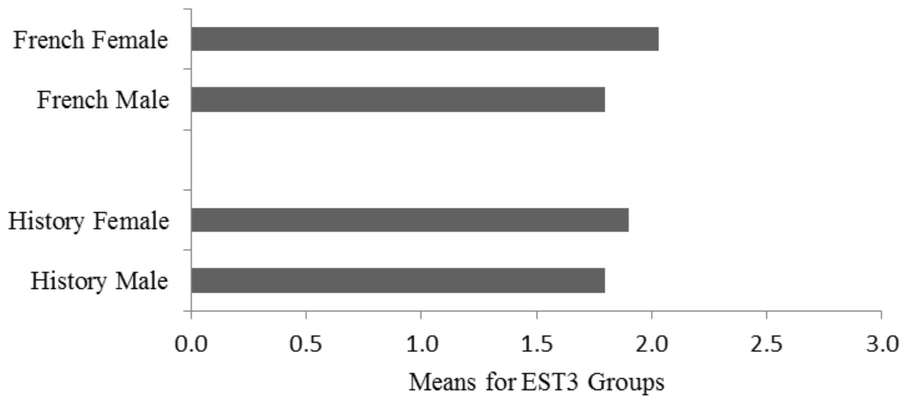
Table 13.35 Means for EST3 Groups by History and Sex – Study 4

		Male	Female
EST3 Group	1	1.4	1.6
	2	1.9	1.7
	3	2.1	2.4
		(1.4 + 1.9 + 2.1) ÷ 3	(1.6 + 1.7 + 2.4) ÷ 3
Means		1.80	1.90

Table 13.36 Means for EST3 by Modern Language (French) and Sex – Study 4

		Male	Female
EST3 Group	1	1.3	1.6
	2	2	1.9
	3	2.1	2.6
		(1.3 + 2 + 2.1) ÷ 3	(1.6 + 1.9 + 26) ÷ 3
Means		1.80	2.03

Figure 13.40 from Tables 13.35 and 13.36 - Means for EST3 Groups by History and Modern Language (French) and Sex - Study 4



The results of the above for the school subjects show that for Mathematics, male and female achieved the same overall outcome. However, for the school subjects of English (Language and Literature), History, Geography and Modern Language (French), the females achieved a higher overall outcome, whereas this situation was reversed for Science (General).

Overall the females achieved higher means than the males not only in terms of school subject type, but also across the majority of the EST3 groupings. There were two notable deviations from this general situation, where the males achieved a higher mean value than the females. These were in Mathematics, male mean 2.0, female mean 1.7 for EST3 Group 2; and in Science, male mean 2.1, female mean 1.8 for EST3 Group 2.

Both of these outcomes, related as they are to a measure of field dependence – field independence, suggest that for the male EST3 Group 2, in this particular sample, the males were able to utilise aspects of both field dependent and field independent skills to their advantage in coping with mathematical and scientific school work. Viewed in a different way, it can be considered that the males of EST3 Group 2 are located in the middle of the field dependent – field independent bipolar continuum, and are able to move either side of it, to at least a noticeable amount, when working on certain school subjects. Thus, being able to focus within given parameters (field dependence) and outside of given parameters (field independence) when required to do so, aids problem solving ability.

Table 13.37 shows interactions between EST3 Groups 1, 2 and 3; and School Subjects, as follows:-.

Table 13.37 Interactions between EST3 Groups (Male and Female) and School Subjects.

School Subjects	EST3 Groups (Male and Female)		
	1	2	3
English (Language and Literature)			
Mathematics	*		*
Science (General)	*	*	
History		*	*
Geography		*	*
Modern Language (French)		*	*

* = interaction

In every case, the means from the raw scores for each of the six school subjects, increase across the three groups of the EST3. Since these EST3 groupings reflect an increase in field independence from 1 to 3, there is (as with Study Three) a strong association between school performance/attainment and level of field dependence – field independence, as measured using the EST3.

Some of the wider implications of the above outcomes from this present investigation, Study 4, have already been stated at the end of the 'Discussion Section' to Study 3.

MANOVA – Tables for EST3/SWT2, NSWT1, GPCT, BAS I Scales, IQ, CSA and School Subjects.

From Table 13.38 Analysis of Variance – Tests of Significance for EST3: SEX is significant (F = 0.4; df 1,121; p = 0.01).

Table 13.38 Tests of Significance for EST3 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	2696.43	121	22.28		
Constant	63933.42	1	63933.42	2868.95	.000
SEX	.93	1	.93	.04	.838

From Table 13.39, Analysis of Variance – Tests of Between-Subjects Effects, it can be seen that the variables of SEX and SEX by EST are significant (F = 1.79; df 1,117; p = 0.0) and (F = 0.17; df 2,117; p = 0.01) respectively, but that EST is not significant (F = 12.33; df 2,117; p = 0.01).

Table 13.39 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	8472.11	117	72.41		
Constant	189783.05	1	189783.05	2620.91	.000
SEX	129.94	1	129.94	1.79	.183
EST3	1786.26	2	893.13	12.33	.000
SEX by EST3	24.40	2	12.20	.17	.845

From Table 13.40, Analysis of Variance – Tests Involving 'Test Type Within-Subject Effect, it can be seen that Test Type or combinations of Test Type are significant, i.e. Test Type (F = 0.02; df 1,117; p = 0.0), SEX by Test Type (F = 0.22; df 1,117; p = 0.0), EST by Test Type (F = .55; df 2,117; p = 0.0) and SEX by EST by Test Type (F = 0.13; df 2,117; p = 0.0).

Table 13.40 Tests involving 'Test Type' Within-Subject Effect
Tests of Significance for T2 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	2426.27	117	20.74		
Test Type	.39	1	.39	.02	.891
SEX by Test Type	4.46	1	4.46	.22	.644
EST3 by Test Type	22.90	2	11.45	.55	.577
SEX by EST3 by Test Type	5.19	2	2.59	.13	.882

From Table13.41, Analysis of Variance – Tests of Significance for Picture Completion Test; SEX and SEX by EST are significant (F = 1.92; df 1,117; p = 0.01) and (F = 0.09; df 2,117; p = 0.01) respectively. However, although EST is not significant at the 5% level, it is at the 1% level (F = 4.12; df 2,117; p = 0.05) and (F = 4.12; df 2,117; p = 0.01) respectively.

Table 13.41 Tests of Significance for GPCT using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	244.65	117	2.09		
Constant	6670.40	1	6670.40	3189.97	.000
SEX	4.02	1	4.02	1.92	.168
EST3	17.23	2	8.62	4.12	.019
SEX by EST3	.38	2	.19	.09	.914

From Table 13.42, Analysis of Variance – Tests of Significance for I.Q., SEX and SEX by EST are significant (F = 1.96; df 1,117; p = 0.01) and (F = 0.70; df 2,117; p = 0.01) respectively, but EST is not significant (F = 9.52; df 2,117; p=0.05).

Table 13.42 Tests of Significance for IQ using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	63.54	117	.54		
Constant	507.12	1	507.12	933.78	.000
SEX	1.06	1	1.06	1.96	.164
EST3	10.34	2	5.17	9.52	.000
SEX by EST3	.76	2	.38	.70	.497

From Table 13.43, Analysis of Variance – Tests of Between-Subjects Effects, it can be seen that SEX and SEX by EST are significant (F = 0.96; df 1,117; p = 0.01) and (F = .05; df 2,117; p = 0.01) respectively, but that EST is not significant (F = 15.32; df 2,117; p = 0.01).

Table 13.43 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	529.39	117	4.52		
Constant	55778.67	1	55778.67	12327.67	.000
SEX	4.35	1	4.35	.96	.329
EST3	138.62	2	69.31	15.32	.000
SEX by EST3	.49	2	.25	.05	.947

From Table 13.44, Analysis of Variance – Tests involving 'Test' Within-Subject Effect, it can be seen that SEX by Test Type, EST by Test Type, and SEX by EST by Test Type are significant (F = 0.87, df 3,351, p = 0.01), (F = 1.48, df 6,351; p = 0.01) and (F = 1.48; df 6,351; p = 0.01) respectively.

Table 13.44 Tests involving 'Test Type' Within-Subject Effect AVERAGED Tests of Significance for MEAS.1 using UNIQUE Sums of Squares.

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	1005.02	351	2.86		
Test Type	2623.20	3	874.40	305.38	.000
SEX by Test Type	7.49	3	2.50	.87	.456
EST3 by Test Type	25.37	6	4.23	1.48	.185
SEX by EST3 by Test Type	25.41	6	4.24	1.48	.184

From Table 13.45, Analysis of Variance – Tests of Significance for WA; SEX, EST and SEX by EST are significant (F = 0.17; df 1,113; p = 0.01), (F = 2.39; df 2,113; p = 0.01) and (F = 0.34; df 2,113; p = 0.01) respectively.

Table 13.45 Tests of Significance for WA using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	12.80	113	.11		
Constant	156.48	1	156.48	1381.12	.000
SEX	.02	1	.02	.17	.685
EST3	.54	2	.27	2.39	.096
SEX by EST3	.08	2	.04	.34	.711

From Table 13.46, Analysis of Variance – Tests of Significance for VI; SEX, EST and SEX by EST are significant (F = 0.16; df 1,113; p = 0.01), (F = 0.23; df 2,113; p = 0.01) and (F = 0.04; df 2,113; p = 0.01) respectively.

Table 13.46 Tests of Significance for VI using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	2.80	113	.02		
Constant	138.53	1	138.53	5585.38	.000
SEX	.00	1	.00	.16	.690
EST3	.01	2	.01	.23	.799
SEX by EST3	.00	2	.00	.04	.958

From Table13.47 Analysis of Variance – Tests of Between-Subjects Effects, it can be seen that the variables of SEX and SEX by EST are significant (F = 1.39; df 1,117; p = 0.01) and (F = 2.07; df 2,117; p=0.01) respectively, but that EST is not significant (F = 26.55; df 2,117; p = 0.01).

Table 13.47 Tests of Between-Subjects Effects
Tests of Significance for T1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	206.39	117	1.76		
Constant	2730.86	1	2730.86	1548.13	.000
SEX	2.46	1	2.46	1.39	.240
EST3	93.66	2	46.83	26.55	.000
SEX by EST3	7.32	2	3.66	2.07	.130

From Table 13.48, Analysis of Variance – 'Subject' Within – Subject Effect, it can be seen that Subject, EST by Subject and SEX by EST by Subject are significant (F = 0.97; df 5,585; p = 0.01), (F = 1.68; df 10,585; p = 0.01) and (F = 0.34; df 10,585; p = 0.01) respectively, but that SEX by Subject is not significant (F = 3.29; df 5,585; p = 0.01).
Tests involving 'SUBJECT' Within-Subject Effect

Table 13.48 AVERAGED Tests of Significance for MEAS.1 using UNIQUE Sums of Squares

Source of Variation	*Sum of Squares*	*DF*	*Mean Square*	*F*	*Significance of F*
Within Cells	105.59	585	.18		
Subject	.87	5	.17	.97	.437
SEX by Subject	2.97	5	.59	3.29	.006
EST3 by Subject	3.03	10	.30	1.68	.083
SEX by EST3 by Subject	.61	10	.06	.34	.970

From the Tables 13.5 to 13.36, and Figures 13.16 to 13.40 of this Study there is an interaction between the EST3 and the variables of Similarities (Figure 13.22), Matrices (Figure 13.23), Speed of Information Processing (Figure 13.24), IQ (Figure 13.27), WA (Figure 13.29), VI (Figure 13.30), English (Lang and Lit) (Figure 13.32), Mathematics (Figure 13.33), Science (General) (Figure 13.34), History (Figure13.35), Geography (Figure 13.36) and Modern Language (French) (Figure 13.37); for both males and females, within and between in some cases, the three groupings of the EST3, in terms of low, medium and high field dependence – field independence designation.

As with the previous three studies:-
A further analysis for this Study (Four) involved the production of a correlation matrix for each of the variables involved.
See table 13.49 for the correlations between EST3; SWT2; NSWT1; GPCT; Recall of Digits; Similarities; Matrices; Speed of Information Processing; I.Q.; WA; and VI.

Table 13.49 Correlation Matrix for the first twelve variables of Study 4

	SEX	EST3	SWT2	NSWT1	GPCT	R of D	SIM	MAT	Sp of I.P.	I.Q.	WA	VI
SEX		.0186	.0818	.1484	-.1171	.1187	.0666	.0398	-.0554	.0975	-.0217	-.0464
EST3			** .3283	** .4293	.2169	.2212	** .3846	** .4717	.1709	** .4659	.0390	-.0410
SWT2				** .6354	.1580	.1173	-.0534	.0940	.1088	.1181	.1328	.0943
NSWT1					.1702	.1038	.1980	* .2757	.1570	* .2653	.0657	.1830
GPCT						.0351	-.0368	.0986	.0226	.0793	.0785	.0280
R of D							.2077	.1249	.1150	** .5835	-.0061	.1219
SIM								* .2903	.1958	** .6208	-.0331	.0145
MAT									. 2072	** .5028	-.0974	.0387
Sp of I.P										** .5527	.0699	.0205
I.Q.											.0523	.1245
WA												-.0359
VI												

2-tailed signif: * - .01 ** - .001

In terms of significance and level of significance, the correlations between EST3, SWT2, NSWT1, Recall of Digits, Similarities, Matrices, Speed of Information Processing, I.Q., WA and VI and other variables of School Subjects are shown in Table 13.50.

Table 13.50 Significant and Non-Significant Correlations between School Subjects and EST3, SWT2 and NSWT1 – Study 4

Variables	Correlations (r)	Significance (p)
EST3/School Subject English Lang/Lit	.4180**	< 0.001
EST3/School Subject Mathematics	.5625**	< 0.001
EST3/School Subject Science (General)	.5465**	< 0.001
EST3/School Subject History	.4211**	< 0.001
EST3/School Subject Geography	.5268**	< 0.001
EST3/School Subject D and T (Product)	.3673*	< 0.01
EST3/School Subject D and T (Food)	.3562**	< 0.001
EST3/School Subject Art	.3850*	< 0.01
EST3/School Subject Music	.3377**	< 0.001
EST3/School Subject Mod Lang French	.5204**	< 0.001
EST3/School Subject Physical Education	.2430*	< 0.01
EST3/School Subject Computer Studies	.4902**	< 0.001
SWT2/School Subject English Lang/Lit	.2396*	< 0.01
SWT2/School Subject Mathematics	.1892	-

SWT2/School Subject Science (General)	.0249	-
SWT2/School Subject History	.0549	-
SWT2/School Subject Geography	.1145	-
SWT2/School Subject D and T (Product)	-.0072	-
SWT2/School Subject D and T (Food)	.2334*	< 0.01
SWT2/School Subject Art	.0491	-
SWT2/School Subject Music	.1196	-
SWT2/School Subject Mod Lang French	.0868	-
SWT2/School Subject Physical Education	.1755	-
SWT2/School Subject Computer Studies	.2949	-
NSWT1/School Subject English Lang/Lit	.4129**	< 0.001
NSWT1/School Subject Mathematics	.4315**	< 0.001
NSWT1/School Subject Science (General)	.2784*	< 0.01
NSWT1/School Subject History	.2959**	< 0.001
NSWT1/School Subject Geography	.3904**	< 0.001
NSWT1/School Subject D and T (Product)	.2313	-
NSWT1/School Subject D and T (Food)	.3769**	< 0.001
NSWT1/School Subject Art	.3014	-
NSWT1/School Subject Music	.3196**	< 0.001
NSWT1/School Subject Mod Lang French	.4016**	< 0.001
NSWT1/School Subject Physical Education	.3034**	< 0.001
NSWT1/School Subject Computer Studies	.4525**	< 0.001

It can be seen from the above Tables 13.49 and 13.50 that EST3 correlates relatively highly with the variables of SWT2, NSWT1, Similarities, Matrices, Intelligence Quotient (IQ) and most of the school subjects. A relatively high correlation between the EST3, SWT2 and NSWT1 would have been expected since, all three are attempting to measure field dependence – field independence. Also, a relatively high correlation is not unexpected between the EST3 and Matrices, because of their geometrical nature, i.e. the testee is required to manipulate shapes mentally within each of the two ‘tests’.
The correlation between the EST3 and I.Q. strongly suggests that, irrespective of whether or not the EST3 is measuring field dependence or field independence, it is also measuring non-verbal reasoning and possibly general cognitive ability. This possibility is further supported by the correlation for ‘Similarities’, a measure of verbal reasoning, and the correlations for most of the school subjects.

The correlation between the EST3 and the GPCT is not unexpected, since the task of the GPCT is to assemble and synthesise pieces of information, whereas the task of the EST3 is to disassemble and segregate, or disembed a particular piece information from an amount of information given, i.e. synthesis (putting together) in comparison to de-structuring (taking apart). Therefore, a higher correlation would have been unexpected.

The correlation for the Recall of Digits Scale, in a forward direction (a measure of immediate auditory/short term working memory), with the EST3 is not unexpected since it is, in many respects, comparing two different skills. However, since memory, in whatever form, i.e. long term or short term/working memory, is considered to be an important cognitive ability relating to ability in general, then a higher correlation would not have been unexpected, especially considering the relatively high correlation between the EST3 and I.Q.

The above argument could also be applied to the low correlation between the EST3 and the Speed of Information Processing Scale, since it is a category of cognitive skill.

The correlation between EST3 and WA is somewhat disappointing since WA is assessed using similar test items/questions to those of EST3. However, the correlation between EST3 and VI is not unexpected since VI is assessed using very different test items/questions to those of EST3.

Conclusion

The lines of enquiry in this Study as stated in Section 13.1 Introduction give similar outcomes as those stated in the Conclusions of Studies One, Two and Three, with regards to the use of the EST3, SWT2 and NSWT1 in particular.

Also, the GPCT was used in this Study (Four) as it was in Study Three, producing similar outcomes.

The use of the BASI Short Form I.Q., obtained through the application of the four scales of Recall of Digits, Similarities, Matrices and Speed of Information Processing, enabled two aspects to be explored and compared with the field dependence – field independence measurements derived from the EST3, SWT2 and NSWT1 as follows:-
Firstly, the direct comparison of an I.Q. measurement with the four measurements of field dependence – field independence, particularly the EST3 (because this had undergone more development work prior to its use in the two Pilot Studies and four Experimental Studies of this thesis, and its administration has similarities to Witkin's GEFT. This enables the idea of a measure of ability (I.Q.) to be compared to the cognitive style of field dependence – field independence.

Secondly, each of the four scales from the BASI used to produce an I.Q. measure, in their own right a distinctive skill. Recall of Digits measures short term working memory; Similarities measures verbal reasoning in terms of the categorisation of verbal concepts into super-ordinant groups; Matrices measures non-verbal reasoning in terms of the manipulation of shapes and patterns; and Speed of Information Processing measures speed of assimilating and applying information. Each of the four scales has been compared to measurements of field dependence – field independence and the other associated variables with this Study (Four).

The details of the results of this Study have been referred to in Section 13.4 i) Discussion, but in general terms the level of evidence for compatibility between the EST3, SWT2 and NSWT1 is encouraging in that the correlations are relatively high, i.e. 0.3283 and 0.4293,respectively.

The GCPT achieved a relatively low correlation with the EST3, i.e.0.2169, which is curious. On the one hand the correlation produced is not totally unexpected since both the GPCT and the EST3 require perceptive and analytical skills. On the other hand the result is unexpected because the primary skill, from a logical perspective, of the GCPT is opposite to that of the EST3, i.e. synthesis/putting together/assembling/completing versus destructuring/taking apart/disassembling/breaking up, of the component parts or complex/simple shapes presented, respectively. Therefore, a relatively high and inverse correlation would not have been unexpected in relation to the above reasoning and arguments.

With regards to the CSA, the outcomes in terms of the correlations between the EST3 and the WA and VI dimensions are unexpected particularly with the VI dimension. One would have expected a higher (and remaining positive) correlation for the WA dimension because a Wholistic or Analytic approach to problem solving should relate to field dependence and field independence, respectively; and the VI dimension a higher and positive correlation because half of the 'Imager' tasks within the CSA, are of a embedded figure/shape type. Therefore, a low or high score with these particular tasks within the CSA should correspond to a field dependence or field independence outcome respectively.

The correlations between the EST3 and all of the school subjects were relatively high, in particular those for Mathematics, Science (General), Geography, Modern Languages (French) and Computer Studies which were 0.5625, 0.5465, 0.5268, 0.5204 and 0.4902, respectively.

The females produced higher scores than the males for the majority of the variables used, i.e. the various tests used, scales, and school subjects, in this Study. The only exceptions to this general outcome were in relation to the GPCT, the Wholistic – Analytic and Verbal – Imager cognitive style dimensions and General Science.

Chapter 14

A Comparison of the Outcomes from Studies One, Two, Three and Four

14.1 Introduction

14.1 i) General Comments

In this chapter the results from each of the four studies will be compared in relation to the principle instruments of the Embedded Shapes Test, Version Three (EST3), Sense Word Test, Version Two (SWT2), and Non-Sense Word Test, Version One (NSWT1); as well as one other instrument, i.e. Gestalt Picture Completion Test (GPCT) from Studies 3 and 4; and a number of school subjects from Studies 1, 2, 3 and 4 in terms of performance/attainment scores. All of the variables used in the Thesis are shown in Table 14.1 as follows:-

Table 14.1 The Total Range and Number of Variables used throughout the Thesis within Studies 1, 2, 3 and 4.

Variable	Study 1	Study 2	Study 3	Study 4
EST3	*	*	*	*
SWT2	*	*	*	*
NSWT1	*	*	*	*
GPCT			*	*
COIT				
Category A			*	
Category B			*	
Category S			*	
Category T			*	
BASI Scales/Short Form IQ				
Recall of Digits				*
Similarities				*
Matrices				*
Speed of Info Process				*
IQ				*
CSA				
Wholistic/Analytic				*
Verbaliser/Imager				*
Wholistic (W)				*
Analytic (A)				*
Verbaliser (V)				*
Imager (I)				*
School Subjects				
English (Lang / Lit)				
Mathematics				
General Science	*		*	*
History			*	*

Geography			*	*
D and T (Product)		*	*	
D and T (Food)			*	
Religious Education			*	
Art			*	
Music			*	
Mod Lang - French	*	*	*	*
GCSE Subjects				
English Language			*	
English Literature			*	
Mathematics			*	
General Science			*	
History			*	
Geography			*	
Mod Lang - French			*	

14.1 ii) Distribution of EST3 Raw Scores into Three or Four Categories

The distribution of raw scores for the EST3 were divided into three categories, i.e. low, medium and high for Studies 1, 2 and 4;and into four categories, i.e. low, low-medium, high-medium and high, for Study 4. The reasons for these categories were briefly explained in each of the chapters related to a particular Study, i.e. Study 1, Chapter 10; Study 2, Chapter 11; Study 3, Chapter 12; and Study 4, Chapter 13.

Traditionally raw scores from measures of field dependence – field independence (Witkin, 1971) have been considered as indicating or giving a bias to either field dependence or field independence, depending on the number of correct responses achieved, i.e. the greater the number of correct responses achieved, the more field independent, with the cut-off point occurring mid-way in the total number of correct responses possible. However, a decision was made to consider the number of correct responses from the Embedded Shapes Test in terms of three categories of low, medium and high, instead of two, in an attempt to provide a greater amount of detailed information from the statistical techniques employed in the analysis of the raw scores from the Embedded Shapes Test used in each Study.

There were three basic reasons for this, which consisted of:-

1. A number of categories would promise a greater resolution and accuracy, with the content of the EST3, particularly within the region of when a field dependent designation becomes one of field independent.
2. Because there are a number of other tests involved, particularly the SWT2 and NSWT1, which are attempting to measure field dependence – field independence as well, albeit

from a verbal modality, it would enable, not only the four (EST3, SWT2, NSWT1and COIT) field dependant – field independent tests to be compared with a greater degree of accuracy, but also the other non-field dependence – field independence tests, i.e. school subjects and GCSE subjects, in terms of the raw scores obtained from them.

3. The management of the overall statistical data would be made relatively more straight-forward when identifying relationships, similarities and differences of outcomes, when the raw scores from the EST3 are compared to that of the other field dependence – field independence tests, as well as the none field dependence – field independence tests, schools subjects and GCSE subjects.

However, there was one exception to the above procedure which related to Study 3. Because the sample size for Study 3, was considerably larger than the sample size for any of the other three studies, it was decided to allocate four categories, which involved an extension of the medium category to produce a low medium and high medium category from the raw scores of the EST3.

The cut-off points, beginning and end, of each of the three or four categories from the raw scores of the EST3 was done by a consideration of the range of raw scores of it, for each of the Studies, 1, 2, 3 and 4.

The following table shows the cut off point for each of the three or four categories of the raw scores for the EST3 in each study.

Table 14.2 The Cut-off Points for the Categories of the Raw Scores for the EST3 in Studies 1, 2, 3 and 4.

	Low		**Medium**		**High**	
Study 1	0	21	22	25	26	32
Study 2	0	17	18	23	24	32
			LM	**HM**		
Study 3	0	19	20 23	24 26	27	31
Study 4	0	21	22	25	26	32

It can be seen from the above table that the ‘low category’ has a wider range of raw scores than the summation of the range of raw scores from the ‘medium and high categories’ combined. This was because the number of testees for each category was approximately the same irrespective of the range of scores achieved, although within each Study and each category the raw scores only differ by a few integers. The start and end points for each category only differ by one integer for all four studies, including the ‘low-medium and high-medium categories’ for Study 3, which is to be expected.

The above arrangement and subsequent analysis for each of the four Studies, offers a graduated set of descriptors for a field dependent or field independent designation, i.e. field dependent (low category), transitional field dependent – field independent (medium category) and field independent (high category). The low-medium and high-medium categories of Study 3, offer a more accurate designation of a transitional field dependence – field independence designation.

Therefore, the field dependence - field independence bi-polar continuum is able to be sub-divided into three or four categories, instead of the traditional two. This allows individual differences, in terms of field dependence – field independence, to be assessed and applied in the learning and teaching context, within the curriculum of different stages and sectors of education (and training). It also takes account of the possibility that a field dependence – field independence designation can be context specific, i.e. some educational (learning and teaching) activities require, or are better suited, to a field dependent approach and others, a field independent approach, e.g. problem solving as a member of a group and problem solving on an individual basis, respectively.

14.2 Distribution of Raw Scores for the Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1)

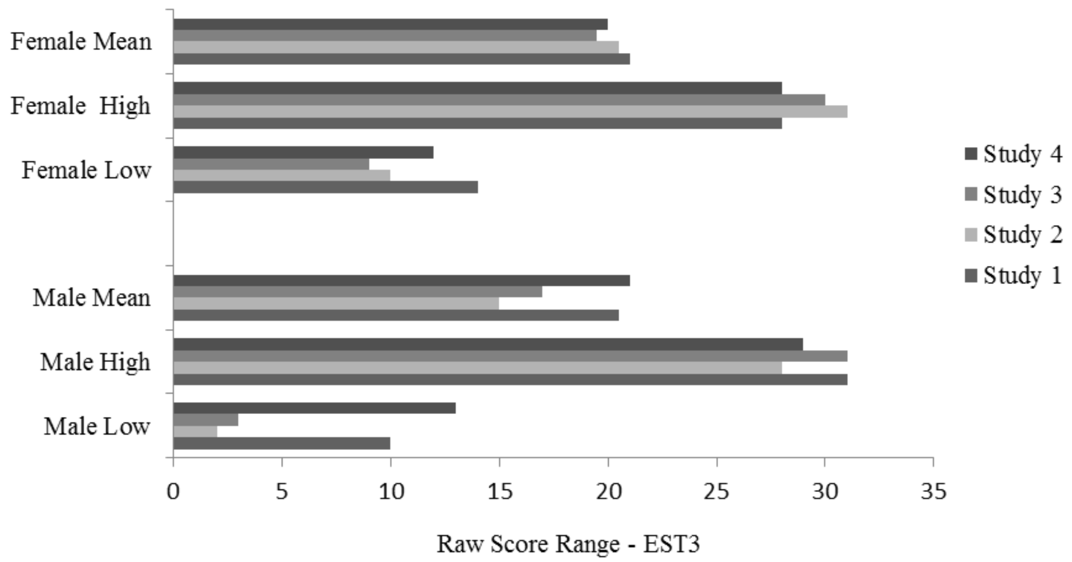
14.2 i) Embedded Shapes Test, Version Three (EST3)

From Table 14.3 and Figure 14.1 the distribution of raw scores for the Embedded Shapes Test (EST3) across the four studies shows some similarities and some differences. Similarities in that there is a wide distribution of raw scores, particularly Studies 2 and 3 for both male and female and differences in that the distribution is less wide, as it is for Study 1 and 4, particularly in terms of the females, when compared to the males for Study 1.

Table 14.3 The Distribution of Raw Scores for the EST3, Studies 1, 2, 3 and 4

	male			female		
	low	high	mean	low	high	mean
Study 1	10	31	20.5	14	28	21
Study 2	2	28	15	10	31	20.5
Study 3	3	31	17	9	30	19.5
Study 4	13	29	21	12	28	20

Figure 14.1 from Table 14.3 - The Range of Raw Scores for Males and Females from Embedded Shapes Test, Version Three (EST3) - Studies 1, 2, 3 and 4.



With regards to the distributions of scores for the Embedded Shapes Tests when they are allocated in a low, medium and high category for field dependence – field independence (i.e. the more correct responses achieved on the Embedded Shapes Test, the more field independent an individual is considered to be, and the less number of correct responses achieved, the more field dependent), they show that the samples for Study 1, 2 and 4 are split approximately into a third for each category. With Study 3 there are two medium categories, i.e. low-medium and high-medium, because the sample size is much larger than any of the samples for the other studies. (See Figures 14.2, 14.3, 14.4 and 14.5)

Figure 14.2 Correct Responses from Response Section (C) (raw scores) arranged into 3 Groups of Low, Medium and High for the Embedded Shapes Test, Version Three (EST3) - Study 1

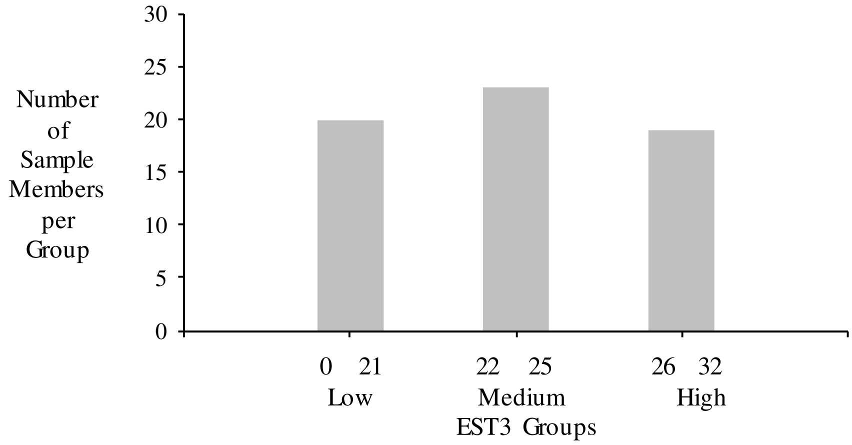


Figure 14.3 Correct Responses from Response Section (C) (raw scores) arranged into 3 Groups of Low, Medium and High for the Embedded Shapes Test, Version Three (EST3) - Study 2

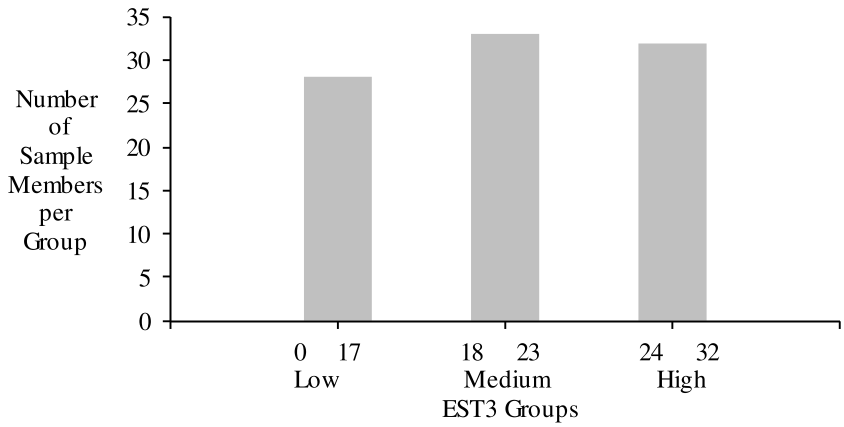


Figure 14.4 Correct Responses from Response Section (C) (raw scores) arranged into 4 Groups of Low, Low-Medium, High-Medium and High For the Embedded Shapes Test, Version 3 (EST3) - Study

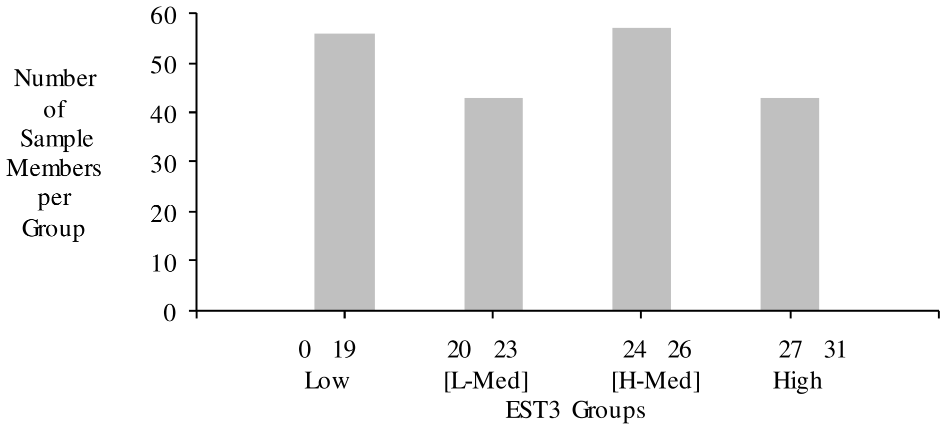
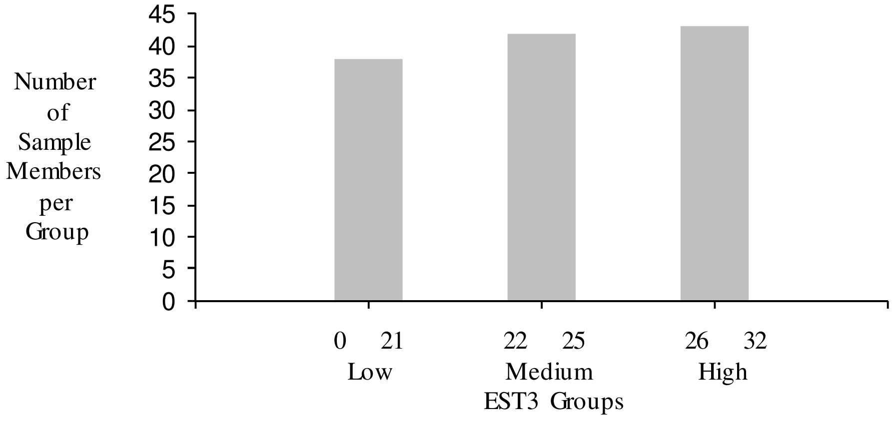


Figure 14.5 Correct Responses from Response Section Section (C) (raw scores) arranged into 3 Groups of Low, Medium and High for the Embedded Shapes Test, Version Three (EST3) - Study 4



Therefore, the resulting distribution based on this arrangement for Study 4 gives the low and high medium categories as approximately equal and the low medium and high categories as approximately equal. However, it is interesting to consider that if the low-medium and high-medium categories were to be combined, the range of scores (which defines these two categories, i.e. 20 – 23 and 24 – 26 respectively), added together, gives 7. This number is not much greater than the defining range of scores for the medium category in Study 1, 2 and 4, which are 4, 6 and 4 respectively, then the medium category would be much bigger than the low or high category for Study 4. (See figures 14.2, 14.3, 14.4 and 14.5).

The reasons for the allocation of the categories of low, medium and high and their corresponding intervals, for the Embedded Shapes Test outcomes, for each of the studies and samples, was stated in Chapter 6, as was the methodology used.

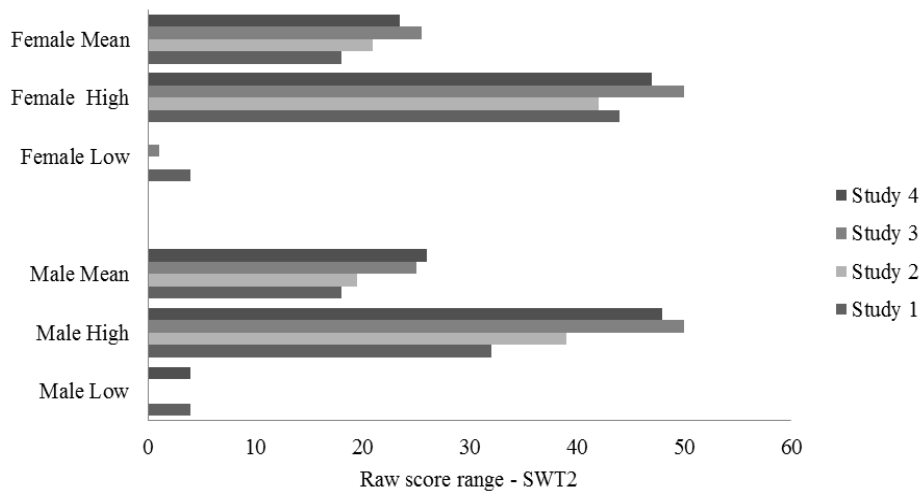
14.2 ii) Sense Word Test, Version Two (SWT2)

From Table 14.4 and Figure 14.6 the distribution of the raw scores for the Sense Word Test (SWT2) across the four Studies incorporates a wide range of raw scores, particularly in Studies 3 and 4. In contrast, the range of raw scores for Study 1 is low, especially for the males of the sample, although no male or female in the sample achieved a zero raw score, as was the case for the males and females of Study 2, the males of Study 3, and the females of Study 4.

Table 14.4 The Distribution of Raw Scores for the SWT2, Studies 1, 2, 3 and 4

	male			female		
	low	high	mean	low	high	mean
Study 1	4	32	18	4	44	18
Study 2	0	39	19.5	0	42	21
Study 3	0	50	25	1	50	25.5
Study 4	4	48	26	0	47	23.5

Figure 14.6 from Table 14.4 - The Range of Raw Scores for Males and Females from Sense Word Test, Version Two (SWT2) - Studies 1, 2, 3 and 4



There could be two reasons for the relatively low performance of the males in Study 1. Firstly, they did not fully understand what they were being asked to do and how to do it; and secondly, they did not indicate as carefully, and therefore, as clearly, as they could have done, the simple word embedded in the complex word; in which case there could be additional reasons for their performance such as under-developed motor skills or less than a positive attitude to the task in hand.

A third reason of course is that they are more field dependent than field independent.

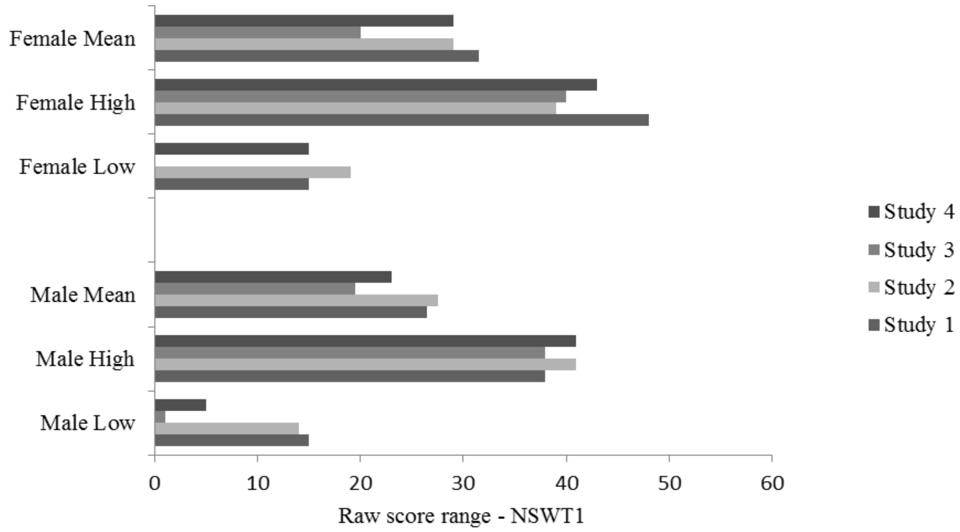
14.2 iii) Non-Sense Word Test, Version One (NSWT1)

Table 14.5 and Figure 14.7 show that the distribution of raw scores for the Non-Sense Word Test (NSWT1) across the four Studies was less than the raw scores for the Sense Word Test (SWT2). This is particularly so for both males and females in Studies 1 and 2, and for the females in Study 4.

Table 14.5 The Distribution of Raw Scores for the NSWT1, Studies 1, 2, 3 and 4

	male			female		
	low	high	mean	low	high	mean
Study 1	15	38	26.5	15	48	31.5
Study 2	14	41	27.5	19	39	29
Study 3	1	38	19.5	0	40	20
Study 4	5	41	23	15	43	29

Figure 14.7 from Table 14.5 - The Range of Raw Scores for Males and Females from Non-Sense Word Test, Version One (NSWT1) - Studies 1, 2, 3 and 4



These differences between the raw scores of the NSWT1 and the SWT2 are a little surprising. The NSWT1 is arguably more difficult, because it contains complex and simple collections of letters or shapes that are more abstract and therefore, have a greater degree of 'embeddedness', than the SWT2 which uses real words for both the complex and simple part of each test item/question, making the task of disembedding relatively easier because of the familiarity of the 'real words' that it contains. However, the maximum number of correct responses is less for the NSWT1 when compared to those of the SWT2, in Studies 3 and 4, which support the above argument.

14.3 Comparison of Raw Scores and Correlations for Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1) - from Studies 1, 2, 3 and 4.

There appears to be a consistency of raw scores from the Embedded Shapes Test (EST3), Sense Word Test (SWT2) and Non-Sense Word Test (NSWT1) within each study and between studies, in terms of their distribution, i.e. very few zero or maximum raw scores. This suggests that the majority of the sample members in each study were able to complete all three of these 'tests' to a similar level of competence which in turn relates to their degree of field dependence – field independence. Also, this outcome gives some evidence that the SWT2 and the NSWT1 are measuring the construct of field-dependence – field independence through the use of words or non-related groups of letters, i.e. sense (real) words and non-sense (collections of letters) words respectively.

For a detailed account and discussion of the raw scores and correlations for the EST3, SWT2 and NSWT1 from Studies 1, 2, 3 and 4, see Sections 10.3, 11.3, 12.3 and 13.3, Results and Analysis; and Discussion and Conclusion, respectively.

14.4 Reliability and Validity

i) Reliability
Cronbach Alphas for Studies 1, 2, 3 and 4.
Correlations for Sex; for Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1) from Studies 1, 2, 3 and 4.
ii) Validity
Sex; Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1).

14.4 i) Reliability

Cronbach Alpha values for the EST3, SWT2 and the NSWT1 from Studies 1, 2, 3 and 4 are shown in Table 14.6 below

Table 14.6 Cronbach Alpha Values for EST3, SWT2 and NSWT1, from Studies 1, 2, 3 and 4

Test	Study 1	Study 2	Study 3	Study 4
EST3	0.84263	0.90281	0.89441	0.84942
SWT2	0.92799	0.93720	0.94493	0.93779
NSWT1	0.91946	0.88725	0.92713	0.91099

The following Correlation Table for Studies 1, 2, 3 and 4 indicate some significant correlations between Sex, EST3, SWT2 and NSWT1.

Table 14.7 Correlations for Sex, Embedded Shapes Test (EST3), Sense Word Test (SWT2) and Non-Sense Word Test 1 (NSWT1)

STUDY 1				
	SEX	**EST3**	**SWT2**	**NSWT1**
SEX				
EST3	-0.1167			
SWT2	0.2234	0.3210		
NSWT1	0.3159	0.1774	0.7851**	
	2 tailed sig * = .01 ** = .001			
STUDY 2				
	SEX	**EST3**	**SWT2**	**NSWT1**
SEX				
EST3	0.2159			
SWT2	0.4023**	0.4343**		
NSWT1	0.4354**	0.4696**	0.7002**	
	2 tailed sig * = .01 ** = .001			
STUDY3				
	SEX	**EST3**	**SWT2**	**NSWT1**
SEX				
EST3	0.0183			
SWT2	0.2284*	0.2114*		
NSWT1	0.2021*	0.2317**	0.4788**	
	2 tailed sig * = .01 ** = .001			
STUDY 4				
	SEX	**EST3**	**SWT2**	**NSWT1**
SEX				
EST3	0.0186			
SWT2	0.0818	0.3283**		
NSWT1	0.1484	0.4293**	0.6354**	
	2 tailed sig * = .01 ** = .001			

ii) Validity

The consistency of the results (raw scores) obtained from the EST3, SWT2 and NSWT1, and their interaction with other 'tests', school and GCSE subjects, indicates a high level of 'face' and 'construct' validity.

14.5 An Additional Study to Provide a Comparative Analysis of Reliability between the Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1);and Group Embedded Figures Test (GEFT).

In this study, a sample of forty Year 8 students, twenty males and twenty females from an urban high school, were used. The EST3; SWT2; NSWT1 and the Group Embedded Figures Test (GEFT) (Witkin et al, 1971) were administered to the sample, in this order, one after the other.

The purpose of this study was to provide sets of raw scores from the above 'tests' to assemble a comparison of reliability to be made between each of them, particularly a comparison between the EST3, SWT2 and NSWT1, and the GEFT.

The procedure for the administration of the EST3, SWT2, NSWT1 was as that detailed in studies 1, 2, 3 and 4, as was the scoring. With regard to the GEFT, the administration and scoring procedure was as that cited in the Manual (Witkin et al, 1971) for the GEFT.

The results obtained from the overall sample, males and females were similar for the EST3, SWT2, NSWT1, as those obtained from the samples in Studies 1, 2, 3 and 4, in terms of a range of scores and differences between male and female testees. A similar set of outcomes was obtained from the GEFT.

The means and standard deviations of the total sample for the EST3, SWT2, NSWT1 and GEFT are shown in Table 14.8.

Table 14.8 Means and Standard Deviations of the Total Sample for EST3, SWT2, NSWT1 and GEFT

Test	Mean	Standard Deviation
EST3	16.8780	7.5553
SWT2	28.0244	5.5108
NSWT1	32.5610	14.5744
GEFT	14.1463	11.3633

The above mean and standard deviation values for the EST3 and GEFT suggest that the normal distribution curve for the EST3 is narrow (raw scores clustered around the mean), when compared to the GEFT, which has a wider normal distribution curve (raw scores widely spread around the mean). This in turn suggests that the EST3 is able to define, with a greater degree of accuracy, than the GEFT, a mid-point between a designation of field dependency and field independency, while at the same time, defining a region that is between a strong field dependency designation and a strong field independency designation. Such an outcome may provide evidence for a degree of task dependency being influential in the determination of a field dependent – field independent designation, i.e. an individual displays a greater degree of field dependency than field independency, depending on the characteristics of a given task/tasks being undertaken, within a given 'test' for field dependency – field independency, i.e. the difference between the EST3 and the GEFT.

With regards to the SWT2 and NSWT1, it is not surprising that both means are approximately twice the size of those for the EST3 and GEFT. This is because the maximum scores for the SWT2 and NSWT1 is 50, whereas for the EST3 it is 32 and for the GEFT it is 25. However, the standard deviation value for the NSWT1 is high when compared to the standard deviation values of the SWT2, EST3 and GEFT. Apart from the mean and standard deviation values for the NSWT1, producing a wide region either side of the mean, which in turn indicates a wide variation of raw scores on this test, it suggests that the nature of this particular test, i.e. neither fully verbal or spatial when compared to the SWT2; and EST3 and GEFT, respectively, is, or at least can be, able to exert a particular influence with regards to a field dependent or field independent designation..

Two further factors may have been influential in the production of mean and standard deviation values obtained for the EST3, SWT2, NSWT1 and GEFT. These are (1) all four 'tests' were undertaken in one 'sitting', and (2) the sample size was relatively small. With regards to(1) there may have been a 'practice effect' taking place, however small, since EST3 had some similarities to the GEFT, and SWT2 had some similarities to NSWT1. Also, all four 'tests' were measuring field dependency – field independency, albeit using two different modalities, so a further influencing factor may have been the level of concentration on the part of the testees across the four 'tests'.

Cronbach Alpha values were calculated, to give a measure of reliability for the EST3, SWT2, NSWT1 and GEFT, and also a comparative measure of reliability between them. These are shown in Table 14.9.

Table 14.9 Cronbach Alpha Values for EST3, SWT2, NSWT1 and GEFT

	EST3	**SWT2**	**NSWT1**	**GEFT**
Cronbach Alpha	0.93544	0.97891	0.96411	0.89234

It can be seen from the above Cronbach Alpha results that there is a high level of reliability for the EST3, SWT2, NSWT1 and GEFT, both within each test and between each test.

In addition, the Cronbach Alpha result for the EST3, SWT2 and NSWT1, in this Additional Study, are similar to those obtained in Studies 1, 2, 3 and 4 (See Section 14.4, Table 14.6, in this Chapter).

However, of particular interest is the difference in the Cronbach Alpha result between the EST3 and the GEFT, 0.93544 and 0.89234, respectively. This would suggest that the EST3 has a greater level of reliability and is therefore, a more reliable measure of field dependency – field independency using a spatial/geometrical modality, to that of the GEFT.

Such an outcome provides evidence for a positive answer to the first research question of the Thesis, namely,
Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?,
and to substantiate the design differences and the reasons for them, (See Chapters 6 and 7), between the EST3 and the GEFT.

With regards to the Cronbach Alpha results for the SWT2 and NSWT1 (0.97891 and 0.96411, respectively) when compared to the GEFT (0.89234), there is a difference. This is not surprising since both the SWT2 and the NSWT1 use a different modality, i.e. verbal, to that of the GEFT which uses a spatial/geometrical modality. However, the Cronbach Alpha result for the EST3 is similar to that for the SWT2 and NSWT1. This can perhaps be explained by the fact that the EST3, SWT2 and NSWT1 have the same authorship for their conception and development, and therefore, are likely to contain hidden similarities within them, in spite of them appearing to be very different from each other, although measuring the same thing, i.e. field dependency, while using a different modality. Such considerations can become misleading if the purpose of a Cronbach Alpha measurement is not brought back into focus in terms of it being a reliability measure of a given test and not between two or more tests.

However, the second research question, namely,
Is it possible to measure field dependence – field independence using a verbal modality?, appears to have been answered with some confidence given the Cronbach Alpha values obtained for the SWT2 and NSWT1, when compared to both the EST3 and GEFT in terms of their reliability.

Therefore, both the Cronbach Alpha values for the EST3, SWT2, NSWT1 and GEFT, and the correlation values between them, indicate a high degree of reliability and relationship, which is able to accommodate a difference in modality for the measurement of field dependency – field independency. This is particularly so with regard to the GEFT because it is the established method within the literature of measuring field dependency - field independency, albeit in terms of a spatial/geometrical modality only. In other words, if the correlations obtained in this Additional Study were very weak for the SWT2, NSWT1 and EST3, when compared to the GEFT, then the second research question could not be answered with the same degree of confidence.
A further analysis within this study was the production of a correlation matrix (Pearson Product Moment (r)) involving the EST3; SWT2; NSWT1 and GEFT are shown in Table 14.10.

Table 14.10 Correlations between EST3, SWT2, NSWT1 and GEFT

	EST3	SWT2	NSWT1	GEFT
EST3		0.4908	0.4570	0.7238
SWT2			0.8247	0.4664
NSWT1				0.4793
GEFT				

A correlation of 0.7238 between the EST3 and the GEFT gives a relatively high level of reliability and indicates a relatively strong relationship between the EST3 and GEFT. This is not unexpected since both the EST3 and GEFT are a similar modality, and within this modality, similar techniques, i.e. test items/questions, to measure field dependency - field independency. However, because of differences within the techniques, the overall construction of, and the detailed methodology/procedure of each test, i.e. EST3 and GEFT, the correlation value is not higher. Therefore, the correlation value provides further evidence, to that of the Cronbach Alpha value, to further suggest that the EST3 is able to measure field dependency – field independency to a greater degree (sensitivity and accuracy) than the GEFT.

The correlations between SWT2, NSWT1 and the EST3, i.e. 0.4908 and 0.4570, respectively, does indicate a difference between the two different forms, i.e. SWT2, NSWT1 and EST3, of field dependent – field independent 'tests', in terms of the modality employed, while at the same time there existing a common relationship between them, i.e. SWT2, NSWT1, compared to the EST3.

The correlations between the SWT2, NSWT1 and the GEFT, i.e. 0.4664 and 0.4793, respectively; are similar to those of the EST3 for the same reason, as well as there being an indication of a common relationship between them, i.e. SWT2 and NSWT1, compared to the GEFT.

In terms of the correlation between the SWT2, NSWT1, i.e. 0.8247, giving a value approximately twice that of the correlations for each of these 'tests' when compared to the EST3 and GEFT, a high value is not unexpected since they each use a verbal modality as a way of measuring field dependency – field independency. This is in spite of one (SWT2) using real words and the other (NSWT1), using non-sense words, which are really collections of letters (See Chapters 6 and 7 for a full description).

14.6 Gestalt Picture Completion Test (GPCT)
Comparison of Raw Scores and Correlations between Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1) and Gestalt Picture Completion Test (GPCT) of Studies 3 and 4.

The distribution of raw scores for the Gestalt Picture Completion Test (GPCT) for Studies 3 and 4 (this test was only used in Studies 3 and 4) is approximately the same, only differing by one point for the males and two points for the females. Such an outcome is indicative of:-

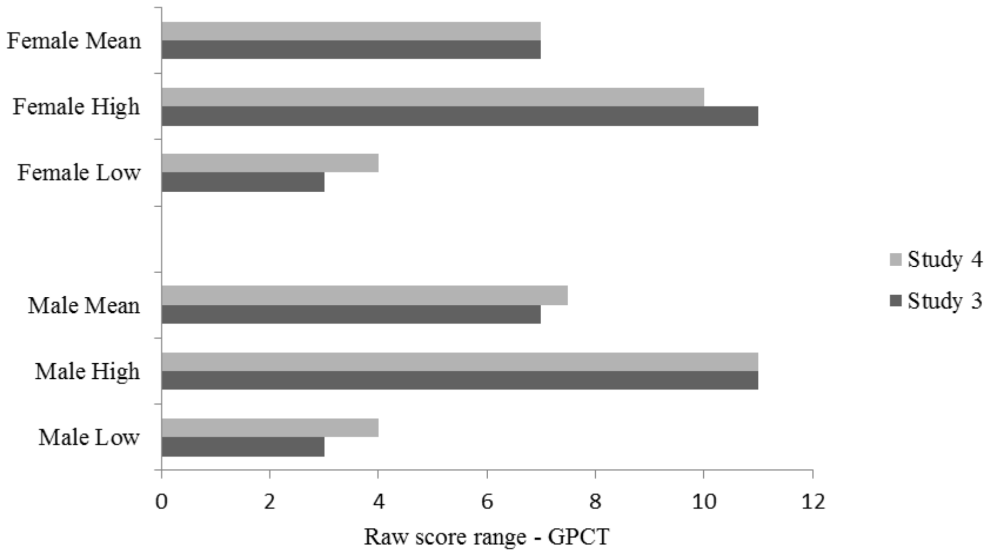
1. How the test was presented to both samples of each study, i.e. a booklet of the 'pictures' and an answer sheet;
2. The size of each sample of 224 and 124 for Studies 3 and 4 respectively,
   tends to confirm issues of reliability and validity of the GPCT, i.e. little difference in outcomes in spite of the difference in the magnitude of the two sample sizes;
3. The EST3, SWT2 and NSWT1 are given credence from a reliability and validity point of view, because the samples of Studies 3 and 4 performed to a similar extent in terms of the overall distribution, as well as the start and end points of the distribution (as did the samples of Studies 1 and 2). Therefore, the outcomes from the EST3, SWT2 and NSWT1, relate well to the outcomes of the GPCT for Studies 3 and 4; and

4. Gives an indication of a similar level of general ability within and between the two samples of Studies 3 and 4 (See Figure 14.8 and Table 14.11).

Table 14.11 The Distribution of Raw Scores for the GPCT, Studies 1, 2, 3 and 4

	male			female		
	low	high	mean	low	high	mean
Study 3	3	11	7	3	11	7
Study 4	4	11	7.5	4	10	7

Figure 14.8 from Table 14.11 - The Range of Raw Scores for Males and Females from Gestalt Picture Completion Test (GPCT) - Studies 3 and 4



14.7 School Subjects from Studies 1, 2, 3 and 4. Comparisons of Significant and Non-Significant F Ratios; Interactions; and Correlations with Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1).

Not all of the same school subjects were used in each of the four Studies for reasons of availability of scores from each of the schools from where the samples, for each of the Studies, were obtained. Therefore, it is not possible to compare the results of many school subjects for each of the Studies in relation to the various 'tests' used in each Study, particularly in relation to the EST3, SWT2 and NSWT1, since these 'tests' were used in each Study.

The EST3, SWT2 and NSWT1 form the basis of the thesis in that they are considered to be measuring field dependence – field independence, using a spatial and verbal modality respectively.

In addition to the exploration of evidence for field dependence – field independence, of a spatial and/or verbal nature, within different school subjects that are incorporated within aspects of learning and teaching, other 'tests' were used. These 'tests' were used within the Thesis to explore how field dependence – field independence relates to other cognitive styles or dimensions, e.g. wholistic-analytic and verbaliser-imager (Study 4); and additional psychological attributes e.g. analytic skills, ability/intelligence, memory, and personality traits and characteristics, and how these in turn relate to aspects of learning and teaching within different school subjects.

However, even if there were more of the same school subjects for each Study, the results of comparing scores from these with scores from the other 'tests' used, in each Study, especially in relation to the EST3, SWT2 and NSWT1, would have to be viewed with caution because the scores for any subject that was the same would have come from four different schools and teachers. Obviously, the variables inherent in such a situation would be extremely difficult to attempt to control.

The only school subject present within each Study was that of Modern Language (French); with General Science present in Studies 1, 3 and 4; and English, Mathematics, History, and Geography, present in Studies 3 and 4.

14.8 Gender Differences and Similarities

Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); and Non-Sense Word Test, Version One (NSWT1) from Studies 1, 2, 3 and 4 / School Subjects from Studies 1, 2, 3 and 4 /Gestalt Picture Completion Test (GPCT) from Studies 3 and 4.

The 'tests' that occurred in each of the four Studies were the EST3, SWT2 and NSWT1, and in two of the Studies, the GPCT. For each of these 'tests', in their respective Studies, the raw score distribution, as well as the lowest and highest score, differed by only a few points between males and females, which was the same for the majority of the other 'tests'. Where differences in the raw score distribution did occur between males and females, within the four Studies, with some of the 'tests', the females achieved a higher level of scoring, i.e. a higher score achieved by more females than males. This occurred in Study 1 for the SWT2 and NSWT1; in Studies 2 and 3 for the EST3; and Study 4 for the NSWT1, (See Studies 1, 2, 3 and 4 for further details).

14.9 Conclusion

A comparison of the outcomes from each of the four Studies has revealed a high level of reliability and validity for the EST3, SWT2 and NSWT1. This in turn has enabled each of these 'tests' to be used with an increasing number of additional 'tests', school (as well as GCSE) subjects from Study 1 through to Study 4.

Of particular interest has been the performance of the NSWT1 and the outcomes that have been produced between it and several other 'tests' and school subjects. Since the NSWT1 is arguably a 'test' that is not fully spatial, in a geometrical sense, or verbal in a word sense, it offers an interface between the two. Therefore, this could present the opportunity to further explore the role of field dependency – field independency across the range of subjects within the school curriculum, which require a mixture of spatial and verbal ability. This perhaps suggests that the NSWT1 could become the forerunner of a multi-modality, field dependent – field independent 'test' which could also have a predictive role with regards to level of analytical ability in different school subjects.

The following Tables for Studies 1, 2, 3 and 4 indicate a high (H) or a low (L) mean score for males and females in relation to a 'test', 'test' sub-category, school or GCSE subjects (variables). Also, the interactions between these variables are indicated as 'no interaction', 'partial/no interaction' or 'interaction'.

Table 14.12 MANOVA Interactions between EST3 and the Variables of Study1

Variable	Male		Female		Level of Interaction across EST3 Groups
	H	**L**	**H**	**L**	
SWT2		*	*		No interaction
NSWT1		*	*		No interaction
Science (General)		*	*		No interaction
Mod. Lang French	*			*	Interaction

Table 14.13 MANOVA Interactions between EST3 and the Variables of Study 2

Variable	Male		Female		Level of Interaction across EST3 Groups
	H	**L**	**H**	**L**	
SWT2		*	*		No interaction
NSWT1		*	*		No interaction
Mod. Lang French		*	*		No interaction

Table 14.14 MANOVA Interactions between EST3 and the Variables of Study 3

Variable	Male		Female		Level of Interaction across EST3 Groups
	H	**L**	**H**	**L**	
SWT2		*	*		No interaction
NSWT1		*	*		No interaction
GPCT	*			*	No interaction
COIT A		*	*		Partial/no interaction
COIT B	*		*		Interaction
COIT S		*	*		Interaction
COIT T	*			*	No interaction
School Subjects					
English (Lit/Lang)		*	*		Partial/no interaction
Mathematics		*	*		Partial/no interaction
Science (General)		*	*		Partial/no interaction
History		*	*		Partial/no interaction
Geography		*	*		Partial/no interaction
D and T (Product)		*	*		Interaction
D and T (Food)		*	*		Partial/no interaction
Religious Ed		*	*		No interaction
Art		*	*		Interaction
Music		*	*		Interaction
Mod Lang - French		*	*		No Interaction
GCSE Subjects					
English Language		*	*		Interaction
English Literature		*	*		No interaction
Mathematics		*	*		Interaction
Science (General)		*	*		Interaction
Geography		*	*		Interaction

Table 14.15 MANOVA Interactions between EST3 and the Variables of Study 4

Variables	Male		Female		Level of Interaction across EST3 Groups
	H	**L**	**H**	**L**	
SWT2		*	*		No interaction
NSWT1		*	*		No interaction
GPCT	*			*	No interaction
Recall of Digits		*	*		Partial/no interaction
Similarities		*	*		Partial/no interaction
Matrices		*	*		Interaction
Speed of Info. Proc		*	*		Interaction
IQ		*	*		Partial/no interaction
W/A	*			*	Partial/no interaction
V/I	*			*	Partial/no interaction
School Subjects					
English (Lit/Lang)	*			*	Partial/no interaction
Mathematics	*			*	Partial/no interaction/ interaction
Science (General)	*			*	Partial/no interaction/ interaction
History	*		*		Interaction
Geography	*		*		Interaction
Mod Lang - French	*		*		Interaction

The magnitude of the partial and full interactions can be found for each of the Studies, in Sections 10.4 i), 11.4 i), 12.4 i) and 13.4 i), Discussion and Conclusion, respectively.

The comparison of the EST3, SWT2 and NSWT1 with the GEFT (See Section 14.5 of this chapter) produced very encouraging results via the Cronbach Alpha values obtained, by giving indications that the EST3, in particular, is able to measure field dependence – field independence to a higher level of accuracy than the GEFT, giving a positive answer to research question one. The absence of a working memory factor for the completion of the EST3 is possibly the most important reason for the difference. This requires further investigation to establish certainty.

The EST3, SWT2 and NSWT1 all require further application, investigation and development (See Chapter 15), to enable a more detailed understanding of the cognitive components inherent in, and the measurement of, field dependency – field independency.

Chapter 15

Further Developments of the Embedded Shapes Test, Version Three (EST3); Sense Word Test, Version Two (SWT2); Non-Sense Word Test, Version One (NSWT1); and Chronological Order Integration Test (COIT)

15.1 Introduction

General Comments

Although each of the original instruments used in the Pilot and Experimental Studies of this thesis, namely the Embedded Shapes Test (EST); Sense Word Test (SWT); and Non-Sense Word Test (NSWT) are at different stages of development, each has a capacity for further development. This situation also applies to the Chronological Order Integration Test (COIT). The objective for further development of each of these instruments would be to increase their sensitivity to measure field dependence – field independence in both spatial (EST) and verbal (SWT, NSWT and COIT) modality.

In terms of a verbal modality, the measurement of field dependence – field independence, can be further explored by the use of words, and simple sentences within complex sentences.

15.2 Embedded Shapes Test, Version 3 (EST3)

In its final form, for the purpose of this thesis, the Embedded Shapes Test consisted of a Worked Example Section of four test items/questions, a Practice Section of four test items/questions; and a Response Section of thirty-two test items/questions, all of which (test items/questions in each section) consisted of two-dimensional complex and simple shapes.

While retaining the basic format of the EST with its three sections, the complexity of the test items/questions could be increased by using only three-dimensional complex and simple shapes; a combination of two and three dimensional shapes for the test items/questions, i.e. some test items/questions having two dimensional complex and simple shapes, and others having three dimensional complex and simple shapes, or possibly more test items/questions with a corresponding allocation of time for completion, i.e. either in proportion to that for the completion of the Response Section within the EST3, or the establishment of a time period for the completion of different test items/questions within a new Response Section of a new version of the EST.

There are many possibilities of increasing the sensitivity and accuracy of measuring field dependence – field independence, using a spatial modality, in addition to the EST3 as Table 15.1 shows.

Table 15.1 Possible Variations in Sequence and Variety of both the Complex and Simple Shapes used in any Embedded Shapes Test

Sequence of test items/questions	**Complex Shapes**	**Simple Shapes**
Logical progression/ following set rules	Two Dimensions (EST3)	Two Dimensions (EST3)
Logical progression/ following set rules	Three Dimensions	Three Dimensions
Logical progression/ following set rules	Combination of Two and Three Dimensions	Combination of Two and Three Dimensions
Random/Miscellaneous	Two Dimensions	Two Dimensions
Random/Miscellaneous	Three Dimensions	Three Dimensions
Random/Miscellaneous	Combination of Two and Three Dimensions	Combination of Two and Three Dimensions
Random/Miscellaneous	Two Dimensions Three Dimensions	Three Dimensions (contained in two dimensional complex shape) Two Dimensions (contained in three dimensional complex shape)
(It is possible for a two dimensional complex shape to contain a three dimensional simple shape and vice versa (Witkin et al, 1971; Pearson, 1981).)		

Miscellaneous equates to a range of triangles, quadrilaterals, polygons and circles for two dimensional complex shapes; and a range of prisms, cones, 'L' and 'H/I' shapes, wedges and blocks for three dimensional complex shapes; either singular or in combinations for both two and three dimensional categories.

With all of the above arrangements and combinations, including the EST3, additional lines can be incorporated into the complex shapes, two or three dimensions, to increase the Gestalt or masking of the simple shape, two or three dimensions, within the complex shape, so as to distract the testee in his/her attempt to locate or disembed the simple shape within the complex shape.

To achieve the same objective to the above, coloured shading or colours, could be incorporated into the complex shapes, two or three dimensions.

Additional lines, coloured shading or colour could also be used on all or selected complex shapes, two or three dimensions, to provide a logical progression following a set of rules, or used in a random manner. An alternative would be to use additional lines, coloured shading or colours only on selective complex shapes, two or three dimensions.

For a logical progression, following a set of rules, to be established for three dimensional shapes, a particular three dimensional shape would have to be selected initially and a set of rules generated to take account of the number (quantity) of the chosen three dimensional shape, to be used their initial angle to the horizontal place and orientation to it, i.e. right or left, and the magnitude of the angle for subsequent rotations.

Therefore, a cube would provide the simplest three dimensional shape with which to build a series of complex shapes, i.e. one, two, three or four, and possibly more, although after four cubes, the potential number of lines involved becomes very complex, since each cube in a given combination would be shown in a transparent form, i.e. all sides of each of the cubes would be shown.

A similar set of rules, to provide a logical progression for a series of complex, three dimensional shapes, could be used to those formulated for the development of the EST3, in terms of the number of cubes, magnitude of an angle of rotation, number of rotations, and the initial direction of rotation, i.e. clockwise or anti clockwise.

Consequently, if a three cube arrangement was used, with two cubes lying on the horizontal plane and one cube positioned directly over the cube to the left, with all three cubes touching each other, this could then be rotated in a clockwise direction, through angle intervals of thirty degrees, to produce twelve (the first would be equal to the last, i.e. No1 would be equal to No12) different connotations of this three cube arrangement.
This in turn would give effectively, twelve complex shapes of three dimensions, and as with the EST3, a different simple shape of three dimensions, would be required to be located and disembedded from each of the complex shapes (orientations) of three dimensions.

To generate more three dimensional complex and simple shapes with a three cube arrangement, one of the cubes could be rearranged so that it overlapped the other two. The resulting new arrangement could then be rotated in a clockwise direction, through angle intervals of thirty degrees to produce twelve, (the first would be equivalent to the last, i.e. No1 would be equal to No 12) different orientations of the over-lapping three cube arrangement. This would be similar to the three cubes touching arrangement, but a different (new) three dimensional simple shape would be required to be located and disembedded from each of the three dimensional complex shapes (orientations) generated.

To generate more test items/questions of three dimensional complex and simple shapes, four cubes could be used. First the four cubes could be arranged to touch each other, with two cubes positioned on the horizontal plane, one cube positioned on top of the left hand cube and the other cube positioned underneath the right hand cube. This touching four cube arrangement could be altered to produce an over-lapping configuration of the four cubes by re-positioning the top and bottom cube to a position half way between each of the two cubes positioned on the horizontal plane.

Both of the four cube arrangements, touching and over-lapping, could then be rotated in a clockwise direction (independently one after the other), through angle intervals of thirty degrees to produce twelve touching (the first would be equivalent to the last, i.e. No1 would be equal to No12) and twelve over-lapping (the first would be equivalent to the last, i.e. No 1 would be equal to No12) three dimensional complex figures with inherent three dimensional simple figures. For each of the three dimensional four cubes touching and over-lapping, complex shapes, a different three dimensional simple shape would be allocated, to be located and disembedded by the testee.

Therefore, an Embedded Shapes Test consisting of twelve different orientations of three touching and three over-lapping cubes; and four touching cubes, and four over-lapping cubes; would give a total of forty-eight, three dimensional complex shapes or test items/questions. In addition, all of these complex shapes would have been generated in a logical manner using the rules of orientation in a clockwise direction, in increments of thirty degrees, to get back to the initial (starting) position of each of the four basic configurations.

As with the EST3, each simple shape would be placed by the side of the complex shape for each test item/question, in an Embedded Shapes Test having three dimensional complex and simple shapes, although the orientation of the simple to the complex shape would not necessarily be the same, and there could be several possible locations of the simple shape within the complex shape for some test items/questions (this could be due to the characteristics of a particular complex and/or simple shape and not as an intentional objective).

The overall ‘test’ format for an additional version of the EST3, i.e. a version consisting of three dimensional complex and simple figures, as described above, would remain the same, i.e. Worked Examples Section, Practice section and Response Section. Also, the test items/questions included in the Worked Examples Section and the Practice Section would be representative of the test items/questions contained in the Response Section, but each simple shape used in each of these sections would be different to any used from any test item/question in the Response Section. With regard to the order or numerical sequence of the test items/questions in the Response Section, this would be ascertained by a pilot study or possible studies to verify the level of difficulty experienced by testees, i.e. the more difficult test items/questions placed towards the end of the EST.

With the development of an EST having three dimensional complex and simple shapes, a situation may arise whereby the test items/questions in the Practice Section could be followed in a numerical progression by the test items/questions in the Response Section (although the Practice Section test items/questions would not be taken into account for the measure of field dependence – field independence purposes), depending upon the analysis from a pilot study or studies, as was the case with the EST3.

An unpublished study (Pearson, 1981) included an original Group Embedded Shapes Test that used a random arrangement of two and three dimensional complex shapes as well as a random arrangement of two and three dimensional simple shapes. The test items/questions did not all have a corresponding two dimensional simple shape to a two dimensional complex shape, or a three dimensional simple shape to a three dimensional complex shape, i.e. with some test items/questions there was a two dimensional simple shape allocated to a three dimensional complex shape and vice versa. This Group Embedded Shapes Test (GEST) (Pearson, 1981) consisted of all of its test items/questions arranged in a Response Section.

This particular Group Embedded Shapes Test (GEST, Pearson) was administered to a sample of 25, Year 8 students (13 males and 12 females), together with the Group Embedded Figures Test (GEFT) (Witkin et al, 1971). Analysis of the outcomes from each of these ‘tests’ (both of which had twenty-five test items/questions) gave a correlation value of 0.72 for the sample and 0.71 for the males and 0.76 for the females; and a field dependence – field independence distribution of 7 to 21 in terms of the raw scores, which were distributed within this range.

A Computer Produced Version of the EST3

The EST3 is currently in the process of being formulated for computer presentation.

This will enable the time for the Response Section (C) to be very accurately recorded, as well as the Practice Section (B), and if necessary, the time required to study the Worked Examples Section (A), and individual test items/questions in any of the three sections.

A computer presentation of the EST3 also allows the possibility of 'feedback' to the testee, whether or not they have achieved an acceptable answer to each test item/question as they proceed from one to the other in both the Practice (B) and Response (C) sections.

It is also the intention of a computer presentation of the EST3 to enable the testee to locate the simple shape within the complex shape, of each test item/question, by blocking or filling it in, which would eliminate the necessity for the testee to draw around it. This would remove the need for well developed fine motor skills to accurately draw around the simple shape within the complex shape.

Therefore, a range of additional information could be obtained from a computer presentation of the EST3.

These would include:

1. A variety of time measurements

2. Feedback to testees during and after the completion of the EST3.

3. A record of the number of attempts at the completion of any test item/question

4. An invitation for the testee to offer questions about their reactions to the EST3 and any comments they would wish to make.

Such information could give insight into the testee's approach to the EST3, mode of thinking and analytical skills.

A combination of quantitative and qualitative evidence would be feasible from a computer presentation of the EST3. This could enable additional information to be related to a testee, and would allow a more accurately located position of them on the field dependence – field independence bi- polar continuum.

15.3 Sense Word Test, Version Two (SWT2)

In its final form for the purpose of this thesis, the Sense Word Test (SWT2) consisted of a Response Section of fifty test items/questions of a simple and complex combination. There was no Practice Section, but there was a Worked Example Section consisting of one simple and complex word combination.

There are a range of possible additional developments to enhance and extend this ‘test’ to measure field dependence – field independence within the context of a verbal modality. These could include the following:-

1. Using longer words (number of letters) for both the simple and complex word for each test item/question combination.

2. The above categories of words could be frequently used words that form part of everyday speech and written activities for the majority of school students (Primary KS2 and Secondary KS3) and adults in general.

3. Selection of less frequently used words and/or technical/specialist words of some description, for both the simple and complex word. (The purpose of using such words in a version of the SWT is to measure of field dependence – field independence, i.e. can the testee disembed a simple word contained in a complex word, and not the familiarity or understanding of the complex word (or simple word) on the part of testees).

4. Considerations of phonetic and/or syllabic characteristics in the selection of the complex word and/or simple word.

5. The number of test items/questions (combinations of simple and complex words) to be presented and attempted within a given time.

6. Different word types, i.e. frequently used and technical/specialist words could be used either on an alternating basis from one test item/question to the other or in alternating blocks of five test items/question within the overall Response Section of a SWT.

7. Complex words could be chosen solely on the basis that they contain two simple words. So with this arrangement the task for the testee would be to disembed two (different in the vast majority of cases for each of the test items/questions) simple words from the complex word. Such a disembedding task would give the opportunity for the reward of two points from each test item/question. However, it may prove difficult to select sufficient, appropriate words to provide a complex word continuing two simple words.

8. The level of difficulty to disembed a simple word from a complex word could increase from the first test item/question to the last, in a manner similar to that with the complex and simple shapes of the test items/questions of the EST3. If this were done for a version of the SWT, it would be done so by using the same procedure, i.e. via a pilot(s) study, as that for the EST3. This procedure could also provide a link, in terms of increasing the difficulty of the test items/questions between a Practice Section and a Response Section.

9. Whatever the type of words selected to form the simple and complex word combination for each of the test items/questions, a major influencing factor to the measurement of field dependence – field independence, is the amount of time allocated for their completion within any version of the SWT. Therefore, the magnitude of an allocated time period, and the derivation of it, in relation to the completion of any version of the SWT, is very important.

10. A further major consideration is the presentation format of the SWT, in terms of how many sections it might have, i.e. Worked Examples, Practice and Response Section, and the space provided between each test item/question and within each test item/question between the simple and complex word. Also perhaps, a double spacing between each letter of the complex word would allow the drawing around the letters that constitute the simple word to be performed a little easier and provide an accurate (unambiguous)indication of the simple word within the complex word.

15.4 Non-Sense Word Test, Version One (NSWT1)

In its final form for the purpose of this thesis, the Non-Sense Word Test (NSWT1) consisted of a Response Section of fifty test items/questions of a simple and complex word (collection of letters for both the simple and complex) combination. There was no Practice Section, but there was a Worked Example Section consisting of one simple and complex word (collection of letters) combination.

There are a range of possible additional developments to enhance and extend this ‘test’ to measure field dependence – field independence within the context of a verbal modality.

All of the possible additional developments cited above i.e. 1 to 10, for the Sense Word Test (SWT2) could be applied to the Non-Sense Word Test (NSWT1) with the addition of :-

1. Randomly generated collections of letters, to form the complex word/letters and the simple word/letters, would remove a degree of restriction in the selection of the complex word/letters and the resulting simple word/letters. By randomly generating collections of letters, the removal of vowels from the selected complex words/letters would be optional because the resulting complex words/letters would probably have or no semantic meaning.

2. The provision of a letter-size space between each letter of both the complex word/letters and the simple word/letters, could make the task of locating and disembedding the simple word/letters within the complex word/letters more difficult, but it would have to be verified through a pilot/experimental study.

   This arrangement would enable the drawing around the disembedded word/collection of letters easier to do and mark.
   However, the randomly generated collection of letters would produce a complex word/letters for each test item/question which is further removed from real words. This would produce a complex word/letters that is arguably less verbal (more so in the original version of the Non-Sense Word Test (NWST1) and more spatial, with any suggestion of phonics and semantics removed, leaving a collection of shapes, albeit letter shapes.

15.5 Sense and Non-Sense Sentences

An alternative to the measurement of field dependence – field independence, using a verbal modality, would be to use a similar approach to that of sense words (SWT2) and non-sense words (NSWT1) via the use of sentences. The same basic methodology would be used, but several sense words or non-sense words (collection of letters) would be required to be disembedded from each of the two different types of sentences.

With ‘sense sentences’ the sentence would form the equivalent of a complex word and different simple words would be required to be disembedded from a number of the words within the sentence.

An example of a ‘Sense Sentence Test’ using the above approach would be as follows:-

1. The car travelled down the road at a very fast speed.

led rave own

(See Appendix N for further examples)

The testees would be required to locate or disembed some of the small (simple equivalent) words within the Sense Sentence (complex equivalent) by drawing a circle around them.

It can be seen from the above format of a possible 'Sense Sentence Test' that more than one 'simple word' can be contained within some words of a given sentence, and for the complete 'test' many words would have to be disembedded for it to be completed.

The simple words would be presented in a different order in a 'test booklet', to where they are in the sentence. This would add a further difficulty to the disembedding task.

If the gap between each of the words in the sentence were removed, the task of locating and disembedding the 'simple words' would become more difficult.

The number of words per sentence and the total number of words for the complete test, as well as the allocation of a time period for its completion, would have to be verified through a pilot/experimental study.

In a similar way, a Non-Sense Sentence Test could be formulated, that incorporated a number of 'non-sense sentences' which would have had the vowels removed from each word within each of them and the spaces removed between each word. Therefore, the resulting 'non-sense sentences' would be the equivalent of a 'non-sense complex word' (large collection of letters) and different 'non-sense simple words' (small collections of letters) would be required to be disembedded from each of the test items/questions.

An example of a 'Non-Sense Sentence Test', using the above approach would be as follows:-

1. The trees of the forest display a variety of colours
   (Th trs f th frst dsply vrty f clrs)
   Thtrsfthfrstdsplyvrtyfclrs

   hfr yfcl tds vr

(See Appendix O for further examples)

The testees would be required to locate or disembed the small collection of letters (simple equivalent) within the 'Non-Sense Sentence' (complex equivalent) by drawing a circle around them.

As with the 'Sense Sentence Test', the 'Non-Sense Sentence Test' can have more than one simple word (collection of letters) contained within the words (collection of letters) of a given sentence, and for the complete 'test' many words (collection of letters) would have to be disembedded for it to be completed.

Each simple word (collection of letters) would be presented in a different order in a 'test booklet', to where they are in the complex sentence (row of letters). This would add a further difficulty to the disembedding task.

The gap between each of the small collection of letters would require to be removed, so as to present a credible level of difficulty for each test item/question.
The number of words per sentence and the total number of words for the complete test, as well as the allocation of a time period for its completion, would have to be verified through a pilot/experimental study.

The sentences used for a 'Non-Sense Sentence Test' would be different from those used for the 'Sense Sentence Test', to reduce a possible practice effect. In addition, capital letters have been retained in each type of sentence and where they occur in the simple words or small collection of letter, to be located /disembedded.

The scores from each of these two 'tests' (Sense and Non-Sense Sentence Tests) could either be used separately or as a combination (this could also apply to the 'Sense Word Test' (SWT2) and the 'Non-Sense Word Test' (NSWT1)) to place an individual on the bi-polar field dependent – field independent continuum from the context of a verbal perspective.

Arguably, the use of sentences instead of words (sense and non-sense in both cases) especially 'sense sentences'; are more realistic in relation to written work, in statutory, further and higher education, because the perceptual and analytical skills involved in disembedding words from words or collection of letters from collection of letters, are inherent in written work in terms of the spelling of words and the construction of sentences.

15.6 Complex and Simple Sentences

A further variation of the measurement of field dependence – field independence within the context of verbal modality, could be the disembedding of a number of factors from either a simple or complex sentence, or two or three simple sentences, to answer a question related to the information contained in either the complex sentence or simple sentences.

This formulation possibly offers an insight into how a field dependence- field independence propensity might relate to the comprehension of written information.

Examples of complex and simple sentences and their allocated questions are as follows:-

Complex Sentences

1. It was the threat of invasion after the defeat of the Allied armies in the Spring of 1940 that resulted in the formation of the Local Defence Volunteers, later known as the Home Guard.

   Why were the Local Defence Volunteers formed?

(See Appendix P for further examples)

Simple Sentences

1. The scientist makes discoveries but has little say in their applications. This is usually the province of politicians, governments and industrialists. Such applications may be used to benefit or exterminate a community.

   Who are the people that make decisions regarding the uses of scientific discoveries?

(See Appendix Q for further examples)

Therefore, a ‘test’ incorporating complex or simple questions or a combination of the two could be formulated, and the scoring could consist of one point for each fact successfully disembedded, from either complex or simple sentences, and used in the answer to their respective questions.

The total score would designate a position on the bi-polar field dependence – field independence continuum, i.e. a high numerical score could indicate a propensity for field independency and a low score for field dependency.

A major difference between this mode of field dependent – field independent measurement, in comparison with the Sense Word Test (SWT2); Non-Sense Word Test (NSWT1); Proposed Sense Sentence Test; and Proposed Non-Sense Sentence Test, would be the increased reading (accuracy and comprehension) and written (spelling and sentence construction) skills. However, this potential difficulty could be reduced or overcome by selective administration of such a measurement of field dependence – field independence within a verbal context.

The source of the material to produce the complex or simple sentences would either be created or taken from a book (fiction or non-fiction) which could be associated with a particular course of study. If the source of the material is related to a given course of study, such a measurement/assessment advocated by this approach, could help to develop and enhance the understanding of the material from a given course on the part of the students, and the study skills of the students involved. In addition, it could enable the teacher to arrange teaching and learning approaches and materials to meet the field dependency – field independency designation of the testees/students.

The time allocated to complete either the Complex Sentence Test or the Simple Sentence Test would be established via a pilot study, as would the number of test items/questions, the number of items to be disembedded, and the method of scoring.
An additional consideration with this idea of using complex and simple sentences for the measurement of field dependence – field independence, would be the level of the complexity of the subject matter of both types of sentence, particularly the complex sentences, i.e. ensuring that the subject matter and level of information processing, was appropriate to the key stage/age of the testees/students.

15.7 Chronological Order Integration Test (COIT)

In its current form, as described and applied in their thesis, the Chronological Order Integration Test (COIT) consists of a series of historical facts in chronological order, which represents the life and work of David Livingstone. Each of the facts are numbered in sequential order and the odd and even numbers used to formulate two different Passages A and B. The objective of this 'test' requires the testee to combine the two sets of facts into a continuous chronological order after hearing the two passages separately with an interval of time (one day as a minimum) in between. The designation of field dependency or field independency is achieved by the degree to which the two sets of facts can be integrated i.e. a number of facts from Passages A and B presented separately whether or not in chronological order within each passage, gives a designation of field dependency; and a number of facts from Passages A and B presented in chronological order, gives a designation of field independency, to give a full account of the life and work of David Livingstone.

The facts for both Passages A and B are presented (read out) to the testees in sentence form, and is heard by the testees as a continuous passage of prose for both Passages A and B.

A number of modifications could be made to the Chronological Order Integration Test to enable it to measure field dependency – field independency more accurately within a verbal context related to the segmented arrangement of process of information.

This might be achieved by a detailed consideration of the following:-

1. The composition of each passage in terms of the range and complexity of the vocabulary; the concepts used and their level of complexity; the number of facts; the sentence construction used; and the length of the sentences, in relation to the number of words (ideally both Passages A and B should have the same number of words).

2. The presentation of each passage by the administrator to the testees in terms of the clarity and diction (audible clear voice), phrasing and appropriate expression.

3. The time period between the reading of Passage A, Passage B and the execution of the written account of Passages A and B on the part of the testees.

4. Taking into account a memory factor, an assessment of audible short term working memory and possibly intermediate memory skills of the testees, immediately before (perhaps the day before) the reading of Passage A, would need to be administered. This gives the possibility of a compensation or adjustment factor to be applied to the testees that have remembered very few facts from both Passages A and B, even though they may have integrated them into a chronological order.
   Such a consideration has implications for the designation of testees as either low or high field independency and high or low field dependency in relation to the number of facts remembered (from A and B) and integrated, i.e. four integrated facts is less than eight integrated facts and a subsequent allocation on the field dependence – field independence bi-polar continuum.

5. The above analysis of the COIT and the possibility of the application of a compensation or adjustment factor pose a dilemma as follows:-

Should a testee who has remembered a lot of facts from Passages A and B and integrated them into chronological order, be deemed to be more field independent than a testee who has remembered a few facts from Passages A and B and integrated them into chronological order?

If used, a compensation or adjustment factor could provide a measure of parity between a large and small number of integrations between facts from Passage A and B, which would relate to an increased accuracy in the measurement of field dependence – field independence, i.e. placement on its bi-polar continuum.

In Study Three, where the Chronological Order Integration Test was used, the various statistical analyses compared the number of facts remembered from Passage A, and Passage B separately, and the number of switches or changes (integrations) from Passage A to Passage B, contained in the written account from each testee. These were then compared to their performance on the EST3, SWT2 and NSWT1. Consequently, all of these measures were related to a designated level of field dependence – field independence via groups 1, 2, 3 or 4 of Study Three in terms of each 'test', males and females

.

Therefore, the proposed argument from Item 5 above, in particular, is that it is possible to improve the measurement of field dependence – field independence that the COIT can provide (in a verbal context). However, this does not mean that the measurement of field dependence – field independence provided by the COIT in its present form, as shown in Study Three, is not valid and meaningful for the purposes of this thesis.

15.8 Conclusion

For a detailed and therefore very accurate measure of field dependence – field independence, using a spatial modality, it may be necessary to use a wide range of complex and simple shapes/figures, not only in quantity but also in complexity. The use of the EST and a new version of this using three dimensional complex and simple shapes, or disembed in this chapter, could enable the above objective to be achieved. By using a two or three dimensional format for the generation of complex and simple figures (beyond the range and complexity of those used by Witkin et al, 1971, in the Group Embedded Figures Test (GEFT) via the application of the EST3 (two dimensional) and a new version of this using three dimensions, single or combined scores could be obtained which would enable individuals to be placed on the field dependent – field independent bi-polar continuum with a greater degree of accuracy.

Such a measurement and assessment of an individual's propensity to be either field dependent or field independent, could also provide a cut-off point from one to the other, because measuring field dependent – field independence using a wide range of tasks with both two and three dimensions, is arguably more realistic to an individual's interactions with real world events on a daily basis.

However, the measurement of field dependence – field independence should not be restricted to a spatial modality alone as referred to above. Of equal validity and importance is the measurement of field dependence – field independence using a verbal modality. Therefore, through the application of the different ways of measuring field dependence – field independence using a verbal modality, as advocated and presented in this thesis, i.e. SWT2, NSWT1and COIT; and the ideas for their further development together with some additional ideas for the measurement of field dependence – field independence, using a spatial modality, as stated in this chapter, field dependence – field independence can be measured across a wider spectrum of cognitive attributes, and with an increased level of accuracy. This in turn may help to establish whether or not field dependence – field independence is context specific, in relation to perceptual and spatial ability.

Chapter 16

Conclusions of the Overall Thesis; the Uniqueness of Field Dependence – Field Independence; the Future of Field Dependence – Field Independence and Cognitive/Learning Styles (Intellectual Styles).

16.1 Introduction

An attempt has been made within this thesis to explore the bi-polar construct of field dependence – field independence in additional detail to that of Witkin et al (1962) in terms of a spatial modality, as well as original exploration of the notion of field dependence – field independence in terms of a verbal modality.

The question as to the exact nature of field dependence – field independence, whether it is a bi-polar or uni-polar construct, how it can be measured and is it inherent in cognitive (spatial and verbal) and social interactions, remains to a certain extent, an open one. In common with all measurements of human abilities and individual differences, it is not without its difficulties from the perspective of its conception and methodology of measurement.

In the field of cognitive styles and learning styles and strategies (Intellectual Styles), field dependence – field independence has a unique history, and has become a focal point for continuing research into its characteristics and possible applications to the processes of learning and teaching.

16.2 Conclusions of the Overall Thesis

The theme of this thesis has been the measurement of field dependence – field independence in the context of both a spatial and verbal modality; and in the case of spatial modality, the development of a more accurate way of measuring field dependency – field independency. By measuring field dependency – field independency using both a spatial and verbal modality, a more precise designation of field dependent – field independent can be achieved.

The work of Witkin et al (1962, 1971,1979) in relation to the formulation of the concept of field dependence – field independence and the categorisation of it as a cognitive style, has produced a fundamental corner stone from which one of the major elements of this thesis has been produced, namely the Embedded Shapes Test (EST3, in its current form). Both the Group Embedded Figures Test (GEFT) (Witkin et al, 1971) and the Embedded Shapes Test

(EST3) (Pearson, 1994, 1998, 2008 and 2009) measure field dependence – field independence from a spatial perspective, using geometrical figures and shapes respectively.

However, there has been no attempt in the work of Witkin et al, and other researchers, to investigate the concept of field dependence – field independence from a verbal perspective, by using letters, words or text. This situation has been addressed within this thesis by the conception and development of the Sense Word Test (SWT) and the Non-Sense Word Test (NSWT) (Chapter 6). In addition to 'these tests', the Chronological Order Integration Test (COIT) (Riding et al, 1989; Riding and Pearson, 1990) has also been used (Chapter 12, Study Three).

Although a definition of field dependence - field independence can be considered in terms of the ability of an individual to disembed a given element from a given context or contextual field, whether the element is a geometrical shape within a geometrical shape, or a word within a word or sentence, such a definition says nothing about the neurological or cognitive processes involved. This situation is further compounded by some researchers (Carroll, 1993) questioning the basic concept of field dependence – field independence as a cognitive style, preferring to categorise it as a measure of general ability related to a manifestation of Cattell's crystallised intelligence, (Cattell, 1967).

Many researchers would argue that there is a strong perceptual ability factor present in the measurement of field dependence – field independence for any individual, whether neuro-typical or autistic (unless at a generally dysfunctional level at one extreme of the Autistic Spectrum Difficulties (ASD) continuum) (Frith and Happé, 2006), but the extent to which perceptual ability is related to general ability remains an open question.

This question can be taken a stage further by posing the supplementary question 'Is perceptual ability applied to a spatial context, the same as that applied to a verbal context?', i.e. the manipulation of geometrical shapes and the manipulation of words and letters. These are important questions for the processes of learning and teaching, as well as for the idea of different styles (cognitive styles) adopted spontaneously and naturally by learners (at all levels) and teachers.
It is possible that whatever the level of perceptual ability, on the part of the individual, it transcends itself into an adopted cognitive style of the learner, which is applicable to both a

spatial and verbal context. The strength of this, i.e. perceptual ability, in relation to spatial or verbal information, gives a propensity for a style preference, i.e. spatial/imager or verbal.

The relationship of a general ability factor to a perceptual ability factor could be explained from the point of view of stimulus and process, i.e. to one individual, spatial information is more meaningful and therefore the processing of it is done without difficulty, whereas verbal information is less meaningful and thus becomes more difficult to process, and vice versa. Dyslexics appear to fall into this particular inter-connection/interplay between stimulus and process (Mortimer, 2009).

Therefore, the measurement of field dependence – field independence, using both spatial and verbal modalities could prove to be useful diagnostic instruments for a number of learning issues (Special Educational Needs and Non-Special Educational Needs), as well as a refinement for the measurement of cognitive style, particularly field dependence – field independence, related to the adopted approach to learning and teaching.

However, it is very difficult to categorise style or define where a spatial or a verbal context starts and ends from a perceptual ability perspective. As indicated above, spatial information is usually associated with, and represented by, shapes of two dimensions and/or three dimensions, which can be found in everyday experiences, or in abstract form found in various creative designs, or in scientific or mathematical theories. Verbal information, on the other hand, is usually associated with letters, words, sentences, paragraphs and text, in the form of written language to articulate and communicate information, but the symbols of written language, i.e. letters and words, have to be perceived before they can be interpreted, understood and applied. Therefore, the perception of language symbols, like the perception of the elements or parts of a shape must first be seen within its context, while at the same time be capable of being disembedded from its context by the individual, for the full significance of its meaning to be realised by the individual.

This situation is further complicated by the fact that within a spatial context there is a wide range of variability, which may not be able to be dissected into a defined difference between perceptual ability and spatial ability. The different types of measurements used in the Studies of the Thesis appear to support such a possibility, i.e. they could be/are considered to be measures of perceptual ability in the general domain of spatial attribution skills, and could be/are considered to be measures of spatial ability.

Also, a verbal context can at times become difficult to define as either verbal or spatial as in the case of a picture and a few words, where both picture and words are symbiotic to each other, or between the SWT and the NSWT (as described in Chapter 6 and Chapter 7). Comparisons between the SWT and the NSWT in relation to their designated modality of verbal, need to be viewed differently, i.e. the SWT test items/questions have semantic meaning because they contain real words, whereas the NSWT test items/questions have collections of letters containing no words, and therefore, have no semantic meaning and so are presented as a collection of shapes, albeit letter shapes.

The above considerations related to the process of measuring field dependence – field independence, in a spatial context, is not always easy to achieve, especially if there are additional cognitive skills or abilities that have to be practiced simultaneously with a perceptual skill or ability. This is exactly what happens when an individual completes the Group Embedded Figures Test (GEFT) and more so with the completion of the Embedded Figures Test (EFT) (Witkin et al, 1962, 1971). As described in Chapter 6, the Embedded Shapes Test (EST) overcomes this problem or additional difficulty for the testee.

Therefore, the measurement of field dependence – field independence, as measured by the EST3, is focusing upon the application of the perceptual ability of the testee and not linking it with a memory ability, producing a greater degree of accuracy to that produced by the GEFT. This difference, as one of the major differences between the EST and the GEFT, is investigated statistically, described and discussed in Chapter 14, Section 14.5, yielding a Cronbach Alpha reliability value of 0.93544 for the EST, compared to 0.89234 for the GEFT. Such a result gives an affirmative answer to the first research question of :-
Is it possible to produce a more sensitive and therefore more accurate measurement of field dependence – field independence using a spatial modality?
The importance of memory, i.e. short term working memory, associated with cognitive tasks as discussed in Chapter 3, Field Dependence – Field Independence and Associated Cognitive and Psychological Attributes, Section 3.6, is a crucial component related to the successful completion of embedded figure (EFT and GEFT) or shape (EST) tests. If the memory component can be reduced or eliminated, then the first research question can be answered positively, i.e. field dependence – field independence can be measured with a greater degree of accuracy.

The second research question of :-
Is it possible to measure field dependence – field independence using a verbal modality?,
has also been addressed through the application of SWT, NSWT, and COIT, Chapters 10 to 13; Studies 1 to 4 for the SWT2 and the NSWT1 and Study 3 for the COIT. Results and analysis from Studies 1 to 4 have produced high Cronbach Alpha reliability values, i.e. from 0.89441 to 0.93799 for the SWT2 and from 0.88725 to 0.94493 for NSWT1, as shown in Chapter 14, Comparisons of Studies 1 to 4, Section 14.4.

However, no measurement is ever perfect and without the desirability for improvement, and in relation to the concept, or aspects of the concept, that is being measured, as well as the instrument that performs the measurement. Consequently, Chapter 15, Further Developments of the EST3, SWT2 and NSWT1, Sections 15.2, 15.3, 15.4, and 15.7, explores and describes possible ways of improving and extending the measurement of field dependence – field independence through the EST3, SWT2, NSWT1 and the COIT. The striving for an improvement in and an extension of the measurement of field dependence – field independence is not only to add to the understanding of field dependence – field independence itself, in terms of its theoretical concept, but also its application to learning and teaching, whether it is used under the name of cognitive style (Witkin et al, 1977); cognitive control (Jonassen and Grabowski, 1993);or by a different name, (yet to be invented) with direct neurological overtones (Riding, Glass and Douglas, 1993; Kozhevnikov, 2011).

The third research question of :-
Is it possible to show a relationship between the measurements of field dependence – field independence, ability and attainment in school subjects?,
poses two questions, i.e. Is there a possible relationship between field dependence and field independence and ability?; and, Is there a possible relationship between field dependence and field independence and attainment in school subjects?.
In an attempt to answer the first of the above questions, the British Ability Scales (BAS1) Short Form IQ (Elliott et al, 1978) was used. This consisted of a measure of memory (Recall of digits), verbal reasoning (Similarities), non-verbal reasoning (Matrices), and speed of working (Speed of Information Processing), see Chapter 13, Study 4, for the full details. The outcomes from these measures and the resulting IQ score were compared to the outcomes from the EST3, SWT2, and NSWT1. These comparisons gave correlations as shown in Table 16.1.

Table 16.1 Correlations between Recall of Digits, Similarities, Speed of Information Processing and IQ

	Recall of Digits	Similarities	Matrices	Speed of Info Processing	IQ
EST3	.2212	.3846**	.4717**	.1709	.4659**
SWT2	.1342	-.0772	.0545	.1358	.1344
NSWT1	.1127	.1497	.2793*	.1940	.2802*

2-tailed Signif: * - .01 ** - .001

These results suggest that there is a strong relationship between reasoning skills, particularly non-verbal reasoning i.e. matrices and spatial disembedding tasks, in terms of EST3.

A further investigation between field dependence – field independence (cognitive style) and IQ (including, general ability) revealed an independent relationship between the two (Riding and Pearson, 1994). Such a relationship supports the description of field dependence – field independence as a cognitive style. A cognitive style of an individual therefore, that begins with the perception (whether at a field dependent or a field independent level) of a cognitive task, and then proceeds to analyse and process the information related to the cognitive task (with a propensity that is associated with a field dependent or a field independent), will be designated as field dependent or field independent.

Therefore, on the basis of the above evidence, the perception of a given cognitive task, i.e. it is seen as a separate entity to a wider contextual field, is performed before general ability is engaged to analyse and solve the cognitive task.

It could be argued that the level of cognitive perception or perceptual ability is different between field dependence and field independence (Milne and Szczerbinski, 2009; Rittschof, 2010) and that this factor has a stronger relationship to cognitive style than it does to cognitive ability.

16.3 The Uniqueness of Field Dependence – Field Independence

Witkin et al may have taken a conceptual leap from the Rod and Frame Test (RFT) and the Body Adjustment Test (BAT) (Witkin et al, 1962) (studies in body orientation) to formulate the concept of field dependence – field independence and the subsequent extrapolation to produce the Embedded Figures Test (EFT) and the Group Embedded Figures Test (GEFT)

(1971) and their application in the assessment of individual differences. However, the concept of field dependence – field independence has encouraged much research into it as a cognitive style, relationships between other cognitive styles, and the cognitive attributes that constitute its properties and characteristics. (Witkin and Goodenough, 1986; Riding and Rayner, 1998; Jonassen and Grabowski, 1993; Zhang, Sternberg and Rayner, 2012)

In terms of a cognitive style, the bi-polar nature of field dependence – field independence relates well to other bi-polar cognitive styles, e.g. holistic and serialist (Pask, 1972), styles of thinking, e.g. convergent and divergent (Guilford, 1962; and Hudson, 1966), which form a major component in Riding and Cheema's Cognitive Style Families (1991) as well as Riding's Cognitive Style Dimensions and Cognitive Styles Analysis (CSA) (1991 and 2000),as described and discussed in Chapters 2 (Field Dependence – Field Independence); 3 (Field Dependence – Field Independence and Associated Psychological Attributes); and 4 (The Cognitive Style of Field Dependence – Field Independence and other Cognitive Styles). Field dependence – field independence also forms the basis of the two original models of cognitive behaviour, and a matrix which maps the historical development and application of cognitive styles in Chapter 7 (Further Development of Field Dependence – Field Independence).

Field dependence – field independence can also be considered to be a cognitive control or global versus articulated style, i.e. the ability of an individual to not be disproportionately influenced by a given perceptual field, which relates well to the bi-polar characteristics of field dependence – field independence, see Chapter 2, Section 2.4 i), – Related Concepts.

Witkin et al's research into field dependence – field independence and subsequent developments, also produced the idea of Psychological Differentiation (1962). This extends the application of field dependence – field independence beyond the cognitive domain to include the social domain. The basic elements of field dependence – field independence remain, i.e. the presence of different levels of perceptual ability, but perception is now manifested in inter-relationships between individuals and/or intra-relationships within the individual. Psychological Differentiation in terms of its social dimensions correlates well with Eysenck and Eysenck's personality theory of extraversion - introversion/stability - neuroticism (1975), i.e. field dependence and extraversion and field independence and introversion, see Chapters 2, 3 and 4.

Field dependence – field independence has many applications in addition to learning and teaching, and the interactions between the two, e.g. match or mismatch of the field dependence – field independence cognitive style between student and teacher, e.g. match or mis-match, and learning difficulties (Riding and Rayner, 1998); and exceptional learners (Chan, 2012). Further applications include, perception (physical, verbal and social); spatial ability (art, design and scientific activities); analytical skills(information organisation, planning and processing); computer screen presentation of information (spatial and verbal); representation of information (graphs, charts, diagrams, figures and tables) (Graff, 2000); shape recognition and orientation; clinical conditions, e.g. autism (Happé and Frith, 2006); school and university subjects choice and occupational choice (Evans and Vermunt, 2013); cultural differences (Witkin, 1967; Zhang, 2004); sex differences (Witkin, 1979); and age-related differences over time, i.e. movement of position on the field dependence – field independence continuum (Bertini et al, 1986) (See Chapter 2, Field Dependence – Field Independence for further details).

It can be seen from the wide range of applications of field dependence – field hat makes a contribution to an explanation and description (not a label) of individual differences in different contexts and situations.

16.4 Further Research in Field Dependence – Field Independence

In Chapter 15 (Further Developments of EST3, SWT2, NSWT1 and COIT) of this thesis, ideas were described and discussed for a proposed further version of the Embedded Shapes Test (EST3) to include two and three dimensional complex and simple shapes, or a version to include three dimensional complex and simple shapes only, which could be used in tandem with the EST3. In a similar manner, ideas were described and discussed to produce new versions of the Sense Word Test (SWT2) and the Non Sense Word Test (NSWT1). In addition to these proposals, further ideas were stated that would utilise the basic concept used in the SWT and NSWT but applied to sentences and paragraphs. A further variation involved simple sentences embedded in complex sentences. The Chronological Order Integration Test (COIT) was also discussed in relation to a number of ideas which could provide further versions of it.

All of the above ideas are attempts at extending the scope of measuring field dependence – field independence as well as the accuracy of its measurement in either a spatial or verbal modality.

However, it is insufficient to attempt to improve the scope and accuracy of the measurement of field dependence – field independence in isolation. It is necessary to correlate any measurement of it with a range of school subjects within the school curriculum, or subjects at further and higher education levels. This needs to be done at an initial learning and teaching level, i.e. at the start of a course or programme of study, so that individual differences, via a measurement of field dependence – field independence, and levels of perceived cognitive ability, assessed by other means, can be taken into account as part of the learning and teaching process. So, unlike some of the results from this thesis, where measurements of field dependence – field independence have been compared with attainment scores only, to ascertain whether or not there are matching characteristics between spatial or verbal field dependent – field independent tasks and particular school subjects, the above approach would be integral to the learning and teaching process at all levels of education, i.e. statutory, further and higher (Evans and Cools, 2011) from the start of a course or programme of study.

An additional requirement from such a research programme, focusing on an independent single cognitive style or a cognitive style as part of a unified model, would be for it to be administered over a period of time with the same sample of students, e.g. a particular Key Stage in Statutory Education.

Research into 'styles' as described above, has been done (Riding and Rayner, 1998; Evans and Waring, 2009), but more needs to be done for the reasons stated. With more empirical evidence, validity and reliability measurements can become self-evident and a possible comparison with the concept of falsifiability (Popper, 1959/1992/2002).

Coupled to the above approach to the process of learning and teaching would be qualitative and quantitative assessments/measurements, i.e. teacher reports and attainment/performance in school or public examinations, e.g. GCSE's, respectively. These could then be compared to direct measurements made in relation to a particular cognitive/learning style; additional cognitive attributes, e.g. memory, or non-cognitive attributes, e.g. personality type, or the different elements of a particular unified model that includes cognitive and non-cognitive attributes.

A longitudinal approach to research into cognitive/learning styles would not only provide more evidence for or against their validity and reliability, in a general sense, but also provide evidence for how the different characteristics of each school subject, or subjects, at any educational and training level, relate to the application of cognitive/learning styles. The description of this process could be reversed by considering how the learner approaches different school subjects, or the cognitive/learning style they have a propensity for. This relationship might change as the degree of complexity of a school subject increases and/or a degree of change within the individual as to their performance/propensity for a particular cognitive or learning style. There is also the additional consideration of whether or not a cognitive or learning style is context dependent (Bagley and Mallick, 1998).

The above factors reflect some of the complexity of styles research, and the variety of factors and influences that constitute individual differences, which is a multi-dimensional concept.

16.5 Further research into cognitive and learning styles (Intellectual Styles) Associated with Field Dependence – Field Independence.

Since field dependence – field independence is part of the epistemology and ontology of cognitive styles, learning styles and learning strategies (Intellectual Styles)(Zhang and Sternberg, 2006 and 2009; Zhang, Sternberg and Rayner, 2012), it is desirable to take it into account, in spite of its unique attributes, with 'styles research' in general. One of the difficulties inherent in 'styles research' is that of definition of a particular style in relation to whether or not the definition/style is referring to an isolated cognitive variable or only one facet of a wider (multi-faceted) cognitive variable which encapsulates many factors that do not have distinct boundaries of separation (Evans, Richardson and Waring, 2013). Several differently named styles in the literature are perhaps presenting different names for the same or a closely related process. An example of this could be that of global – analytic (Witkin et al, 1962) and Holist-Serialist (Pask, 1972), both of which are related to field dependency – field independency.

An additional problem with style definition and reliability is the way in which research studies have tended to focus on a particular style without comparing it in a rigorous way with other styles, although some studies have made comparisons between styles (Riding and Rayner, 1997), respectively.

A further concern is related to the practical significance of the application of cognitive and/or learning style to the process of learning and teaching (Coffield et al, 2004). While attempts at a unification of either cognitive styles (Riding and Cheema, 1991) or cognitive/learning styles (Rayner, 2000) and associated non-cognitive factors, e.g. personality characteristics/traits (Onion, 1983) and environmental factors (Dunn and Dunn, 1974), are to be welcomed.

Further detailed research is required to validate the definition of single styles and unified models to ascertain the validity and reliability of their application to the learning and teaching process, to enable adjustments to take place, i.e. the approach adopted and materials used, as the learning and teaching process proceeds. Such a proposal would need to be administered over several weeks, to at least cover the teaching and learning of a given topic within a given subject.

The same basic idea could be applied to the teaching and learning of a particular subject or several subjects over a school year. In such a situation, the subject chosen could reflect field dependent – field independent characteristics in relation to a greater dominance of a spatial or verbal modality, e.g. Art, Design and Technology, Science, Geography and English Language and Literature, History, and Modern Languages, respectively.

Although Witkin et al (1967) explored, to a certain extent, the measurement of field dependence – field independence over time, further longitudinal studies need to be implemented. This would provide important information with regards to an individual's position on the field dependent – field independent bi-polar continuum from the perspective of, level of educational experience, type of occupation and age.

Further research into field dependence- field independence is not only applicable to education, learning and teaching, at all levels, it is also applicable to the areas of investigation already cited in Section 16.3 of this Chapter, but also Chapter 2 (The Cognitive Style of Field Dependence – Field Independence), where a more detailed discussion is presented.

16.6 Conclusion

Continuing research into field dependence – field independence has the potential to produce solutions to many aspects of learning, teaching and a further developed definition of individual differences. Because the initial stage of its measurement is one of perception, which follows spontaneously into analytical skills, incorporating general ability, all of which are attributes and skills related to cognitive and social domains, it presents a rich variety of topics for research, all of which can be inter-connected.

The application of various scanning technologies, i.e. Functional Magnetic Resonance Imagery (fMRI) and Positron Emission Tomography (PET), is enabling increasingly detailed neurological investigations to take place (Eysenck and Keane, 2010), which are beginning to provide evidence to show which part or parts of the human brain are involved with particular types of cognitive tasks. This, together with additional scanning techniques(Corbetta and Shulman, 2002), as well as paper and pencil, and computer-presented embedded shapes tests, will yield a variety of data that is likely to provide new insights into physical and social perceptions, spatial ability and non-verbal reasoning.

Neurological studies into human cognitive processes, aided by increasing levels of technological instrumentation to provide improved details of observation and accuracy of measurements, may also provide very well defined definitions of differences between a cognitive and a learning style (and strategy) beyond that of the present time. This potential situation could have consequences for research into field dependence – field independence in the form of observations and measurements of the human brain while engaged in the process of disembedding figures or shapes. Such observations and measurements of the gross and fine structure of the human brain, in a functioning mode, could possibly indicate why one individual is designated field dependent and another field independent.

These techniques in tandem with questionnaires and self-report inventories can also investigate emotional problem-solving and possibly provide further insights into the wider aspects of field dependence – field independence, to encompass in greater detail, Witkin et al's model of psychological differentiation (1962). If sets of detailed neurological and psychological information were to be obtained, a detailed map of individual differences could begin to be established (an advance on the current understanding and application of field dependence – field independence), to show definite, or not, links between a number of psychological attributes/characteristics, which at present tend to be viewed as separate entities, e.g. perception (physical and social), cognitive ability and personality types.

However, with regard to the research outcomes of this thesis, a further line of statistical enquiry would be to use a factor analysis to include the EST3; SWT2; NSWT1; COIT; the BAS1 Scales, Recall of Digits, Similarities, Matrices, and Speed of Information Processing;

1Q; Wholistic-Analytic and Verbal-Imager Dimensions; and the Wholistic, Analytic, Verbal, Imager components separately; GPCT; and a range of school subjects, to obtain ‘loadings’ and to give the prominent loadings appropriate descriptions. This process could reveal additional relationships to those obtained from the correlations and ANOVA statistical processes used.

In addition to the above, i.e. the variables involved and the statistical techniques used, the use of a personality questionnaire, e.g. Big Five (Costa and McCrae, 1993) with the EST3, SWT2, and NSWT1, and the core subjects of the National Curriculum would present the opportunity for an investigation into the major aspects of Psychological Differentiation (Witkin et al, 1962). From this, measurements, direct and indirect, of perceptual ability; cognitive/analytical ability, of both a spatial and verbal modality; personality characteristics/traits; and the characteristics of some, or all, school subjects, would be obtained. In theory and practice, the ideal would be to use all of the school subjects within the school curriculum for research into field dependence – field independence and the overarching concept of psychological differentiation. Evidence would then be provided which would enable the characteristics of each school subject, in terms of their learning and teaching components, to be linked to the cognitive, spatial and verbal, and non-cognitive components of field dependence – field independence and psychological differentiation. This additional evidence would provide a more detailed understanding of the nature of ‘psychological differentiation’ and fundamental aspects of the cognitive style of field dependence – field independence.

Such a body of evidence may indicate and establish the importance of field dependence – field independence as the premier cognitive style.

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Appendices

Appendix A: Embedded Shapes Test , Version One (EST1)

PILOT G.E.F.T. (1) F.P. 87

NAME

MALE / FEMALE

AGE (Years and Months)

DATE

Number of Correct Responses

to Section C. ______

Time Taken to Complete

Section C (Minutes and Seconds)

______

Number of Correct Responses

to Section B. ___

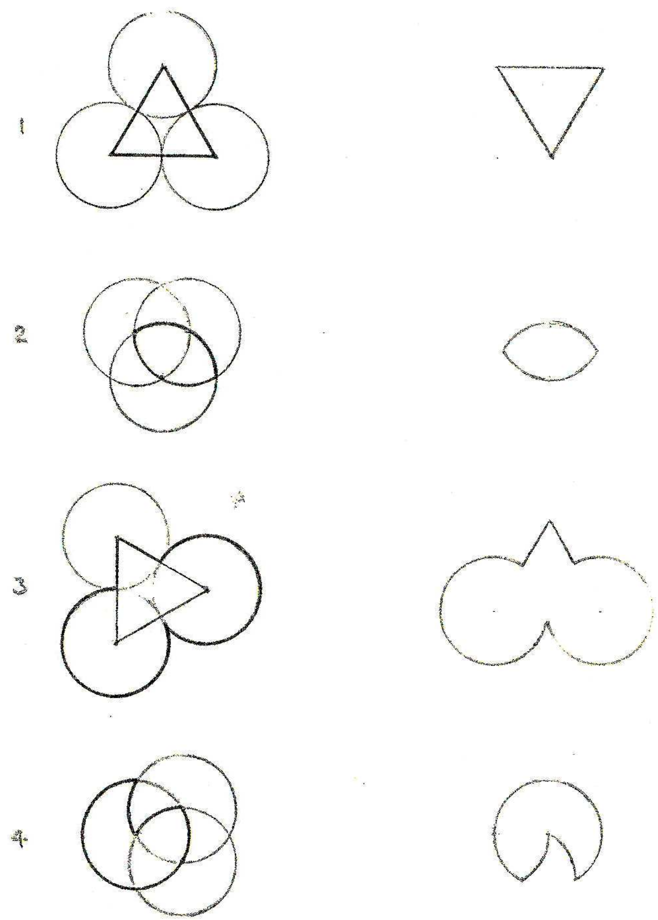
INSTRUCTIONS FOR THE COMPLETION OF G.E.F.T. ITEMS.

Each item (question) consists of a complicated shape and a simple shape. The simple shape is contained (or embedded) in the complicated shape.

1. Find the simple shape in the complicated shape.
2. When you have located the simple shape in the complicated shape – draw around (in pencil) the simple shape – accurately and heavily.
3. Your response to each item must be completely correct to gain a mark.
4. You can rub out a reponse and rework an item without losing any marks.
5. You do not need to use a rule or drawing instruments.
6. When you have completed all of the items to Section C write down the time taken (in minutes and seconds) in the front of this booklet in the space provided.

SECTION A

WORKED EXAMPLES



SECTION B

PRACTICE EXAMPLES

Complete the following items.
You have four minutes to do this.

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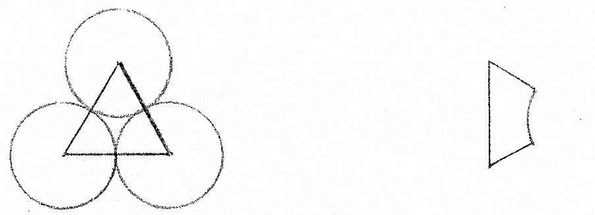

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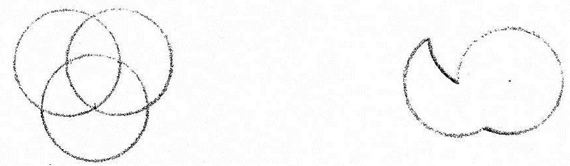

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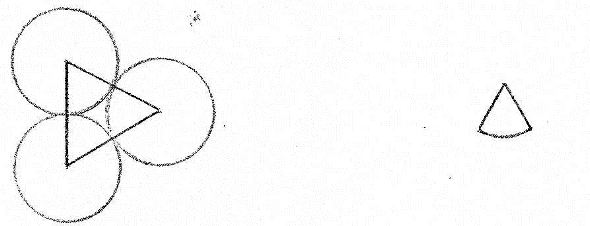

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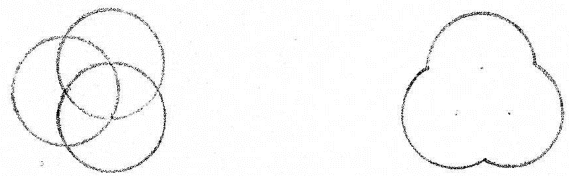
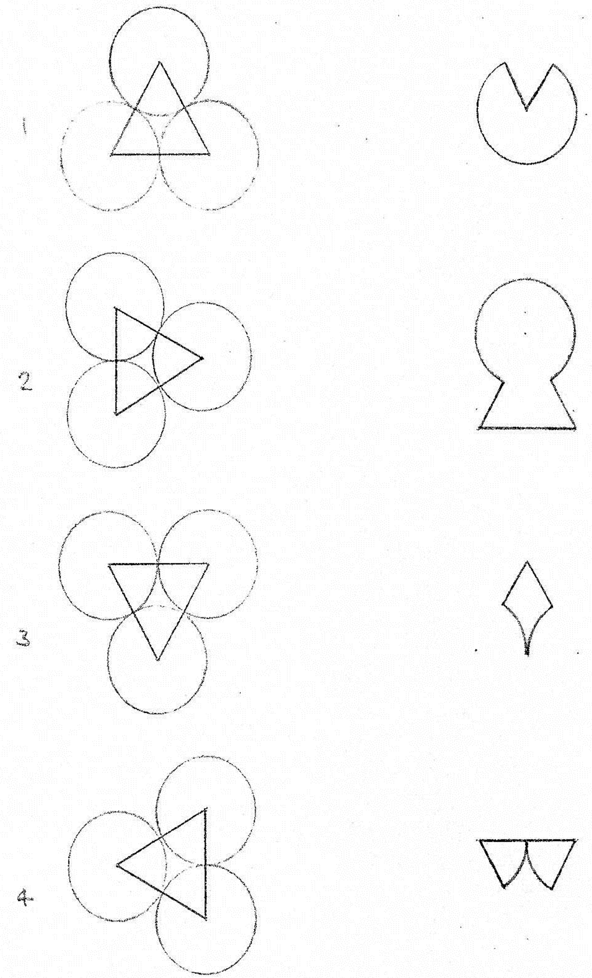
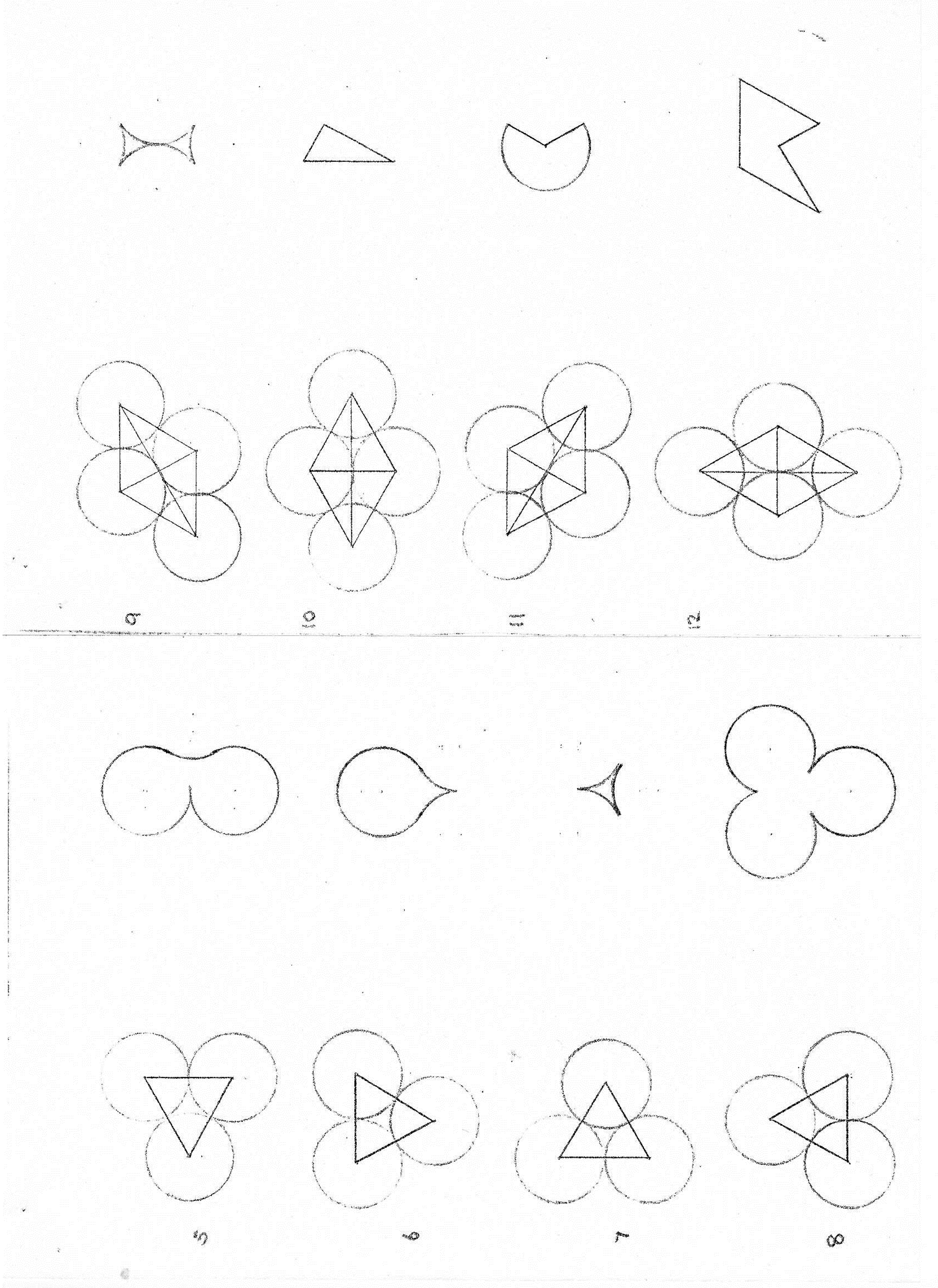


SECTION C

RESPONSE EXAMPLES

Complete the following items in your own time.

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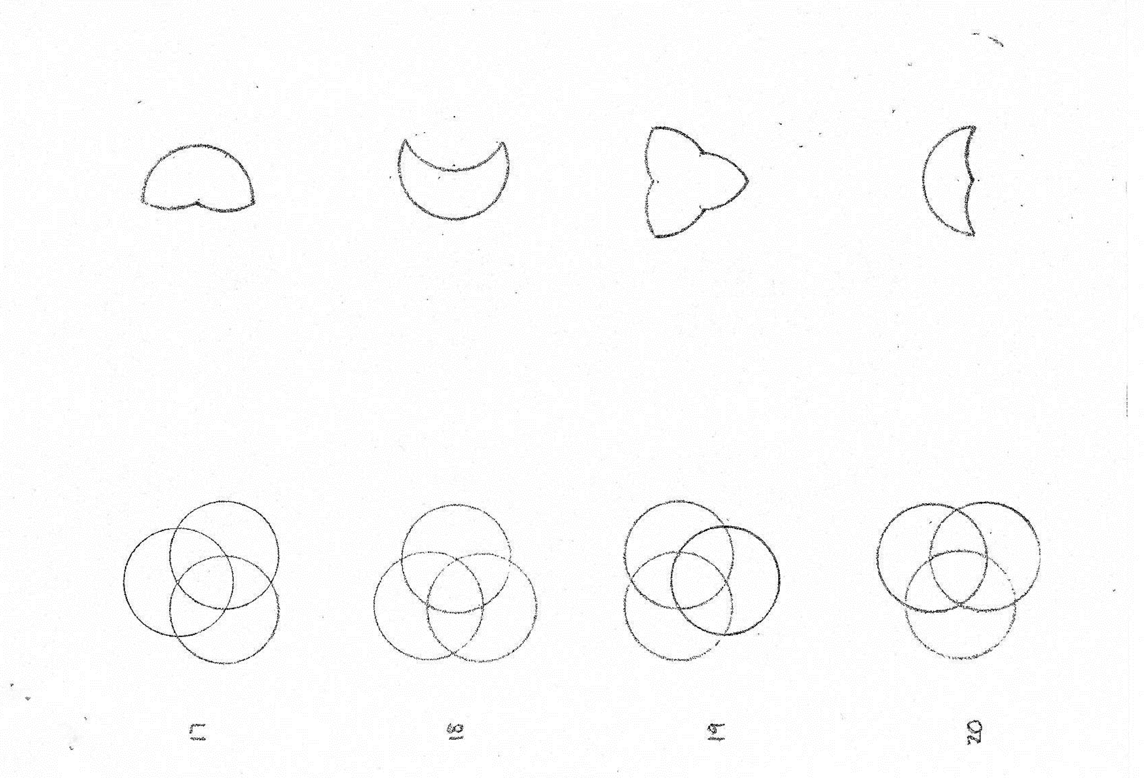
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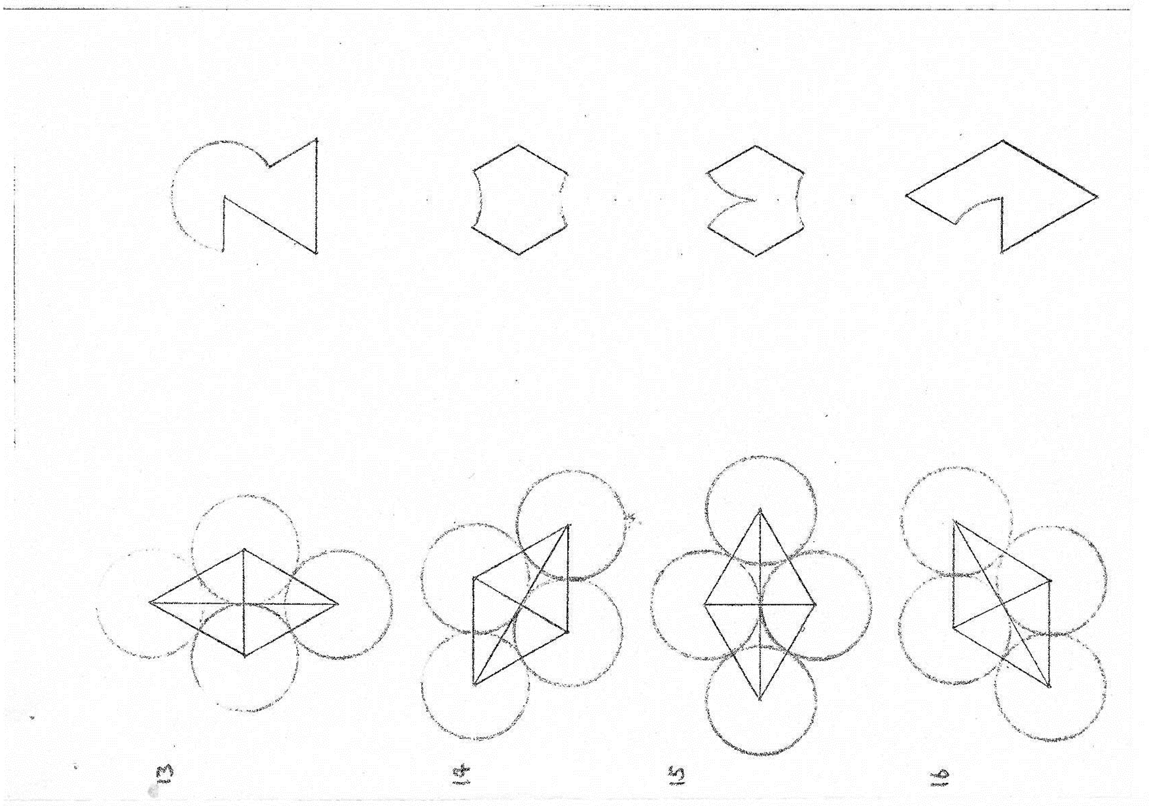
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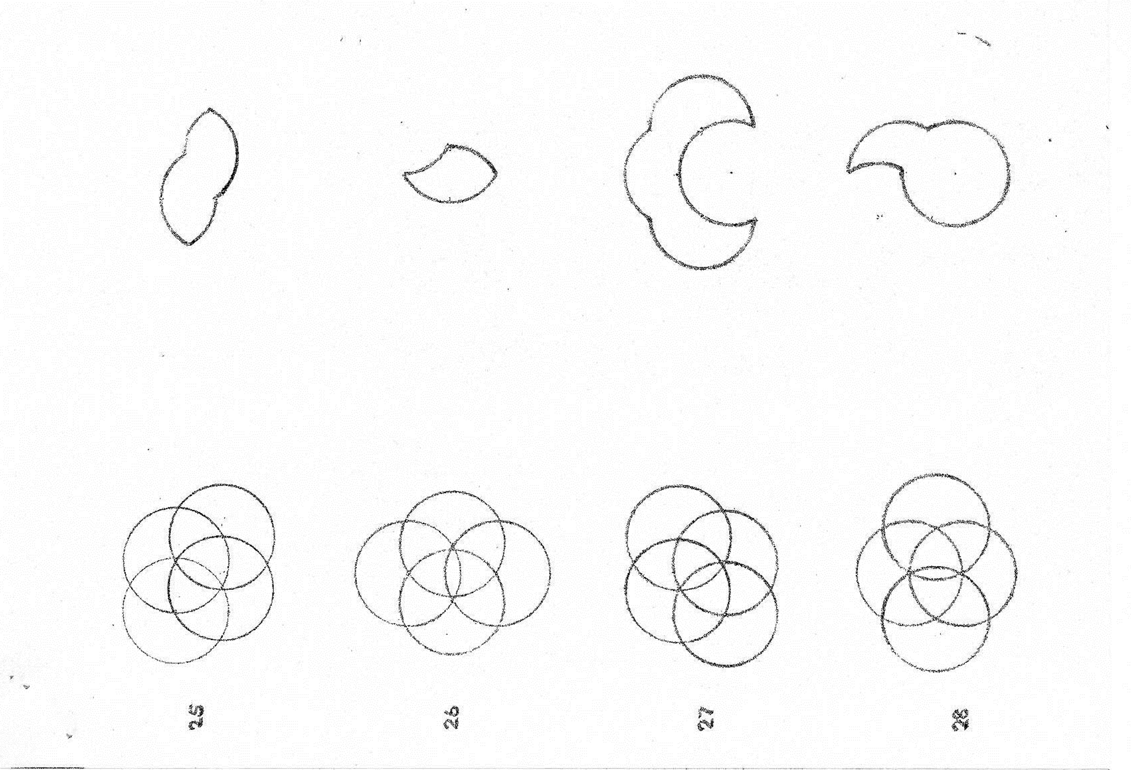
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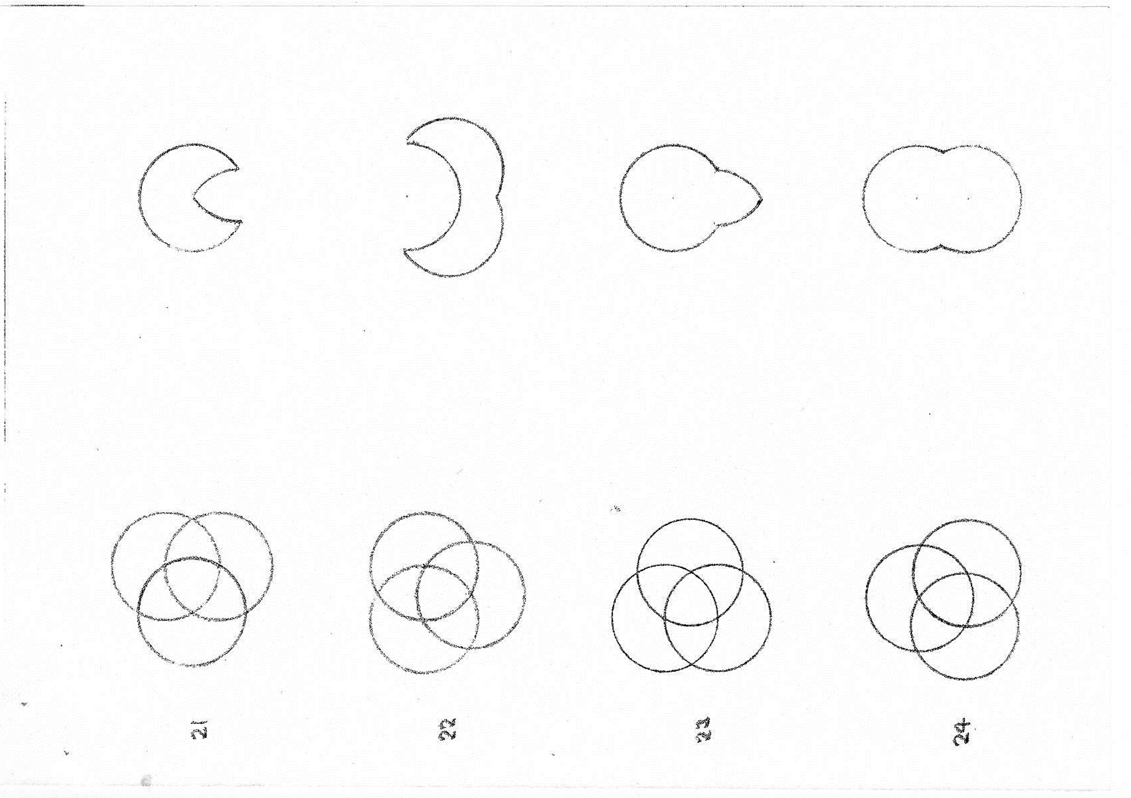
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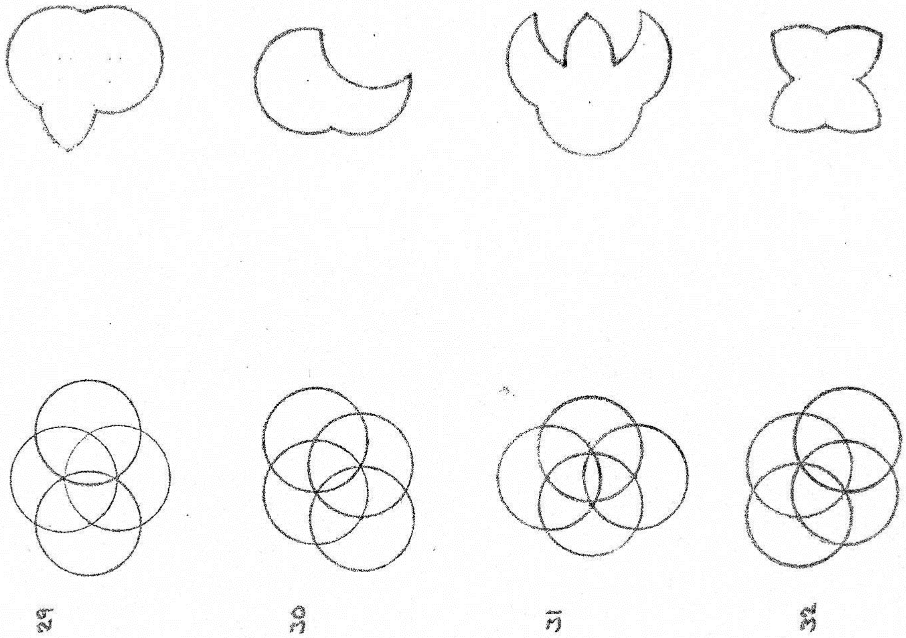

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Appendix B: Embedded Shapes Test, Version Three (EST3)

PILOT G.E.F.T. (2) F.P. 87

NAME

FEMALE/MALE

AGE (Years and Months)

DATE

Number of Correct Responses to Section C.

Number of Correct Responses to Section B.

INSTRUCTIONS FOR THE COMPLETION OF G.E.F.T.

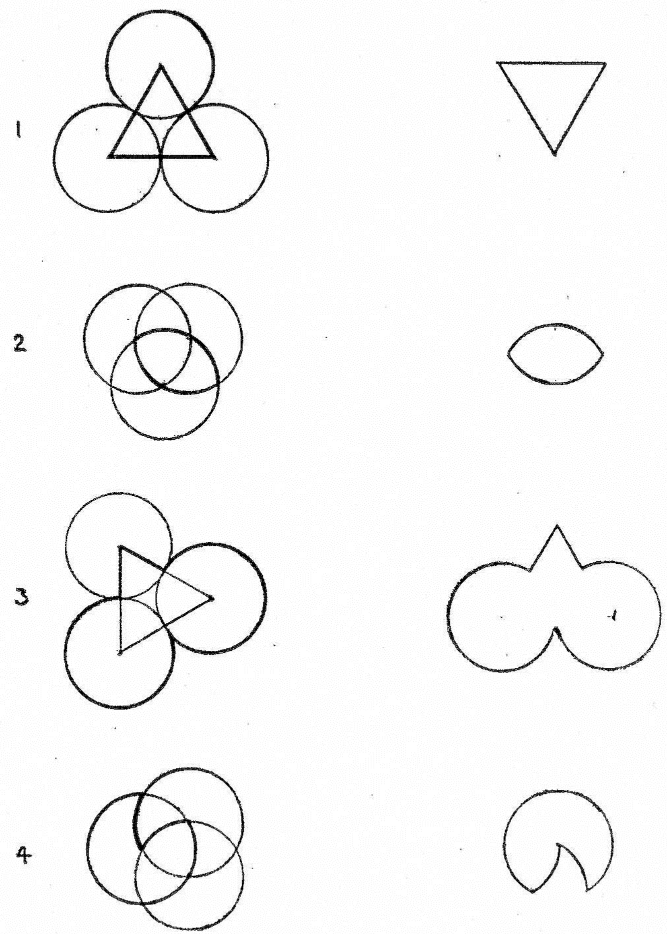
ITEMS.

Each item (question) consists of a complicated shape and a simple shape. The simple shape is contained (or embedded) in the complicated shape.

1. Find the simple shape in the complicated shape.
2. When you have located the simple shape in the complicated shape- draw around (in pencil) the simple shape- accurately and heavily.
3. Your response to each item must be completely correct to gain a mark.
4. You can rub out a response and rework an item without losing any marks.
5. You do not need to use a rule or drawing instruments.

SECTION A

WORKED EXAMPLES



SECTION B

PRACTICE EXAMPLES

Complete the following items.

You have $1\frac{1}{2}$ minutes to do this.

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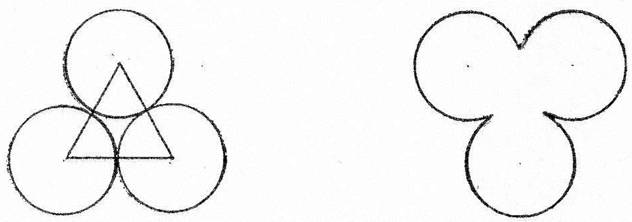

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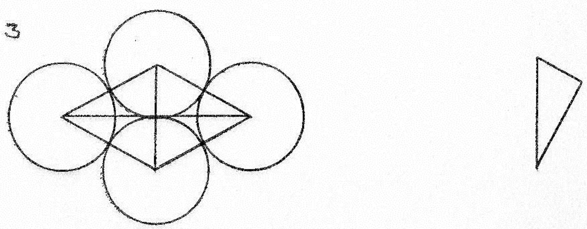

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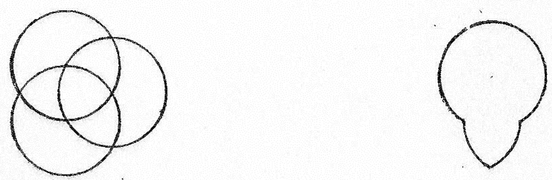

SECTION C

RESPONSE EXAMPLES

Complete the following items.

You have 12 minutes to do this.

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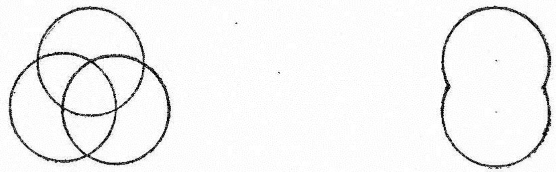

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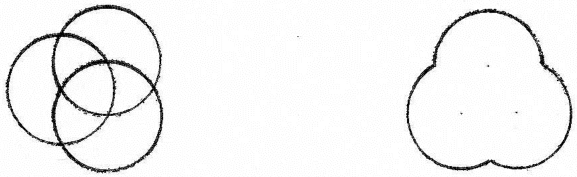

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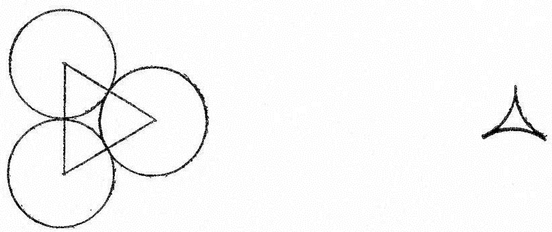

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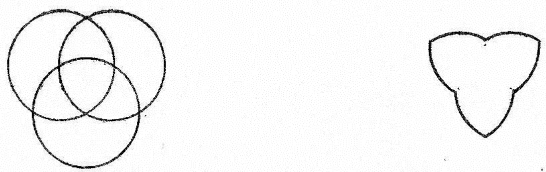

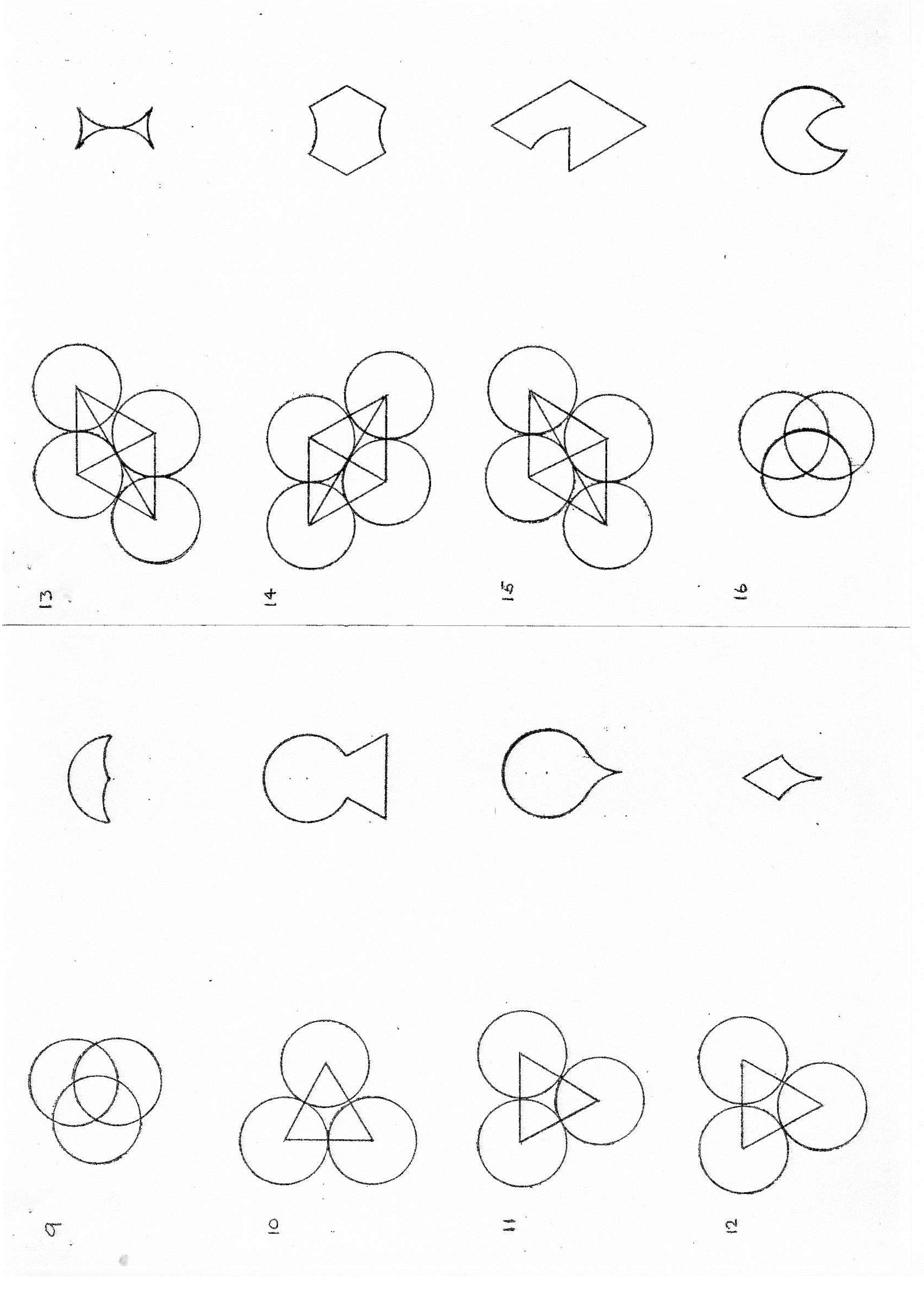
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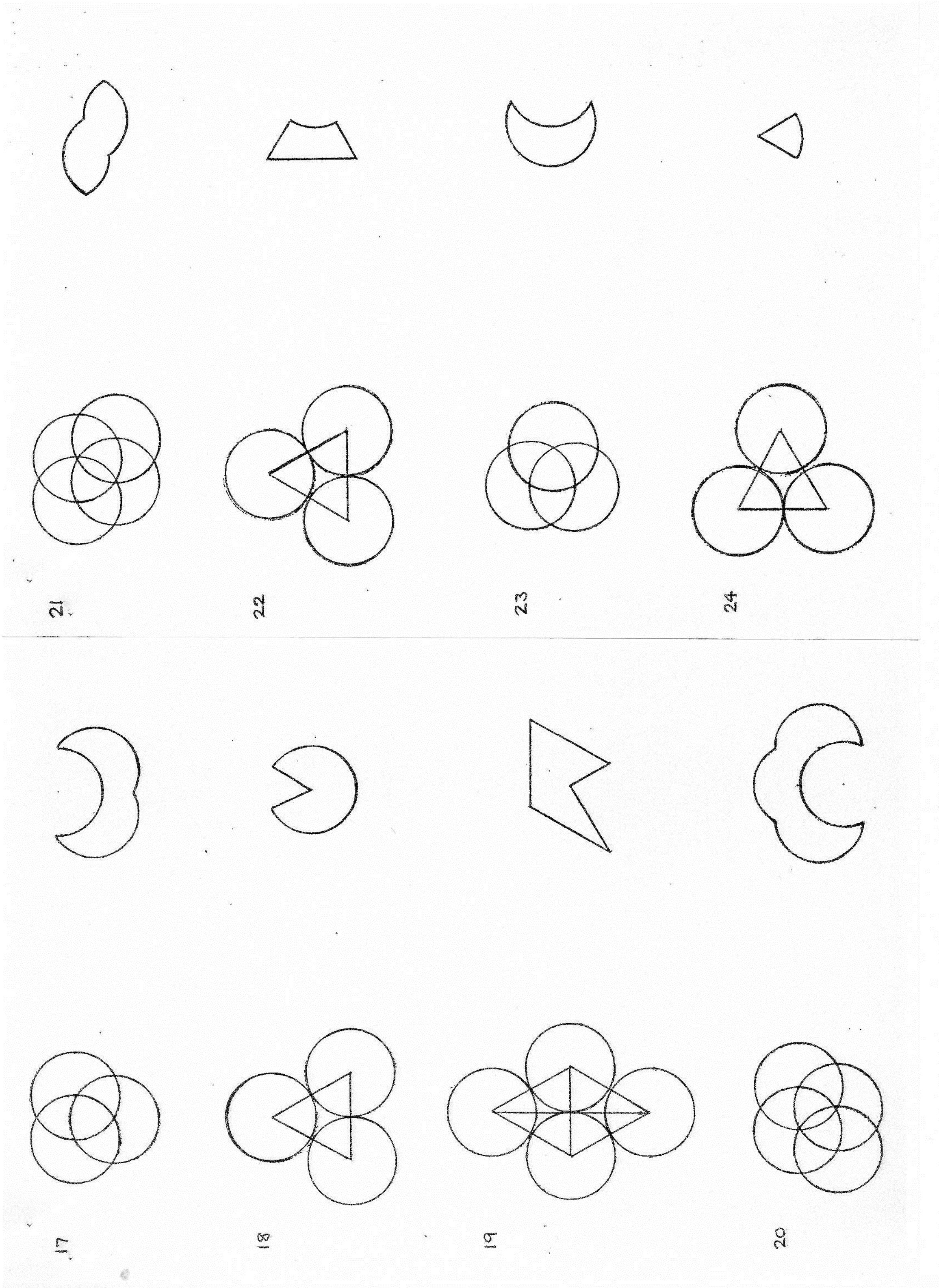
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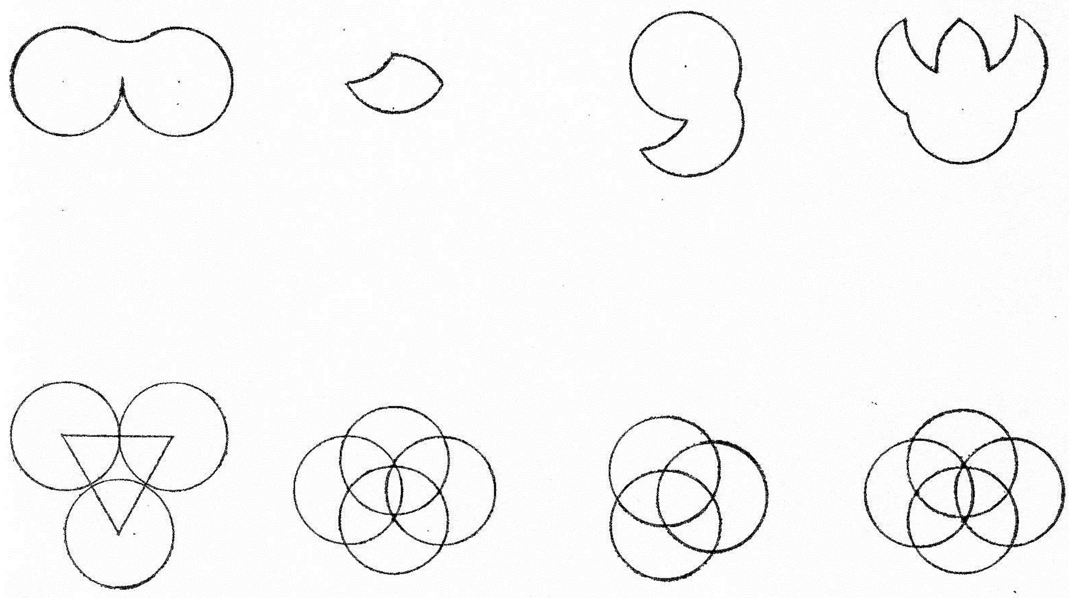

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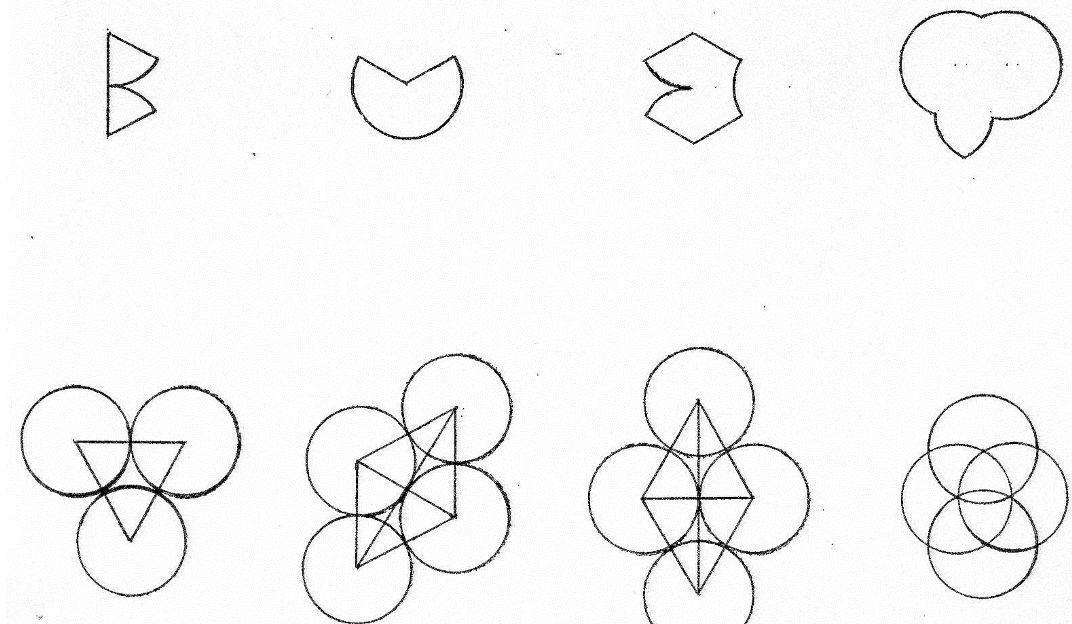

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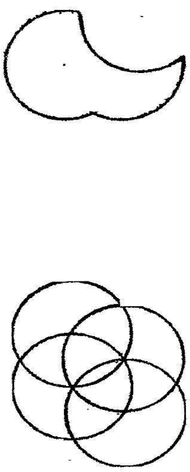

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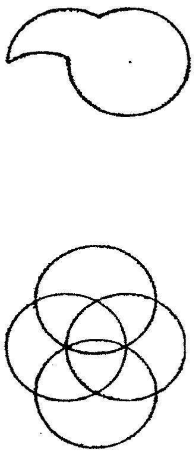

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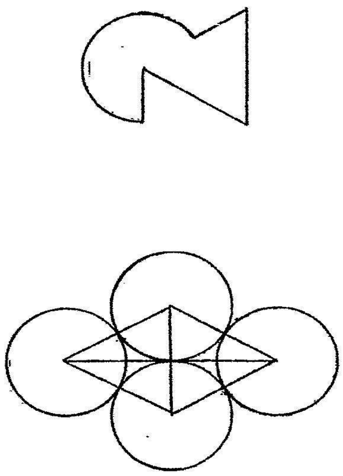

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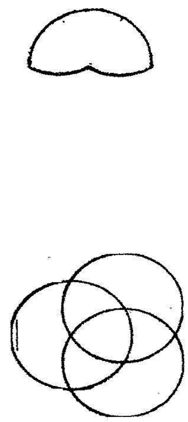

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Appendix C: Answers to Embedded Shapes Test, Version Three (EST3)

PILOT G.E.F.T. (2) F.P. 87

NAME

FEMALE/MALE

AGE (Years and Months)

DATE

Number of Correct Responses to Section C.

Number of Correct Responses to Section B.

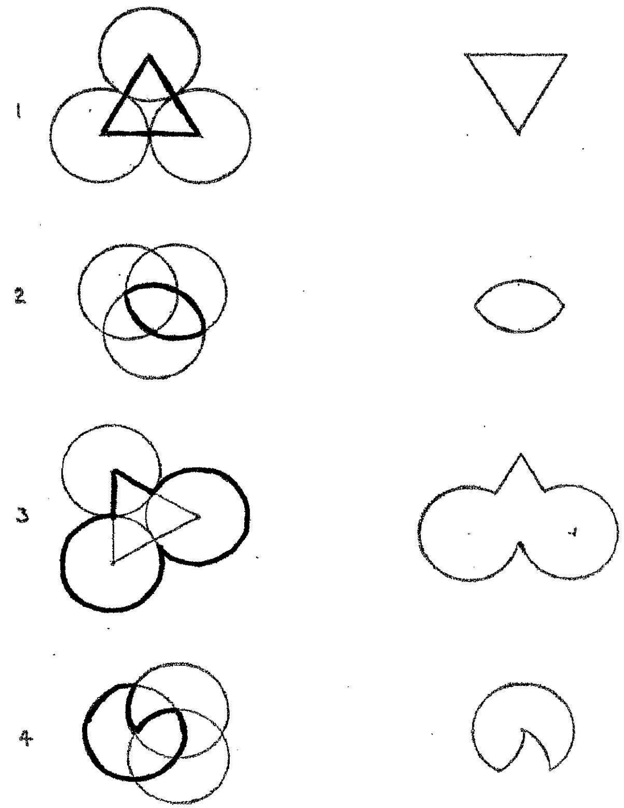
INSTRUCTIONS FOR THE COMPLETION OF G.E.F.T. ITEMS.

Each item (question) consists of a complicated shape and a simple shape. The simple shape is contained (or embedded) in the complicated shape.

1. Find the simple shape in the complicated shape.
2. When you have located the simple shape in the complicated shape- draw around (in pencil) the simple shape- accurately and heavily.
3. Your response to each item must be completely correct to gain a mark.
4. You can rub out a response and rework an item without losing any marks.
5. You do not need to use a rule or drawing instruments.

SECTION A

WORKED EXAMPLES



SECTION B

PRACTICE EXAMPLES

Complete the following items.

You have 1½ minutes to do this.

1

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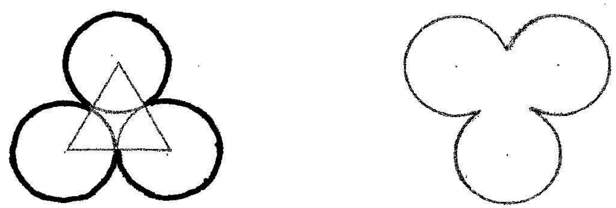

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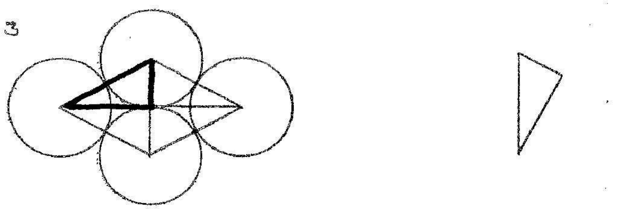

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SECTION C

RESPONSE EXAMPLES

Complete the following items.

You have 12 minutes to do this.

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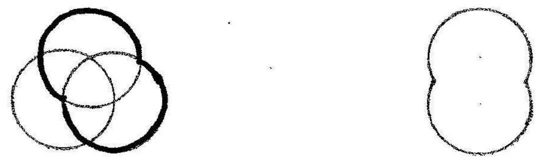

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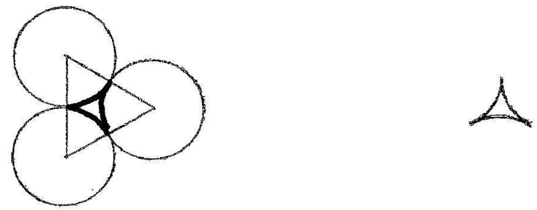

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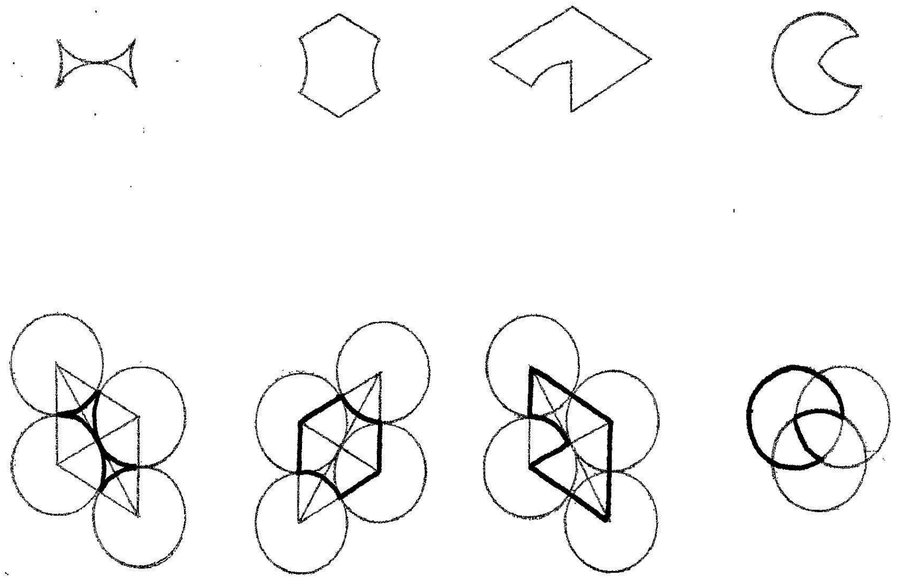

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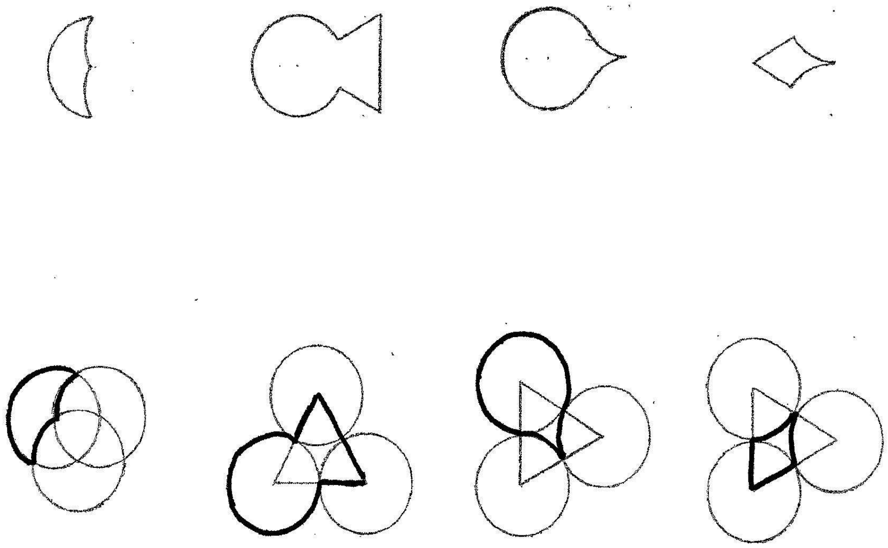

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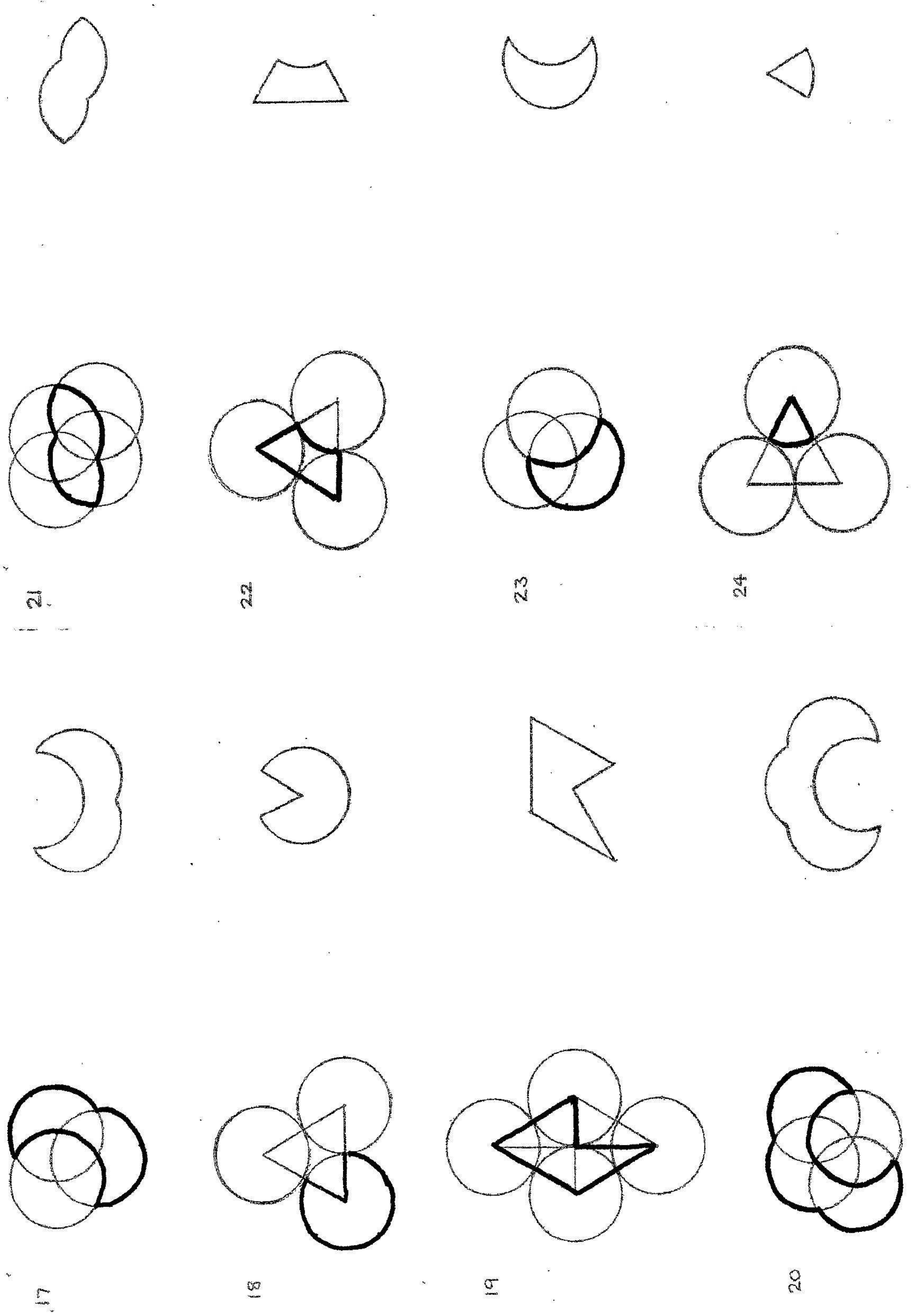
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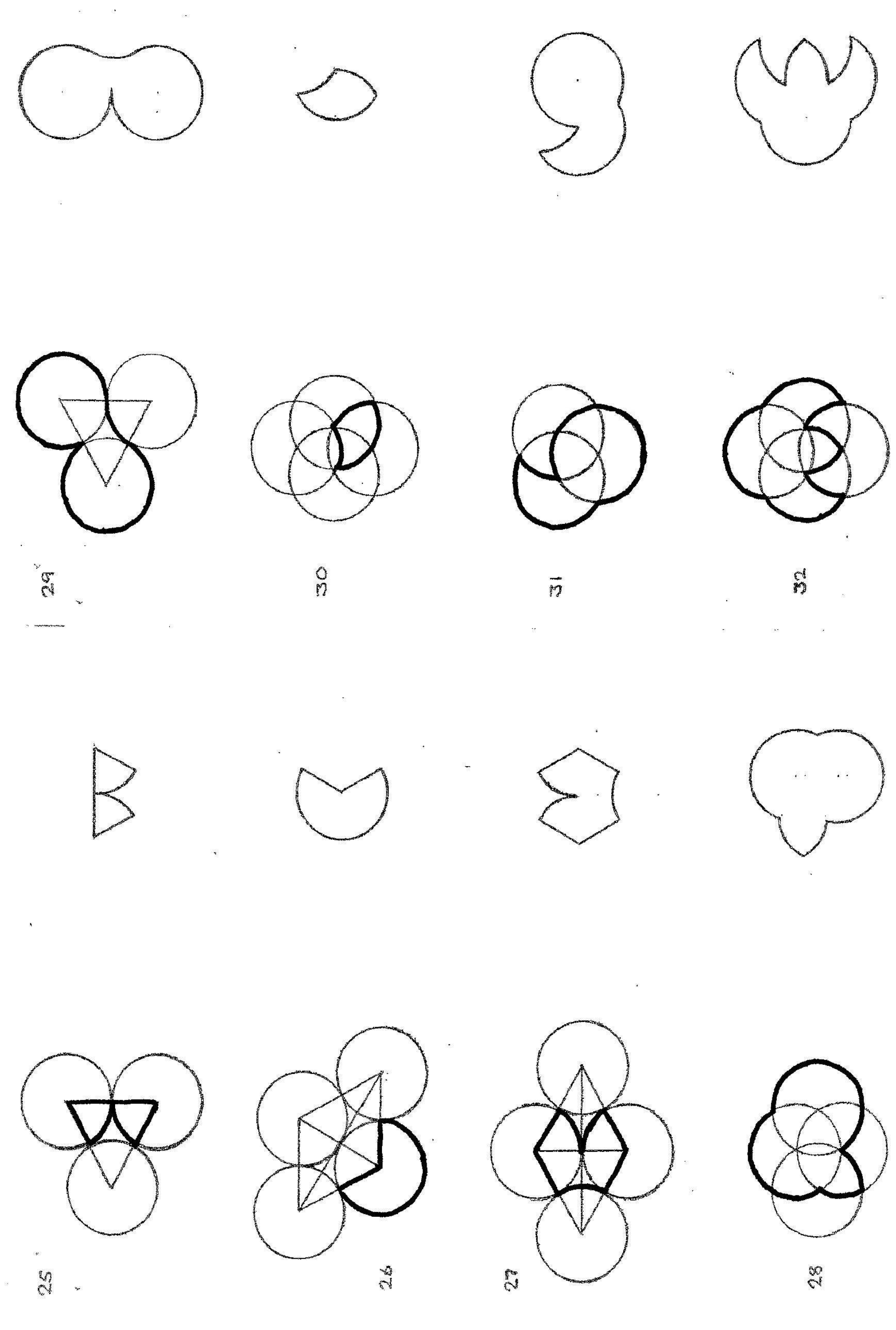
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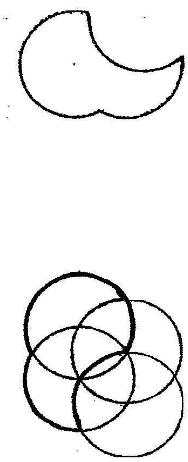

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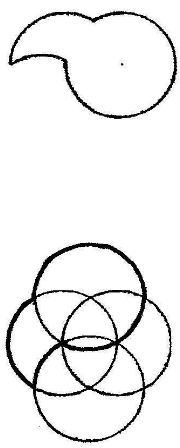

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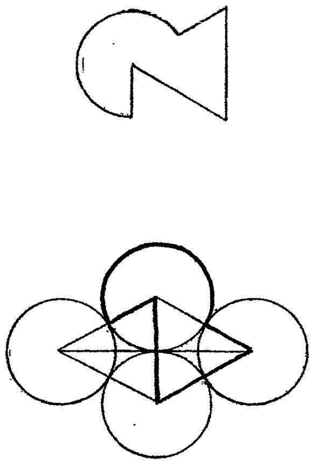

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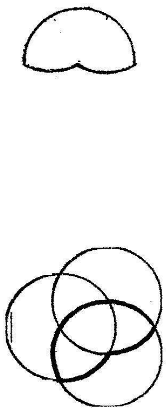

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Appendix D: Sense Word Test, Version One (SWT1)

NAME AGE FEMALE/MALE

Find the little word within the big word. Draw a circle around the little word within the big word.

EXAMPLE: awarded war

I.	inelastic	last	26.	sample	amp
2.	passing	ass	27.	examined	mine
3.	already	read	28.	unknown	now
4.	starting	tart	29.	department	art
5.	separate	rat	30.	attention	tent
6.	distribution	but	31.	predict	red
7.	following	low	32.	essentially	sent
8.	announced	noun	33.	magnitude	nit
9.	played	lay	34.	origin	rig
10.	someone	me	35.	fits	it
11.	companies	pan	36.	squared	are
12.	family	am	37.	polyester	yes
13.	compared	par	38.	without	thou
14.	gains	in	39.	signature	gnat
15.	research	ear	40.	flakes	lake
16.	reasonably	son	41.	cereals	real
17.	assumed	sum	42.	consumers	sum
18.	business	sin	43.	guarantee	ran
19.	computer	put	44.	thats	at
20.	houses	us	45.	microwave	crow
21.	marks	ark	46.	desired	sir
22.	equation	at	47.	minutes	nut
23.	whisker	his	48.	manager	nag
24.	estimated	mat	49.	failure	ail
25.	probability	rob	50.	appeared	pear

Appendix E: Sense Word Test, Version Two (SWT2)

NAME FEMALE/MALE F.P. 37

AGE YEARS MONTHS DATE

Find the little word within the big word. Draw a circle around the little word within the big word. You have one minute to do this.

EXAMPLE: war awarded

1.	last	inelastic	26.	amp	sample
2.	ass	passing	27.	mine	examined
3.	read	already	28.	now	unknown
4.	tart	starting	29.	art	department
5.	rat	separate	30.	tent	attention
6.	but	distribution	31.	red	predict
7.	low	following	32.	sent	essentially
8.	noun	announced	33.	nit	magnitude
9.	lay	played	34.	rig	origin
10.	me	someone	35.	it	fits
11.	pan	companies	36.	are	squared
12.	am	family	37.	yes	polyester
13.	par	compared	38.	thou	without
14.	in	gains	39.	gnat	signature
15.	ear	research	40.	lake	flakes
16.	son	reasonably	41.	real	cereals
17.	sum	assumed	42.	sum	consumers
18.	sin	business	43.	ran	guarantee
19.	put	computer	44.	at	thats
20.	us	houses	45.	crow	microwave
21.	ark	marks	46.	sir	desired
22.	at	equation	47.	nut	minutes
23.	his	whisker	48.	nag	manager
24.	mat	estimated	49.	ail	failure
25.	rob	probability	50.	pear	appeared

Appendix F: Answers to Sense Word Test, Version Two (SWT2)

NAME

FEMALE/MALE

F.P. 37

AGE YEARS MONTHS

DATE

Find the little word within the big word. Draw a circle around the little word within the big word. You have one minute to do this.

EXAMPLE: war awarded

1.	last	inelastic
2.	ass	passing
3.	read	already
4.	tart	starting
5.	rat	separate
6.	but	distribution
7.	low	following
8.	noun	announced
9.	lay	played
10.	me	someone
11.	pan	companies
12.	am	family
13.	par	compared
14.	in	gains
15.	ear	research
16.	son	reasonably
17.	sum	assumed
18.	sin	business
19.	put	computer
20.	us	houses
21.	ark	marks
22.	at	equation
23.	his	whisker
24.	mat	estimated
25.	rob	probability
26.	amp	sample
27.	mine	examined
28.	now	unknown
29.	art	department
30.	tent	attention
31.	red	predict
32.	sent	essentially
33.	nit	magnitude
34.	rig	origin
35.	it	fits
36.	are	squared
37.	yes	polyester
38.	thou	without
39.	gnat	signature
40.	lake	flakes
41.	real	cereals
42.	sum	consumers
43.	ran	guarantee
44.	at	thats
45.	crow	microwave
46.	sir	desired
47.	nut	minutes
48.	nag	manager
49.	ail	failure
50.	pear	appeared

Appendix G: Non-Sense Word Test, Version One (NSWT1)

NAME FEMALE/MALE F.P. 87

AGE YEARS MONTHS DATE

Find the little group of letters within the big group of letters. Draw a circle around the little group of letters within the big group of letters. You have one minute to do this.

EXAMPLE: tl vrtlly

1.	stn	qstn	26.	hr	chrcl
2.	ln	lng	27.	cr	ccrt
3.	l	mls	28.	nml	nmlld
4.	chl	schlng	29.	ptn	xcptnl
5.	pn	wpng	30.	rbc	brbc
6.	hnc	tchncl	31.	lg	lgnt
7.	nrn	ngnrng	32.	wlln	twllng
8.	tmn	dprtmnt	33.	hrb	bthrbs
9.	rctc	prctcng	34.	rdb	ncrdbl
10.	ss	pssbl	35.	shb	wshbl
11.	vnn	cnvnnt	36.	ccs	nccssbl
12.	ctn	dctnl	37.	ndm	cndmnts
13.	mxm	mxmm	38.	rn	msrng
14.	pr	prd	39.	tlgh	nghtlght
15.	rbl	grbl	40.	ppl	sppld
16.	grm	prgrmm	41.	nm	mnmm
17.	tch	tchr	42.	pgt	prpgtng
18.	sr	rsrch	43.	nls	prsnlstn
19.	hfl	fthflly	44.	strc	cnstrctd
20.	mn	cmmnly	45.	jst	djstbl
21.	ntc	ntcpt	46.	prx	pprxmtly
22.	vl	nvlv	47.	ng	ngns
23.	tn	mprtnt	48.	scr	dscrptn
24.	rq	rqrd	49.	trdc	ntrdctry
25.	hlgc	psychlgcl	50.	prt	tmprtr

Appendix H: Answers to Non-Sense Word Test, Version One (NSWT1)

NAME FEMALE/MALE F.P. 87

AGE YEARS MONTHS DATE

Find the little group of letters within the big group of letters. Draw a circle around the little group of letters within the big group of letters. You have one minute to do this.

EXAMPLE: tl vrtlly

1.	stn	qstn	26.	hr	dhrcl
2.	ln	lng	27.	cr	ccrt
3.	l	mls	28.	nml	nmlld
4.	chl	schlng	29.	ptn	xcptnl
5.	pn	wpng	30.	rbc	brbc
6.	hnc	tchncl	31.	lg	lgnt
7.	nrn	nghrng	32.	wlln	twllng
8.	tmn	dprtmnt	33.	hrb	bthrbs
9.	rctc	prctcng	34.	rdb	ncrdbl
10.	ss	pssbl	35.	shb	wshbl
11.	vnn	cnvnnt	36.	ccs	nccssbl
12.	ctn	dctnl	37.	ndm	cndmnts
13.	mxm	mxmm	38.	rn	msrng
14.	pr	prd	39.	tlgh	nghtlght
15.	rbl	grbl	40.	ppl	sppld
16.	grm	prgrmm	41.	nm	mnmm
17.	tch	tchr	42.	pgt	prpgtng
18.	sr	rsrch	43.	nls	prsnlstn
19.	hfl	fthflly	44.	strc	cnstrctd
20.	mn	cmmnly	45.	jst	djstbl
21.	ntc	ntcpt	46.	prx	pprxmtly
22.	vl	nvlv	47.	ng	ngns
23.	tn	mprtnt	48.	scr	dscrptn
24.	rq	rqrd	49.	trdc	ntrdctry
25.	hlgc	psychlgcl	50.	prt	tmprtr

Appendix I: The Words from which the Test Items/Questions of NSWT1 were derived

1	question	26	charcoal
2	long	27	accurate
3	miles	28	enamelled
4	schooling	29	exceptional
5	weeping	30	barbecue
6	technical	31	elegant
7	engineering	32	towelling
8	department	33	bathrobes
9	practicing	34	incredible
10	possible	35	washable
11	convenient	36	inaccessible
12	educational	37	condiments
13	maximum	38	measuring
14	proud	39	nightlight
15	agreeable	40	supplied
16	programme	41	minimum
17	teacher	42	propagating
18	research	43	personalisation
19	faithfully	44	constructed
20	commonly	45	adjustable
21	anticipate	46	approximately
22	involve	47	engines
23	important	48	description
24	required	49	introductory
25	psychological	50	temperature

Appendix J: Chronological Order Integration Test (COIT): Passage A

PASSAGE A.

1. David Livingstone was born on 19th March, 1813 at the village of Blantyre in Lanarkshire, Scotland.

3. In order that he might overcome the drawback of leaving school at an early age he attended a Latin class and qualified himself at the age of 23 to undertake a college course.

5. In the autumn of 1836 he entered Anderson's College, a medical school in Glasgow.

7. He continued his medical studies in the Charing Cross Hospital, London.

9. With his imagination fired, Livingstone was anxious to get to Africa and in 1840 he sailed in the ship "George" for the Cape of Good Hope.

11. When he stepped ashore at Simon's Bay on March 11th, 1841 he was an erect, well-set young man with a noble head and brilliant blue eyes under shaggy eyebrows.

13. On the voyage the captain had taught Livingstone some of the principles of navigation which was to prove invaluable to him later on his journeys of exploration.

15. The six weeks which he spent on the road to his first mission station gave him every chance of using his remarkable powers of observation.

17. In 1845 he married Mary Moffat, the daughter of a missionary, in the stone church at Kuruman.

19. But he was not happy remaining in one place, so in 1849 he set off northwards, in the company of two English travellers, in search of Lake Ngami.

21. Unfortunately his children were seized with fever so, in 1852, he said goodbye to his family as they set sail for England.

23. In 1859 one of his expeditions sighted Lake Nyassa for the first time and also caught glimpses of the slave trade which was to have such a tragic effect upon African life.

25. Such were his frustrations on his last journey that at one stage he was feared lost and in October 1871 H.M.Stanley, a Welshman, was sent to find Livingstone, who had not been heard of for 5 years.

27. When he died, as a result of dysentery and malaria, his followers decided to bury his heart in Africa.

29. On the 18th April 1874 his body was buried in Westminster Abbey.

Appendix J: Chronological Order Integration Test (COIT): Passage B

PASSAGE B.

2. At the age of 10 David Livingstone left the village school for the neighbouring cotton mills where he worked at the spinning jenny to earn a few coppers which helped to supplement a scanty family income.

4. His father was an Elder at the little Congregational Church where David was a member.

6. In 1838 he offered himself for missionary service to the London Missionary Society which sent him to London for further theological training.

8. During his stay in London he met the great African Missionary, Robert Moffat, who turned the young man's attention to Africa.

10. Livingstone was of medium height, slight and wiry in figure.

12. His voyage to Africa took 3 months, the ship calling first at Rio de Janeiro.

14. After a 4 week stay with Dr. John Philip in Cape Town he made the long journey North to Kuruman by boat and on foot.

16. He was able to see for the first time the wild life and the native life in the wide spaces of Africa.

18. After spending four years in his first station at Mabotsa, he moved further North to the edge of the Kalahari Desert where he lived the life of a settled missionary for five years.

20. His first expedition stirred his imagination and later he set of to reach Sebituane, this time with his wife and children.

22. In November 1855 he made the most spectacular of his discoveries the Victoria Falls, which cast clouds of spray into the sky as the Zambesi fell into its narrow gorge.

24. His final journey into Tanganyika territory began on the 4th April 1866 and was to last until 1873.

26. Livingstone battled on through the swamps, undaunted by pain, constant soakings and hostile tribesmen but on 1st May 1873 his faithful African followers found him dead in his tent.

23. They carried his body, together with all his papers and instruments across Africa to Zanzibar.

30. All Britain mourned the loss of a great explorer and a great Christian.

Appendix K: Gestalt Picture Completion Test (GPCT) Answer Sheet

NAME F.P. 90

FEMALE / MALE

AGE (YEARS and MONTHS)

DATE

WRITE DOWN A WORD OR PHRASE THAT DESCRIBES WHAT YOU THINK EACH OF THE FOLLOWING EXAMPLES AND ITEMS ARE:

EXAMPLE A

EXAMPLE B

ITEM 1

ITEM 2

ITEM 3

ITEM 4

ITEM 5

ITEM 6

ITEM 7

ITEM 8

ITEM 9

ITEM 10

ITEM 11

ITEM 12

ITEM 13

Appendix L: Answers to Gestalt Picture Completion Test (GPCT) (Street, 1931)

Practice (Example items/questions)

A A man, A man’s face

B An airplane (An aeroplane).

Response items/questions

1 A dog, A puppy

2 A boat, A sailboat

3 A cat, A pussy

4 A stove, An oven, A range

5 A baby, A child, A boy

6 A table

7 A soldier, A Japanese soldier

8 A man on horse back

9 A rabbit, A bunny

10 A locomotive, An engine

11 A boy on a tricycle or bicycle

12 A man’s face

13 A camera man, A picture man

Appendix M: British Ability Scales (BASI): Question and Answer Booklet for Recall of Digits; Similarities; Matrices; and Speed of Information Processing Scales.

NAME

D.O.B.

MALE/FEMALE

DATE

CLASS

RECALL OF DIGITS

1
2
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11
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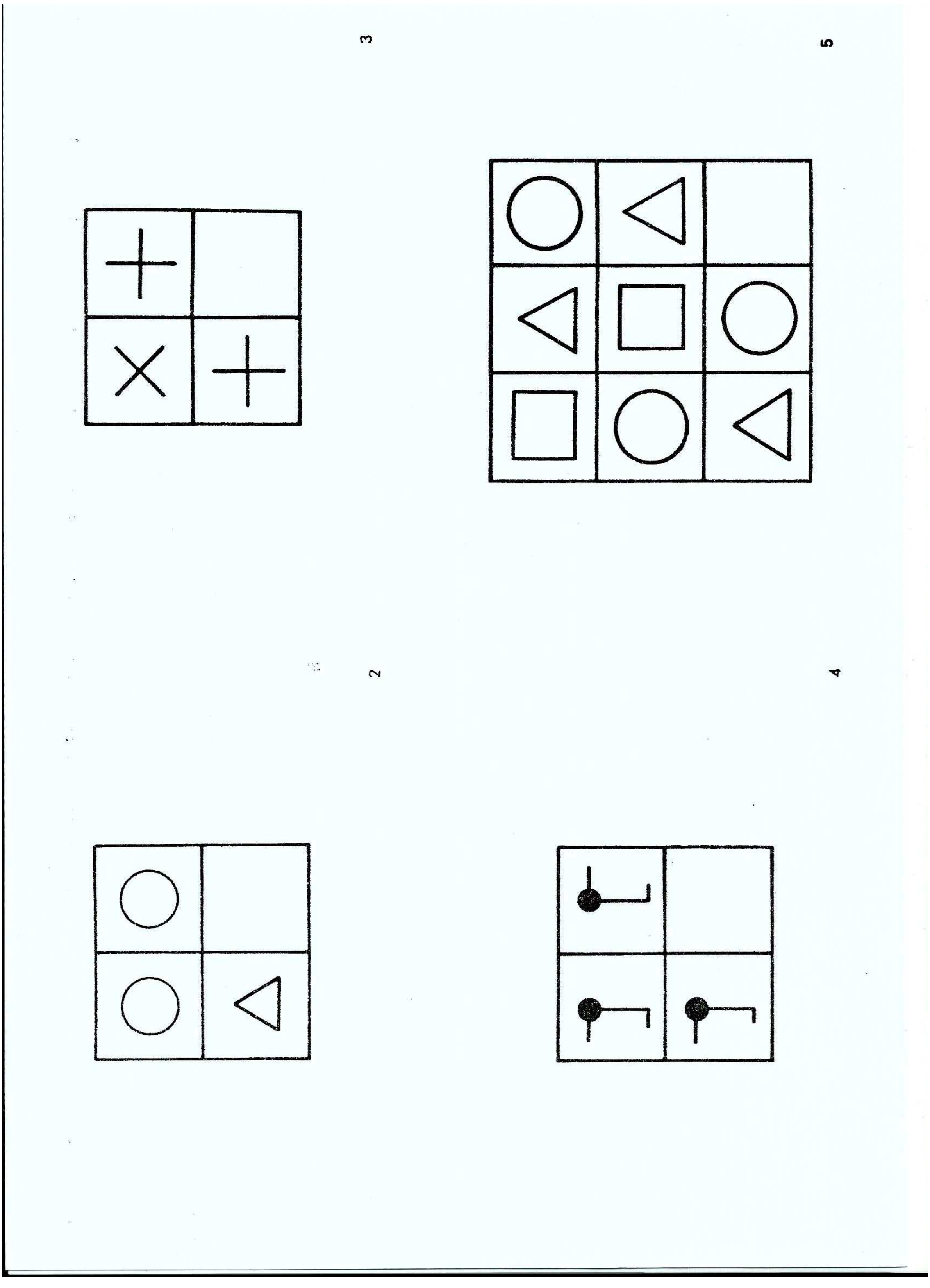
35
36

SIMILARITIES

Item		Class Name
i Orange, Strawberry, Banana		
1 Red, Blue, Brown	18	
2 Milk, Lemonade, Coffee	24	
3 Skirt, Hat, Trousers	24	
4 Lion, Mouse, Cow	34	
5 Daisy, Rose, Dandelion	34	
6 Rectangle, Hexagon, Circle	35	
7 Cod, Shark, Pilchard	50	
8 Peas, Cabbage, Carrots	54	
9 Cupboard, Table, Bed	55	
10 Sandal, Slipper, Boot	57	
11 Measles, Chickenpox, Mumps	60	
12 Steel, Silver, Copper	64	
13 Mosque, Chapel, Synagogue	68	
14 Water, Oil, Blood	71	
15 Sad, Worried, Happy	74	
16 Ice, Steam, Snow	86	
17 Book, Telephone, Newspaper	87	
18 Sun, Wood, Oil	107	
19 Poem, Song, Statue	107	
20 Hotter, Fatter, Cleverer	108	
21 Democracy, Justice, Equality	125	

MATRICES



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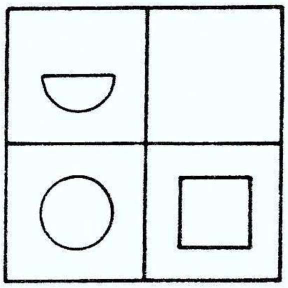

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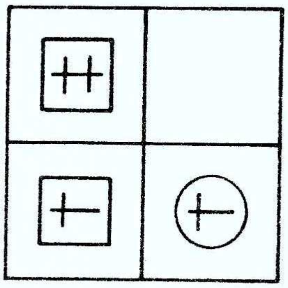

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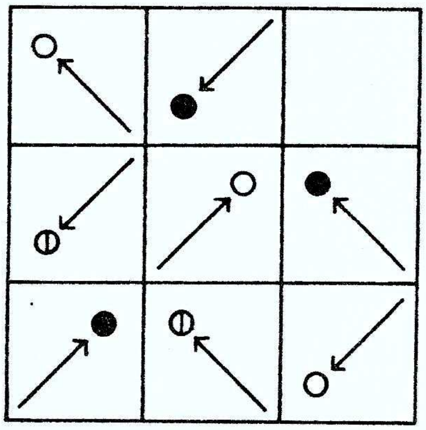

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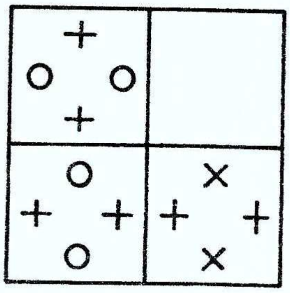

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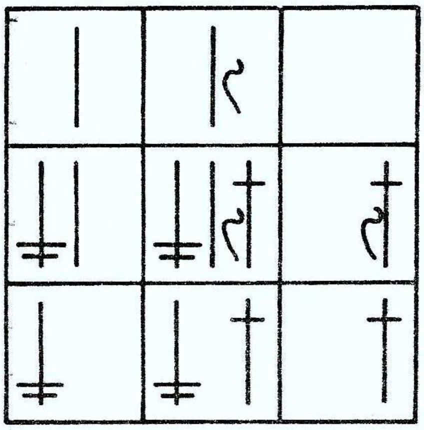

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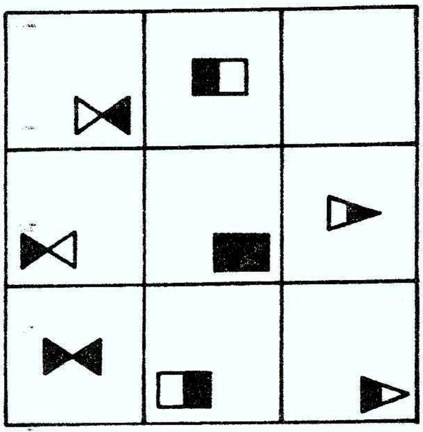

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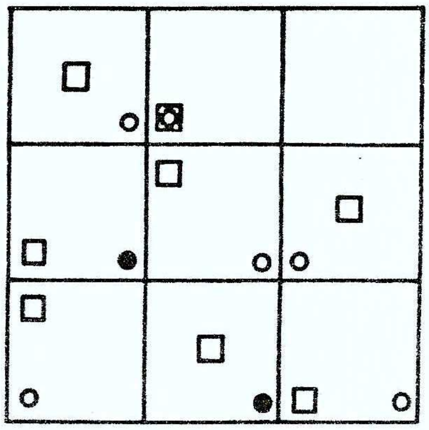

SPEED OF INFORMATION PROCESSING

3	9	5	5	2
2	8	6	4	7
8	4	5	3	9
9	7	8	6	3
3	9	5	7	3

iv

80	92	26	49	94
50	41	21	66	27
39	13	50	52	13
70	28	29	62	31
64	61	55	16	31

v

63	22	55	92	69
83	47	25	45	31
25	82	22	24	27
85	10	57	74	80
61	59	63	52	98

21

11	27	75	20	30
85	22	21	46	71
91	39	59	79	86
21	72	73	14	26
47	18	88	71	23

22

44	54	28	48	96
23	66	45	55	85
63	42	79	91	22
29	94	13	95	14
36	65	26	11	78

23

67	28	69	25	68
36	24	72	38	54
92	40	56	96	48
60	81	99	12	18
58	69	47	83	25

24

95	18	28	64	37
38	44	56	89	57
68	70	81	54	10
60	90	58	87	84
46	31	35	82	53

25

305	186	869	957	544
882	321	569	934	405
324	949	618	933	799
684	283	419	352	528
733	959	563	497	719

26

651	344	783	973	886
336	259	686	767	702
168	641	747	678	759
814	726	114	282	855
862	338	816	151	843

27

973	768	975	656	579
501	881	189	480	742
601	192	655	860	875
109	966	155	366	816
688	447	537	128	888

28

124	482	403	644	550
645	465	178	925	594
499	953	721	467	784
876	739	855	497	373
341	617	490	502	662

29

340	499	753	331	626
915	758	424	851	548
271	249	242	216	269
654	110	196	588	379
780	987	281	142	833

30

Appendix N: Sense Sentence Test

1 The car travelled down the road at a very fast speed.

led rave own

2 There were twenty elephants in the zoo.

ant went

3 America is a very large country but not the biggest in the world.

big try

4 Computer games help to develop manual dexterity but they can strain eyes and fingers.

yes game man put train

5 To dance to pop music requires a lot of energy.

lot an

6 Chips and crisps are not good for a person if they are eaten a lot.

he hip go lot ten hips eat

7 Although Beethoven was deaf he could hear music in his imagination.

as oven nation ear

8 Atomic energy is necessary to prevent a black out.

lack tom atom vent

9 Football is a very popular sport all over the world.

all port foot ball the pop

10 A champion one hundred metres runner can travel this distance in about nine seconds.

tan red run amp on an his con met

Appendix O: Non-Sense Sentence Test

1 The trees of the forest display a variety of colours
(Th trs f th frst dsply vrty f clrs)
Thtrsfthfrstdsplyvrtyfclrs

hfr yfcl tds vr

2 There were one hundred and seventy two cars on the car park
(Thr wr n hndrd nd svnty tw crs n th cr prk)
Thrwrnhndrdndsvntytwcrsnthcrprk

snt wrn nty rdn

3 Formula One car racing is a very expensive sport
(Frml n cr rcng s vry xpnsv sprt)
Frmlncrrcngsvryxpnsvsprt

ngsv rml vs crr

4 Michael Faraday discovered electro magnetic induction
(Mchl Frdy dscvrd lctr mgntc ndctn)
MchlFrdydscvrdlctrmgntcndctn

dlc lFrd dct gnt

5 Any model of a smart phone can do many things
(ny mdl f smrt phn cn d mny thngs)
nymdlfsmrtphncndmnythngs

tp nymd nyth ncn

6 Our galaxy is called the Milky Way Galaxy
(r glxy s clld th Mlky Wy Glxy)
rglxyscllldthMlkyWyGlxy

yGl ysc th lkyW

7 The speed of light is three hundred thousand kilometres per second
(Th spd f lght s thr hndrd thsnd klmtrs pr scnd)
Thspdflghtsthrhndrdthsndklmtrsprscnd

ght mtrs hr hspd

8 The Queen is the Head of State of the United Kingdom and the Head of the Commonwealth of Nations

(Th Qn s th Hd f Stt f th ntd Kngdm nd th Hd f th Cmmnwlth f Ntns)

ThQnsthHdfSttfthntdKngdmndthHdfthCmmnwlthfNtns

ngdm nst mn fStt

9 9. The rainbow is made up of seven colours

(Th rnbw s md p f svn clrs)

Thrnbwsmdpfsvnclrs

vnc hrnb rs dpf

10 10. Everyone needs to exercise at least three times a week.

(vryn nds t xrcs t lst thr tms wk)

vrynndstxrcstlstthrtmswk

rt rynn xrcs swk

Appendix P: Complex Sentence Test

1 It was the threat of invasion after the defeat of the Allied armies in the Spring of 1940 that resulted in the formation of the Local Defence Volunteers, later known as the Home Guard.

Why were the Local Defence Volunteers formed?

2 By the end of October, when over seventeen hundred German aircraft had been destroyed, the Battle of Britain was over and Hitler had decided to postpone indefinitely the invasion of the British Isles.

What did Hitler decide to do after the Battle of Britain?

3 London was raided night after night and the other great ports, particularly Bristol, Plymouth and Southampton suffered severely and in mid-November the Midland cities, especially Coventry and Birmingham, were attacked.

When were the Midland cities attacked?

4 Fire-watching and Home Guard duties became compulsory for civilians in their spare time, and a network of new civilian defence forces, including the Observer Corps and the National Fire Service, was built up.

Write down the name of one civil defence force.

5 It was after the retreat from Dunkirk, followed by the victory of the RAF in the Battle of Britain, that bombing of the metropolis began on a major scale at the beginning of September, 1940.

What happened to the metropolis at the beginning of September 1940?

Appendix Q: Simple Sentence Test

1 The scientist makes discoveries but has little say in their applications. This is usually the province of politicians, governments and industrialists. Such applications may be used to benefit or exterminate a community.

Who are the people that make decisions regarding the uses of scientific discoveries?

2 The question 'Is Science Good or Evil?' is a complex one. It is a question usually asked by less thinking people. This is because such people relate the horrors of war with science.

Why do 'less thinking' people regard the answer to the above question to be a simple one?

3 Science can be divided into a number of broad areas. These include Physics, Chemistry, Biology, Cosmology, Engineering, Psychology and Sociology. Such sciences can be classified into physical, living and social.

Give the names of two classes of science.

4 Stoic Philosophy reminds men and women of their littleness compared to the Universe. It attempts to calm the selfish passions of men and women. Christianity emphasises the rights of others and our willingness to respect this.

What is the main difference between Stoic Philosophy and Christianity?

5 Modern philosophy is considered to have started in the sixteenth century. Francis Bacon and René Descartes are associated with its beginning. Philosophical thought before this time is called ancient and medieval.

Give the names of the three periods of philosophy mentioned in the above statement.