University of Southampton

Faculty of Social Sciences

Research and Graduate School of Education

Cognitive Load and the Writing Process:

The Paradox of the Dyslexic Writer

In Higher Education.

Volume One of Two

By Geraldine A. Price

Thesis presented for the degree of Doctor of Philosophy

July, 2003

UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL SCIENCES

RESEARCH AND GRADUATE SCHOOL OF EDUCATION

ABSTRACT

Doctor of Philosophy

Cognitive Load and the Writing Process: The Paradox of the Dyslexic Writer In Higher Education.

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This research examines the impact of the dyslexic cognitive profile on the writing process. Seven undergraduate and postgraduate students from a University have participated in this study. The research records writing behaviours which occurred during the production of a written assignment. The task environment is naturalistic and embedded in the student's coursework. Real time sampling data are used in conjunction with semi-structured interviews, drafts of written work and final text products to examine how the dyslexic students meet the demands placed upon them in the writing process in a Higher Education environment.

The data show that, despite very individual cognitive profiles, a combination of working memory capacity and speed of processing deficits *combined with* weak literacy scores results in a disproportionate percentage of time being spent upon the translation component of the writing process. Thus, text generation and time and task are affected. The findings also demonstrate that these students have developed compensatory strategies, adapted to the cognitive deficits, to cope with the demands of this discourse community.

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This thesis was submitted for examination in July, 2003.

It does not necessarily represent the final form of the thesis as deposited in the University after examination.

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ACKNOWLEDGEMENTS

Firstly, I would like to thank Professor Brumfit for his guidance. I have valued his comments and advice which have helped me to sharpen up this work. Secondly, I would like to mention Dr. Gemma Moss with whom I had many discussions in the early formulation of the work. It was useful that our fields were so different. She often stopped me in my tracks and made me re-consider many aspects of literacy development which I have taken for granted.

I would like to thank the many students over the years who have helped me to understand what it is to be dyslexic, and in particular the seven dyslexic students who participated in this study and who gave so generously of their time.

Finally, I wish to thank my husband, Tony, without whom this would not have been possible. His constant encouragement and support have carried me through the work. I am indebted to him for his meticulous proof-reading. He has listened as I have explained my ideas thus enabling me to develop my thoughts. His patience and good humour have been most appreciated.

Preface:

This thesis brings together many related fields: education, cognitive psychology and neuropsychology. The hub of the study is dyslexia, and the spokes radiating from this are concerned with a) the writing process; b) the writing demands in Higher Education, with a specific focus on the dyslexic writer; c) the role of working memory, speed of processing and automaticity in the writing process; and d) the impact of the cognitive profile on the writing process and the production of a written assignment. It is primarily about the dyslexic writers' experiences, and the difficulties these writers encounter within the task environment. The research draws upon theories of:

- Developmental Dyslexia
- Writing Process
- Working Memory.

The research aims to bring about a synergy of the current theoretical perspectives in these areas so that there is a platform for future interdisciplinary dialogues.

Much has been written about dyslexia, the role of working memory and the writing process. Over the last hundred years, the debate about the causes of dyslexia has raged and taken many twists and turns with growing understanding and advances in technology for monitoring and measuring brain physiology. Many of the studies of dyslexic learners have focussed upon the relationship between dyslexia and reading difficulties with *young* children. There is a fast-growing research community interested in the writing process. Again, the studies have frequently examined the young, novice writer and, more recently, writing in Higher Education with non-dyslexic students. As dyslexic students work their way up the educational system, more have entered Higher Education, and this has been reflected in the increase in ethnographic studies of the problems faced by dyslexic students in this sector. The Disability Discrimination Act, Part IV relating to special educational needs (SENDA) has also stimulated interest in factors relating to assessment, identification and support for these students. The combination of the writing process and the dyslexic writer in Higher Education

has been overlooked, and this research seeks to redress the balance. Although many of the issues explored are linked to cognitive psychology, the study is firmly located in a phenomenological epistemology.

The first chapter helps to ground the research and demonstrates the impetus for the investigation which seeks to explore the paradox of the dyslexic writing behaviours in relation to cognitive load and the writing process. Chapter Two reflects upon current research in the three fields concerned with this work. The literature in these fields is considerable, and I have, therefore, selected carefully to set out the parts of the jigsaw which are pertinent to this research and which provide the foundations for the development of the framework for this multi-dimensional study. Chapters Three and Four examine the research methodologies of these divergent fields and seek to explain the approach adopted. The research design rests upon the need to combine quantitative and qualitative information. This has been achieved by collecting data from real time sampling of the writing process in conjunction with ethnographic data from semi-structured interviews, draft writing and finished products. Bringing together elements of education and cognitive psychology requires careful research design so that the findings can inform future research and can reshape thinking in this area. Chapter Five provides background information about the seven students who have participated in this research. Educational history and experiences together with detailed, individual cognitive profiles are scrutinised. In Chapter Six the data are presented and analysed systematically. The research design relies in part on the replication of a data collection method devised by Torrance and his colleagues (Torrance, *et al.*, 1999) and utilises the computer program which was set up to analyse the real-time sampling data. These data are juxtaposed with the dyslexic writers' perceptions so that the student voice is part of the equation. The subsequent findings are examined, and conclusions are drawn in Chapter Seven. Finally, the implications for pedagogy are described and ways forward for research which combines education, cognitive psychology and neuro-psychology are discussed.

Chapter One: How I came to this project

1.1 How questions change

As a practitioner in the early 1970s, I was brought to an abrupt halt and was made to question many of my fundamental beliefs about intelligence, literacy and education. When working as a key-skills consultant in a boys' grammar school, developing a whole-school policy and programme for the introduction and progression of key-skills teaching during tutorial time, I came across an anomaly. A member of the Science department asked me to look at one of his 15 year old pupils (who will be called Tristan for the purposes of this work) from the 'accelerated' group: a group of twenty pupils who were being entered for six GCEs in Year 10. Before conducting my assessment of the boy, I did some preliminary enquiries by discussing his academic ability as one of the 'elite' group, his motivation and his progress. Tristan came from an academic background rich in support: both his parents were professors at the local university and at twenty-two years of age his elder brother held a PhD in Astro-physics. Tristan, according to staff, was a pleasure to teach because he picked up concepts easily, was a logical and clear debater and demonstrated sophisticated verbal skills of communication. His command of language in oral sessions in lessons was 'second to none'. Staff anticipated that he would obtain A grades in his thirteen GCE subjects and was 'university material'. However, they also spoke of his 'endearing qualities': qualities which they were prepared to overlook in Lower School because of his obvious ability. Staff thought of him as an absent-minded professor type whose organisation was weak and whose handwriting was untidy and contained many crossings out.

I was puzzled by the confident teenager who became anxious and evasive during assessment. His silent reading comprehension was above his chronological age yet his single word spelling demonstrated a large discrepancy. I checked and re-checked my figures but could not get his spelling age above nine years three months on the standardised test. Having asked Tristan to provide me with a sample of his writing, I was perplexed when he made excuses and apologised for leaving his piece at home. I assured him that this was not an insurmountable difficulty

because I could obtain samples from his History, Geography and English teachers. As an after-thought, I decided to ask him to read aloud a passage from a standardised test. It was a painful experience for both of us: he stumbled and stuttered his way through what should have been an easy passage, making many wild guesses and many semantic substitutions. On further investigation, it became apparent that his unease at showing his prose writing was wide-spread: few of his teachers, on closer inspection of their mark books, had evidence and were embarrassed to find that he had managed to give plausible excuses for non-submissions. He had slipped through the net.

I worked on his spelling, the initial request, and tried to adapt the 'remedial' experience to his intellectual ability and his functional needs. What the headmaster would have thought if he came into our lunch-time sessions to see us playing Scrabble, I do not know. Although there was some improvement in Tristan's spelling, it was more by intuitive, good luck than through methodology grounded in theory! I tackled what was perceived as his immediate problem. I often wonder what Tristan is doing today.

This was the start of a quest which, so far, has endured thirty years. I became determined to find out why an intelligent teenager from a good socio-economic background, with the advantages of the best the educational system had to offer could reach Year 10 with such weak literacy skills. My first questions were: how could someone with demonstrable ability not be able to spell, and to read with such difficulty; and how could someone with such inaccurate reading skills be able to comprehend? Although I did not know it at the time, this was my first introduction to dyslexia.

Over the years the questions have changed and in a sense reflect my progress. I propose to examine my questioning over the years so that a developmental perspective can be reached to account for my current hypothesis. I shall put this into the context of the various avenues of research into dyslexia, and the impact the research has had upon classroom practice.

1.2 Changing Definitions of Dyslexia and their Impact upon Education

To answer the question 'What is Dyslexia?' would seem a simple task. However, the plethora of definitions of dyslexia reflect the complexity of this field. It has been the subject of research for neuro-psychologists, cognitive psychologists, geneticists, neurologists, educational psychologists and, of course, educationalists, each with their own terminology and theoretical constructs. To try to develop a definition which would be acceptable to all these areas would be impossible. There has been no agreement after over 100 years on the definition of the disorder or syndrome, variable or otherwise, of dyslexia or specific learning difficulties. Research literature demonstrates no agreement internationally on a definition of terminology. BUT research literature demonstrates agreement of the seriousness and intractability of the learning problems encountered. Trying to define the term dyslexia/specific learning difficulties has been the subject of acrimonious and, some would say, futile debate for decades. The difficulties in defining the terminology reflect divergent opinions about causes and remediation; reflect trends in approaches: the behaviourist approach has now almost disappeared and has been superseded by the cognitive approach. These approaches are reflected in research and colour conclusions and findings of data. Many of the definitions reflect the current research issues, the need to develop a taxonomy for dyslexia and models of identification.

For the purpose of this work I shall use the terms 'dyslexia' and 'specific learning difficulties' interchangeably. That is not to say that I am not unaware of the controversies surrounding both these terms. This is not the arena to debate such a loaded issue. However, I shall make passing references to historical changes and uses where they affect research findings.

It is necessary to turn back the pages of history to obtain an understanding of the lines of research and the current thinking in the early 1970s when I first became aware of the puzzling case of Tristan.

Interest in dyslexia began in the 19th century with the medical profession. Morgan reported in the British Medical Journal about one of his young patients, Percy, who wrote his name as 'Precy'. He described the boy thus:

> " (Percy) has always been a bright and intelligent boy, quick at games and in no way inferior to others of his age. His great difficulty has been – and is now – his inability to learn to read. This inability is so remarkable and so pronounced, that I have no doubt it is due to some cognitive defect."
>
> Morgan, 1896, cited in Thomson, 1984, p.4-5

Morgan's research was echoed by Hinshelwood who observed similar behaviours with patients who appeared healthy and normal, yet suffered from 'word blindness' (Hinshelwood, 1917). He defined this as a congenital defect in children with undamaged brains, and that it was characterised by an inability to learn to read. The keen interest in the subject by the medical and psychological professions led to the notion of dyslexia as a 'syndrome' – a term which is used most specifically in medicine. To qualify as 'a condition or syndrome' there has to be a distinct aetiology, identifiable characteristics, prognosis and response to intervention. This would eventually open up the research fields in an attempt to determine aetiology, characteristics and intervention.

A medical model understandably became prevalent. The language associated with this model can be seen in the use of 'disorder', 'congenital defect', 'disease', 'diagnosis', 'prognosis' and 'intervention'. The emotive phrase 'word blindness' has its origins in a physical/medical condition. Translated into educational settings, this engendered a checklist mentality for identification and diagnosis.

The definition given by the World Federation of Neurology in 1968 further advanced the medical model, cited by Critchley (Critchley, 1970):

> "(Dyslexia is) a disorder manifested by difficulty in learning to read despite *conventional* instruction, *adequate* intelligence and *socio-cultural opportunity*. It is dependent

> upon fundamental cognitive disabilities which are frequently of constitutional origin."
>
> (My italics)
> Critchley, 1970, p.11

The term 'disorder' heightens the medical model effect, whilst 'constitutional' has undertones of the need to distinguish between those with neurological dysfunctions or brain damage, and the group who are simply 'born with it'.

The second prevailing theme is that of the IQ/RA (Intelligence Quotient/Reading Age) discrepancy: the concept that 'normal' children who have no physical or neurological impairments demonstrate a discrepancy between adequate intelligence and an inability to read. The above definition fuelled debate: what makes instruction 'conventional'; who defines 'adequate' intelligence; and what 'socio-cultural opportunities' would satisfy the definition?

Indeed, my two initial questions regarding Tristan were being reflected in these definitions.

The Bullock Report, (Bullock, 1975), whilst muddying the waters by rejecting the term dyslexia as being 'not susceptible to precise operational definition', chose the term *specific reading retardation*, a term developed by Rutter (Rutter *et al.*, 1973). The definition of this clearly falls within the IQ/RA discrepancy model, yet drawing upon the terminology of the medical model:

> " A syndrome characterised by severe reading difficulties which are not accountable for in terms of low intelligence and which are not explicable merely in terms of the lower end of a normal distribution of reading skills."
> Bullock, 1975 cited in Young *et al.*, 1983, p. 15

Critchley and Critchley provide additional weight to the IQ/RA discrepancy model:

> " Developmental dyslexia is a learning disability which initially shows itself by difficulty in learning to read, and later by erratic spelling and lack of facility in manipulating

> written as opposed to spoken words. The condition is cognitive in essence, and usually genetically determined. It is not due to intellectual inadequacy, or to lack or socio-cultural opportunity, or to emotional factors, or to any known structural brain defect."
>
> Critchley *et al.*, 1978, cited in Pavlidis *et al.*, 1987, p. 1

The distinction between written and spoken language would fit the descriptions of Tristan which were clearly observed by his teachers.

These definitions could be called exclusionary: for example, if the child does not have an IQ of 90+ he is not, by definition, dyslexic. Most of these definitions exclude brain damage or neurological dysfunction. So what does the dyslexic child look like to the practitioner? These children should be easy to identify because their reading problems do not stem from:

- a lack of parental encouragement (socio-economic opportunities);
- missing out on aspects of instruction (conventional instruction);
- a mismatch between intellectual ability and attainment.

Such exclusionary factors are useful to researchers. They provide clear-cut delineations and will enable comparison and correlations to be drawn. However, what message did such definitions give to educational practice, and how was this message interpreted in an educational setting in terms of the teaching experiences which would provide opportunity for the dyslexic pupil?

In the 1970s, many schools faced with these questions utilised the C.A.T. (Cognitive Assessment Tests) scores to provide a starting point in diagnosis. The non-verbal and the verbal scores were compared. Single word reading and spelling tests were administered. Discrepancies between the scores were examined. Children, thus identified using the IQ/RA discrepancy model, were given remedial help, the focus of which was to increase reading and spelling abilities. Many children at this time were exposed to small group teaching: a 'more of the same' or a 'brute force' approach to reading. An essentially bottom-up methodology was adopted, concentrating upon building up visual memory for words to assist reading and concentrating on the spelling of high frequency words, many of which

were irregular. For the latter a phonics approach was used which was a) unsuitable for irregular words; and b) not necessarily the most appropriate method for a dyslexic learner.

It is little wonder that the populist perception of 1970s and 1980s that dyslexia was a middle-class syndrome, a euphemism for slow learners, did little to enhance pedagogy. Parents of dyslexic children felt that the term dyslexia had less stigma attached to it than 'less able' or 'slow learner'. To this day, the term dyslexia has a certain acceptability which 'general learning difficulties' does not have with some parents. This may be because of sociological factors and the importance of literacy in our society. At that time, if a person was illiterate or, even worse, could not learn skills which were considered basic, viz. to read and write, despite having been taught, the prevailing attitude was that such a person was relegated to a sub-stratum of the population.

Some of my questions about Tristan were partially answered: how could someone with demonstrable ability not be able to spell and find reading so difficult? Simplistically, the answer could be because he is dyslexic. However, the second question - how could someone with such inaccurate reading skills be able to comprehend - brought into question the issue of what is reading?

One possible answer to the second question about Tristan could be summed up by the idea that reading is a 'psycholinguistic guessing game'. (Goodman, 1967). Much of the research into dyslexia has focussed on the reading process, and the idea that a dyslexic person is someone who cannot read or spell is still a prevalent misconception adhered to by the media. This was borne out by my experiences with the secondary-aged pupils who could get some meaning from text if there was sufficient context upon which to draw but who failed miserably when attempting single word standardised reading tests. For the dyslexic reader it would appear that much store is set by the context so that the phonological skills could be by-passed. It demonstrates that the older dyslexic readers develop intuitively an interactive approach to reading because it is the only approach which will enable them to survive the process. Smith, concurs with this:

> " ..... reading is not a passive activity but involves complex intellectual processes that must always be actively initiated and directed by the reader."
>
> Smith, 1978, p.9

Nevertheless, by the end of the 1970s I felt constrained by the focus on reading. My questions had developed. I wanted to know why a phonics approach worked for some dyslexic adolescents and not others. I felt that an understanding of the cognitive processes of reading might help in the diagnostic identification of dyslexic pupils. This led to controversial issues of sub-types which still dog researchers.

1.3 Discrepancy Models/Sub-types of Dyslexia

As I became more experienced I was aware that dyslexic learners did not differ only in their reading and spelling ability from 'normal' readers. There were many other factors which occurred which led me to believe that dyslexia was indeed a 'constellation of difficulties' (Tansley *et al.*, 1981). In the early 1980s the definitions looked backwards and took us forward in thinking:

> " Children with specific learning difficulties are those who in the absence of sensory defect or overt organic damage, have an intractable learning problem in one or more of reading, writing, spelling and mathematics, and who do not respond to normal teaching."
>
> Tansley *et al.*, 1981, p. 259

The definition opens up the field and encompasses writing and mathematics. Yet, it was apparent that not all dyslexic children have the same profile of difficulties. The pupils I taught had sequencing difficulties; had problems with visual perception; appeared to have problems with short term and working memory. This made my work more complex and challenging but also begged the question: what causes the difficulties?

In order to answer this question it was necessary to be aware not only of developmental stages in the acquisition of reading but also to examine the

cognitive structures involved in the reading processes and to try to understand the impact of the dyslexic deficits in the reading process. Questions such as what is reading and how do children develop the skills of reading from the mechanics to higher order skills (the developmental continuum of reading) were of general interest to me at the time in that they helped me to refine my questions about the dyslexic reader. It was vital that I understood how a 'normal' child learnt to read in order that I could explain why Tristan's cognitive profile might have a bearing upon the process. More importantly for me it would help me to devise effective ways of ensuring that his literacy development progressed.

As an English graduate who had experienced no difficulties in learning to read, I had not considered what was involved: I took reading for granted. Tristan's problems made me consider the issue of reading. Frank Smith's ideas of the nature of reading were to stop me in my tracks and helped me to consider what it is we do when we read (Smith, 1978). His psycholinguistic approach fitted well with the questions which were evolving with Tristan. To Smith reading was:

> "not just the eyes but also the mechanisms of memory and attention, anxiety, risk-taking, the nature and uses of language, the comprehension of speech, interpersonal relations, sociocultural differences, learning in general and the learning of children in particular."
>
> Smith, 1978, p.2

Tristan's short term memory was poor; he demonstrated anxiety when he had to read aloud in class or when he had to concentrate upon the act of reading for any length of time; and as I got to know him, it became obvious that he was never prepared to take risks in his reading but rather laboured over every word, every syllable and every letter. Smith's statement 'children do not need to be very smart to learn to read' (ibid.) stuck in my mind as I clutched at ideas to explain Tristan's dilemma. Smith was not concerned with a discussion of the definition of reading but rather looked at the process itself and the role of comprehension in this process. In order to minimise the physiological aspects of reading – the visual decoding – Smith examines the visual and cognitive factors in reading and at this time helped me to consider the causes of Tristan's failure to acquire literacy.

I adopted a miscue analysis approach to finding out the causes of Tristan's difficulties whilst trying to understand the normal reading developmental continuum. The phonological and direct routes to reading exemplified in Marshall's work helped me to unpick what was happening to Tristan (Marshall, 1982). He argued that there are three routes to reading. Route A is the direct route which is the look and say approach which Tristan tried to use, though unsuccessfully; Route B is the 'barking at print' approach which certainly did not apply to Tristan who could not pronounce the words effectively. Such a route is often exemplified by the children in school who sound fluent but who have little comprehension of what has just been read. Tristan was the opposite to this in that he spent most of his time trying to extract meaning despite decoding inaccuracies. Route C, according to Marshall, was the phonic route whereby orthographic knowledge is used to convert grapheme-phoneme correspondences. Tristan, although expending his energy on trying to use limited and rigid phonic rules, did not have sufficient orthographic knowledge to make the most of this approach despite coming from a highly literate family and with a good surface command of oral language. Thus, it appeared that there was more to the problem than an examination of 'normal' reading development. It was imperative to develop a clearer understanding of the causes of dyslexia in order to consider pedagogical issues.

Exploring the aetiology of dyslexia in the early 1970s was fascinating. The psychological model superseded the medical model as more and more psychologists became interested in dyslexia research. The psychological model was interested in process and product; cognitive dysfunctions which could cause reading failure; and causal features of specific cognitive functioning. However, cognitive psychology is a wide field, and the specialisms within it are too numerous to go into here. The result is that this research field is extensive, examining reading, for example, from a very specific and narrow focus. Nevertheless, the pivotal element in most of the research was reading failure and what caused this. The prerequisites of learning to read were analysed. Some research studies examined phonological functioning (Tallal, 1980). Visual

processing, a highly controversial area, was looked into (DiLollo *et al.*, 1983, Vellutino *et al.*, 1973, Lovegrove *et al.*, 1986). However, some of the correlations were considered tenuous and did not spell out how some of these cognitive problems related to the reading behaviour of a *dyslexic* child.

Other researchers have examined reading behaviours. The dyslexic reader often sounds out and substitutes words while reading. However, these behaviours are also seen in younger children who are in the initial stages of learning to read (Bryant *et al.*, 1986). This would suggest that dyslexic readers have a developmental delay and that eventually they will be able to learn to read. This did not help me to explain why Tristan had not learnt to read by secondary school.

Many researchers considered patterns of reading behaviour which led to defining sub-groups of dyslexia. Early models of sub-groups were posited (Myklebust *et al.*, 1962). Two broad sub-groups emerged: visual or auditory dyslexics. The visual dyslexics have difficulties with visual discrimination and perception and learn best through auditory channels whilst the reverse is true for the auditory dyslexics. Further sub-groupings gave rise to distinctions between 'p' and 'l' sub-groups: the former are able to read fairly accurately but are much slower and hesitant; the latter read more quickly but with many errors and substitutions (Bakker *et al.*, 1990). The terms dysphonetic and dyseidetic were used to make the distinction between those with phonological and those with visual reading difficulties (Boder, 1973, Liebeman *et al.*, 1985). This research had great significance for practitioners and guided decisions about different teaching methods. Those of us in the Special Education field were particularly interested in these findings: they also had an impact upon identification and assessment of dyslexic children so that a more detailed cognitive profile could be drawn. It would make a difference to my teaching to find out if Tristan was a dysphonetic or a dyseidetic dyslexic. As a young teacher this suggested that there were different types or sub-groups of dyslexia which needed to be identified very finely in order to choose the best method of supplying support. Thus, it appeared that dyslexic children had individual deficits which needed to be examined.

The notion of a variety of deficits gave rise to further research. In one sense this harks back to Hinshelwood's work, which tried to explain why a child with perfectly good vision could not 'see' the words he was reading and which led to the notion of a deficit in the visual processing systems. This approach examined dyslexic deficits in memory, segmentation, verbal, visual and double deficit. The visual deficit theory is making a come-back after being ousted and somewhat discredited by those who supported the verbal deficit theory. (Stein *et al.*, 1982, 1985, 1993) Verbal deficit refers to language problems caused by difficulties in language processing (Vellutino, 1979); problems with segmentation and synthesis of sounds (Snowling *et al.*, 1986); and word finding difficulties (Denckla *et al.*, 1976, Snowling *et al.*, 1989). Verbal memory difficulties were measured by digit span tests. Deficits in short-term memory tasks were noted with dyslexic children. (Thomson, 1982, Rugel, 1974, Miles, 1982) It has also been shown by the work of Baddeley,(Baddeley, 1976), that phonological coding is important in short-term memory tasks. Another approach is the double deficit theories of which there are two: one is a combination of phonological and naming speed difficulties; and the second combines phonological and visual disorders.

1.4 From Research to the Classroom – Identification and Assessment

Adelman, writing about diagnostic assessment of dyslexia/learning disability (LD) states :

> " As used by practitioners, the classification of a youngster as LD not only implies a contemporary problem ..... but also implies that the cause of the problem is related to central nervous system dysfunctions and (predictively) that learning problems will continue until corrective action is accomplished."
>
> Adelman, 1979 p. 57

Rather than see each of the above-mentioned areas of research into deficit as separate, I would prefer to consider them as parts of a continuum of dyslexia and adopt a more holistic approach to the identification and assessment of difficulties.

The role of the educational psychologist in schools in the 1970s and 1980s was that of the expert coming to advise teachers. Many of the tests in use to identify learning difficulties could only be administered by educational and clinical psychologists. Teachers were not deemed able, by many psychologists, to interpret and analyse the results and data. Thus, identification and hence educational policy was driven by the research in cognitive psychology.

Wechsler Intelligence Scales (WISC) tests (Wechsler, 1946) were used by educational psychologists. They were not designed to be tests for dyslexia but the information which is extracted from the sub-tests gives a cognitive profile which can be examined. The traditional spiky profile is suggestive of a dyslexic child because of the discrepancies of ability which are demonstrated. Nevertheless, the analysis by educational psychologists frequently pointed out the discrepancy between high overall IQ scores (and frequently high performance scale scores) and the relatively lower verbal scale scores.

Whilst the IQ/RA discrepancy model was used by educational psychologists as proof of a specific learning difficulty, and was adopted by many local education authorities (LEAs) as a benchmark for funding for pupils with severe difficulties, the teaching profession adopted a more pragmatic approach: it was felt that a profile of cognitive *strengths* as well as weaknesses was much more valuable to the choice of an appropriate methodology for teaching these children. Identification and diagnosis became an almost scientific process. An approach which encouraged cognitive profiling was adopted as a means of providing data about cognitive deficits.

However, not all dyslexic children get as far as being examined by an educational psychologist. The Code of Practice, developed by the DfEE, has strict guidelines for the identification of pupils and a structured progression for decisions about who should or should not be seen by an educational psychologist (DfEE *et al.*, 1994). Thus, a teacher-friendly battery of cognitive tests was needed. During the mid 1970s, I was lucky enough to be in one of the schools which was used for the pilot for the Aston Index (Newton *et al.*, 1976). This is a diagnostic screening device

which provides data about general functioning and specific underlying cognitive skills.

> "The aim ..... was to see which test items (if any), isolated 'at risk' children. Thus, if a child scored poorly on a particular test item, one would expect him to do poorly at reading and/or spelling two years later if that item was a useful predictor of written language difficulties. Conversely, children performing well on the Index items might be expected to do well in written language."
>
> Newton *et al.*, 1976 p.1

The Aston Index attempts to profile children into visual or auditory dyslexic types, reflecting current theoretical thrusts. The sub-tests were used to assess visual sequential memory, perceptuo-motor skills, auditory sequential memory, laterality, ability to discriminate and blend sounds, (simple, phonological tests) and underlying ability and readiness to read. This tool was used most frequently at the time by teachers because it gave a wide spectrum of information in a short time and allowed them to screen children easily. Although its validity has now been discredited, it was accessible to teachers and helped to provide a cognitive profile which would inform teaching. The tests were based on the Standford-Binet Intelligence Tests, the English Picture Vocabulary Tests and the Goodenough Draw-a-man test. Some researchers have questioned the validity of using this combination of tests to predict general underlying ability and have disputed the need to predict, preferring rather to find out what the child can do (Newcomer, 1977, Lovell, 1972). The question - is this an auditory or a visual dyslexic - was constantly asked. The analysis of the data determined the dyslexic type which in turn determined the individual learning programme for that dyslexic child. The British Picture Vocabulary Scales (Elliot, 1996) and Ravens Matrices (Raven, 1960) were also used by teachers to provide further evidence of dyslexia (identification) and individual, cognitive strengths and weaknesses (diagnosis).

> "Prescriptive teaching should follow from the particular test battery used to diagnose specific learning disabilities. The battery should explore: basic sensory modalities including visual, auditory and tactile perception; motor co-ordination and equilibrium; and 'visual-auditory-motor cross modalities'."
>
> Tarnopol *et al.*, 1975 cited in Tansley *et al.*, 1981, p. 209

1.5 From Research to the Classroom – Teaching Methodology

The examination of the different dyslexic types and the various deficits which could be present helped in the choice of a 'best fit' teaching method which would benefit Tristan. The influence of cognitive psychology and its emphasis on word recognition systems spilled over into the classroom. If the child was a 'visual' dyslexic, with frequent reversals of certain letters, for example, p/b, b/d, u/n and m/w, the use of mnemonics and, in severe cases, the use of the Edith Norrie Letter Case, (Norrie, 1939), were advocated as giving the most success for the cognitive profile. It is widely agreed by practitioners that the most difficult sub-group to remediate is the 'auditory' dyslexic. Those with auditory/language deficits tend to make slower progress than the 'visual' dyslexic. Because of the difficulties in auditory perception, memory and integration, these children have difficulties with phonetic analysis and need to be taught initially by a 'whole word'/ look-and-say approach. The Fernald tracing method was utilised (Fernald, 1943). A number of teaching programmes were published: for example, the Alphabetic-Phonic system was derived from Orton's theory, linking letter combinations of phonemes and digraphs to an appropriate sound (Gillingham *et al.*, 1956) ; and the Bangor Dyslexia Teaching System, incorporating a sequential, small-step approach (Miles, 1989).

The use of multi-sensory language programmes was a dominant feature of the 1980s and still remains to this day for the 2% of children with the most severe and intractable difficulties who require individual support. Such programmes as the Kathleen Hickey Language Programme (Hickey, 1976) and the Alpha to Omega programme (Hornsby *et al.*, 1976) were adopted by specialist dyslexia teachers. These programmes were psycholinguistic in origin, incorporating phonics, articulation and speech training. Thus, their development reflected the thrust of research findings. Training in the analysis of the structure of the English language and development of syntactic and semantic knowledge underpinned these programmes. They were highly structured, cumulative and sequential in nature. Teaching was multi-sensory in that it endeavoured to establish high levels of control over skills in the visual, auditory, motor and kinaesthetic areas of learning. In this way faulty linkages in cognitive functioning were remediated. Behaviourist

objectives were apparent, and the programmes have been criticised and mis-used by many teachers (and pupils) who were impatient with the thoroughness of the training. Such teaching programmes appear to ensure success for various sub-groups of dyslexia, including the dysphonetic and the dyseidetic dyslexic profiles.

As a practitioner, I realised that, whilst this bottom-up approach to language instruction was essential for the children with whom I was dealing, it did not meet all of their needs. The language programme, although effective, was laborious. Secondary school children who are at least four years behind their chronological age in reading and/or spelling have severe literacy difficulties. However, they are having to cope with a curriculum which is segmented and proceeds at a speed which is not commensurate with their literacy functioning. For many of these children the 'vicious-circle cycle' was maintained in schools: they were placed in low-ability groups because of low literacy attainment levels, despite the ability to grasp the conceptual nature of the lessons in the higher-ability groups. Taking these children back to single consonant sounds, for example, p,n,t, did not help them to keep up with the pace of secondary school lessons. Another element was required: study skills training which adopts a top-down (concept driven/metacognitive) model of working. The process of learning was a rapidly expanding research field which examined the use of metacognition and learning styles in the process of learning (Flavell, 1979), (Brown *et al.*, 1986), (Entwistle *et al.*, 1983), (Honey *et al.*, 1986). In the mid 1980s I was appointed to head one of the first special dyslexia units in Hampshire and was able to mould the curriculum as I saw fit. The theoretical basis of this curriculum was psycholinguistic and multi-sensory, adopting an interactive-compensatory model of learning (Presland, 1982, Stanovich, 1980). The work of de Bono (de Bono, 1981) and the Somerset Thinking Skills Programme (Blagg *et al.*, 1988) were based on a metacognitive approach to learning. Whilst not agreeing totally with the claims made by Feuerstein of his Instrumental Enrichment Programme (Feuerstein *et al.*, 1980), which, he stated, could change the intelligence levels of children, the idea that learning styles were a factor of success influenced the development of a 'thinking skills' curriculum.

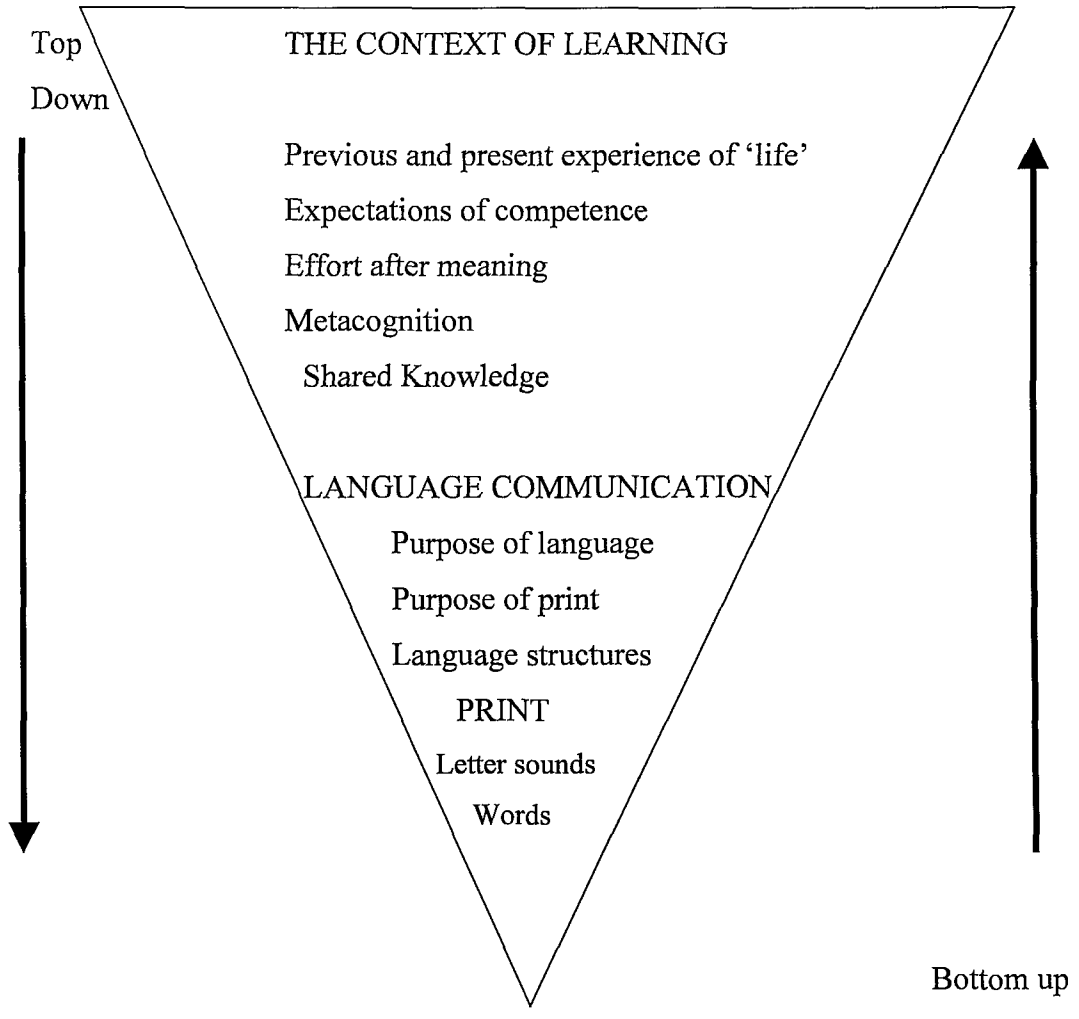


Fig. 1 Bottom-up/Top-down Models Combined

Thus, the apparent dichotomy of the bottom-up/top-down models was merged so that reading and study skills teaching could be combined. (see Fig. 1). Its aims were two-fold: to teach the 'mechanics' or code-cracking of reading and to increase functional literacy. However, central to these principles was my growing understanding of the dyslexic learners' cognitive infrastructure or architecture and its significance to the process of learning to read and acquire literacy abilities – the information processing approach to literacy. Goodman's 'psycholinguistic guessing game' has been discredited by Adams and Stanovich, because it was built on the premise that good readers depend on context for word recognition, and that they make less use of letter information than poor readers as they read (Stanovich, 1980, Adams, 1994). Goodman argued that fluent readers are more efficient users of visual cues, and need to use very few of them. Current views on reading

acquisition have toppled this view and Keith Stanovich's interactive-compensatory model is now more widely accepted among reading researchers than Goodman's model. Stanovich's model takes account of neurolinguistic models and states that fluent readers need less processing capacity for word recognition and thus free up more capacity for comprehension. My experience with the dyslexic adolescents confirmed this: because they had problems with word recognition, they allocated a disproportionate amount of processing capacity to this task with the resulting drop in comprehension levels. Indeed, the adoption of this model seemed the most natural to ensure functional literacy.

> "process(es) at any level can compensate for deficiencies at any other level"
>
> Stanovich, 1980 p. 33

I observed that their difficulties were with verbal efficiency in terms of phonological knowledge and specific knowledge of language structures and also their automaticity (or lack of) of processing language (Perfetti, 1985).

By the early 1990s my research questions had shifted. If I was to develop teaching resources which would incorporate the above thinking and take into account the impact of metacognition on learning for dyslexic pupils, I had to find out about the reading process and its effect upon the writing process. Hence the question: are there differences in the cognitive and neurological functioning of dyslexic learners?

1.6 Cognitive and Neurological Aspects of Dyslexia

Could it be that there are neurological and anatomical differences between the brains of dyslexic and non-dyslexic people? The answers to this question would most certainly help academics to understand the behaviour and observable difficulties experienced by dyslexic learners but would also help educationalists to devise teaching methodology which is most suited to the dyslexic learner.

> "If a child does not learn the way we teach, can we teach him the way he learns.....?"
>
> Chasty, H. in Pumfrey *et al.*, 1990 p. 269

Research into the differences between the right and the left brain functioning is well catalogued. If, as stated by Duane, dyslexia is 'a condition of differential aptitude' (Duane, 1991), then an understanding of the neurobiological features of aptitudes and behaviours related to reading and learning is important. The interest and excitement in the neurological research in the 1990s is significant for our understanding of dyslexia and to inform practice.

Neurological research into dyslexia has produced a number of theories: single causative theory which states that a dysfunction is highly localised, for example, a perceptuo-motor dysfunction; mass actionist theory, which posits that the working of the brain depends upon a variety of complex and interconnected cognitive activities, linked by specific cortical areas; and multiplicity of causation which relates to brain symmetry theories and which states that the more asymmetrical the brain, the less 'interference' there is between the two hemispheres. Improvements in measuring the working of the brain have advanced our awareness of how the dyslexic brain functions. Magnetic resonance imaging (MRI) has shown that the dyslexic brain is symmetrical compared with the asymmetrical non-dyslexic brain (Galaburda *et al.*, 1989, Hynd *et al.*, 1990). This becomes significant when one considers that the left hemisphere (which deals with language, though not exclusively) in the non-dyslexic brain is larger than the right hemisphere. Thus, the symmetry of the dyslexic brain highlights an immediate capacity deficit in the left hemisphere functioning which could account for reading disorders and difficulties. Research also demonstrated that the more asymmetrical the brain, the smoother and quieter are the connections during information processing. Thus, the symmetrical dyslexic brain is 'noisy', and this could affect working memory capacity, for example, which is crucial to the writing process. (The post-mortem studies demonstrated that dyslexic brains are symmetrical.) Such research leads to the idea of an unusual balance of skills which I frequently observe in my dealings with dyslexic people.

I decided to devise teaching approaches and to develop teaching resources which would take account of the outcomes in the classroom of the hemispheric differences and which would meet the needs of the dyslexic adolescent's frustrations in discrepant literacy ability and speed of conceptual mapping. In other words, to provide a system to by-pass phonological difficulties whilst at the same time achieving functional literacy levels which were commensurate with intellectual ability.

I developed the 'Five Point Plan' (see Fig. 2) which was a system for coping with reading at a level above the pupil's reading age (RA) level. Thus, they would be able to cope more effectively with the texts presented in the various subject areas within the curriculum and would be able to interact with non-fiction texts at an independent level of operation. This system aimed at developing:

- prediction and summary skills
- matching reading style to reading purpose
- comprehension self-monitoring.
- Metalinguistic skills.

Five Point Plan

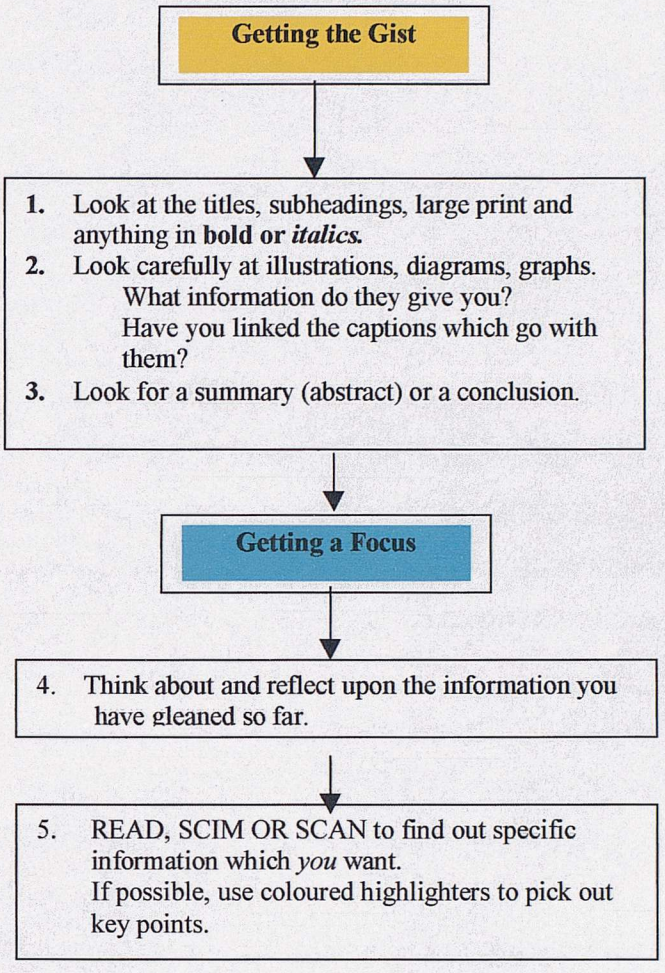


Fig. 2 5 Point Plan System for Accessing Text

The manner in which specific areas of the dyslexic brain develop bears specific relationship to the difficulties experienced in metalinguistic skills. Geschwind produced evidence through extensive case studies that the development of the angular gyrus is thought to be the area of the brain that co-ordinates the metalinguistic processing ability of humans (Geschwind, 1982). If the angular gyrus, the posterior parietal region of the brain, fails to develop at the *correct maturational time* then a disability in the area of higher order language skills could occur. It is thought that delay in development could be happening in dyslexic children. This coincides with the very difficult demands of academic development being made on the secondary-aged pupil. The National Curriculum for Secondary Schools assumes that higher order literacy skills are in place. In the future, children

may reach secondary schooling with these lower-order literacy skills in place as a result of the National Literacy Strategy, however, in the late 1980s this could not be said to be the case for most secondary schools pupils and in particular for those dyslexic pupils with severe literacy problems. Dyslexic children often lack phonological skills. Initially these are needed to make sense of language and to develop spelling, reading and metalinguistic skills such as word associations. The Five Point Plan system would by-pass these phonological difficulties to some extent.

It is vital to increase the dyslexic pupils' ability to communicate on paper. Because of the severe nature of the difficulties of the pupils in the Special Dyslexia Unit, the writing process and support of this was carefully managed. Initially, the pupils had to be taught to dictate ideas to Learning Support Assistants (LSAs), moving on to production of information in written format. Alternative methods of written communication were advocated and de Bono's simple tables were adapted to facilitate this (de Bono, 1981). For some of the weakest pupils this format was the only one which they were able to produce for GCSE examinations, whilst for others this was a stepping stone to the production of essay format. This will be elucidated in Chapter 7, section 7.4.2.

I observed the dyslexic pupils as they wrote their essays. It was fascinating to examine this process. Whilst it is agreed by many that writing is a recursive exercise within a broadly linear structure (Bereiter *et al.*, 1987, Hayes *et al.*, 1980), it would appear that the dyslexic experience was chaotic and time-consuming. My next question was: do dyslexic writers adopt strategies and approaches to writing, governed by language performance which is affected by their condition? This led to an examination of the writing process which will be discussed in detail in Chapter Two.

1.7 Dyslexic students in the Higher Education Context

In the early 1990s I moved to the University and worked in the Dyslexia Support Service (DSS). Initially, DSS was set up to support the literacy needs of dyslexic children in local secondary schools, where there was no specialist support facility. It enabled me to examine the effects of dyslexia and provided a much-needed

service for the local education authority for the severely dyslexic children. I secured NCET (National Council for Educational Technology) funding to analyse the use of portable computers with dyslexic children and students and was able to compare the ways different age groups utilised the machines to communicate information in academic settings. DSS's dyslexia research and work were not widely advertised in the University. However, some undergraduates, who had been identified as dyslexic prior to entry to university, visited DSS. In 1992 there were seven dyslexic students who attended the DSS on an informal basis. They recognised that in DSS there was someone who understood their problems and who could give them advice about how to cope with academic studies. In the period 1992 to 1996 the number of dyslexic students requesting help increased from 7 to 124. This reflected changes in compulsory education, and the growing awareness that dyslexia was acceptable in society. The aspirations of dyslexic children were raised by identification in schools, and some students were encouraged to apply for HE. However, acceptance of students with 'learning difficulties' in Russell Group Universities was, and is still, a subject for discussion by academic tutors.

As the numbers of students who were prepared to admit that they were dyslexic increased, it became apparent that there was a need to support the students, and DSS was the best equipped to do so. Dyslexia Services was set up to provide a variety of support services for departments and students. A referral system is in operation and students find their way to the Services by a number of routes:

1. As part of the Admissions procedures, after formal declaration of dyslexia on UCAS forms;
2. Referral by academic tutors, concerned about the unexpected examination results or following submission of a written assignment;
3. Self-referral

Thus, students fall into two main categories: those who enter HE having been identified as dyslexic and who are willing to make this known; and those students who, for whatever reasons, have slipped through the educational net and have not been formally identified as dyslexic. All students who have declared dyslexia as a disability on their UCAS form are screened on entry in order to ascertain their

current needs and to draw up an appropriate study skills programme to meet the demands made upon them by the chosen course. DSS also conducts cognitive assessments to find out if a student is dyslexic or has study skills difficulties. These assessments provide information about:

- the nature of the difficulties
- the severity of the disability/difficulties
- the effects of the disability/difficulties upon learning
- the provision required for individual students.

On registration with the DSS the students are assessed using the standard discrepancy/exclusionary models mentioned previously, standardised phonological tests, standardised rapid naming tests, standardised short term memory tests and tests of visual and auditory perception. In this way, together with in-depth interviews, the student's cognitive profile is obtained. From this, an individual learning plan (IEP) is drawn up.

In the early days, students came furtively to DSS to discuss their problems and difficulties. Although the cognitive profiles and the resulting communication difficulties were similar to those I had encountered with dyslexic children in schools, it soon became apparent that there were additional elements which needed consideration. Obviously, the dyslexic students who attend DSS have, *on the surface*, acquired the literacy skills necessary to perform adequately at the level required in Higher Education (HE). It was not necessary to implement a rigorous, bottom-up approach to the teaching of reading skills because the students had reached a mechanical level of reading which enabled them to access texts, albeit ineffectively and inefficiently for their purposes. They by-pass their phonological difficulties by relying heavily on context.

In a sense my questions had not changed but were rekindled when I met Isolde. Isolde, a second year Sociology student, was a mature student of 33 years of age who had taken the decision to return to study when her two young children were both full-time at Primary school. She had left school at 15 having been told by her teachers that she should either take up hairdressing or get married! She became a

successful hairdresser and enjoyed the creativity which the job provided, and the chance to use her strong verbal skills. She had always felt that she was capable of intellectual study despite the insurmountable difficulties she had experienced at school when trying to communicate her ideas on paper. She attended a local college and completed an Access course before entering HE. She struggled through her first year at university. While enjoying the intellectual stimulus provided by her sociology course, she was aware that her difficulties had not receded with age and that she had to work longer hours than her peers to do her written assignments. At first she put this down to the gap in her studies and kept hoping that she would 'get up to speed' by the end of the first year. She came to DSS puzzled and frustrated, asking for help with her ineffective reading. After a detailed assessment, I brought up the subject of dyslexia with her and explained what the syndrome was. After her immediate emotional response, she admitted that many of the things I told her about the impact dyslexia has on academic studies helped her to understand many of her childhood incidents. She was aware why she found lectures, seminars, research reading and written assignments difficult to cope with but had no idea how to improve her way of working.

Isolde demonstrated clearly to me that the counselling aspect of support was crucial to maintaining success but that the study skills' needs of HE dyslexic students were similar to those of the secondary school children working towards GCSE and 'A' levels. Thus, the work I had developed in schools was appropriate to the circumstances but needed to be extended and adapted to the new academic setting. Isolde enjoyed reading her sociology texts although she found them time-consuming because she often had to read and re-read sections before she could understand what was being said. She had not developed skimming skills, and tended to 'read aloud' in her head and sub-vocalised difficult passages to aid comprehension. A lack of any system for note-making made written assignments not only difficult but also time-consuming. Isolde relied upon her **auditory memory** to gather information for essays, information from lectures and seminars. Interestingly, she noted that when doing her research reading she relied upon 'hearing what I read' – silent sub-vocalisation which also taps into auditory memory. As she commented, rather like the way her young children read!

My question now was could I develop an educational support programme which would extend literacy skills with students whose literacy development had been arrested (but which was to some extent functional) but which would also take into account the symmetricality of the dyslexic brain and its concomitant impact upon research reading and writing demands?

A top-down approach was therefore the appropriate method of supporting the dyslexic HE student. The lack of higher order reading skills was the main difficulty, and this has been tackled by developing the 'Five Point Plan' (Appendix 1) to meet the needs of HE student reading experiences. The evolution of this system more closely links it with writing to reflect the experience of the current context. Spelling ability is not considered an important issue by most dyslexic HE students. That is not to say that their spelling problems have disappeared but that technology can support them: unlike their experience in schools, in HE it is acceptable for the machine to help them. The findings of my NCET research demonstrated that dyslexic children's and students' spelling can improve and be sustained by being taught how spelling checkers are organised and what the user has to do to help the machine work out the spelling. Intractable spelling difficulties are thus by-passed, and the students are taught how to use technology to their advantage (Price, 1994). In this way the need for the bottom-up approach is side-stepped. A proof-reading system (Appendix 9) has been devised to help students cope with spelling checkers and also to develop metacognition as a long-term solution to their problems. Support for the dyslexic students is centred upon their writing experiences, with the reading being an adjunct of the process.

DSS work with dyslexic students highlights the fact that the generic dyslexic difficulties – poor working memory capacity, difficulties processing and retrieving language and disorganised thought processes – have not disappeared and have an impact upon studying. Dysfunctional organisational skills – in reading and in written expression – are often the greatest problem for many dyslexic students in HE. These, in addition to the dyslexic cognitive patterns, need to be addressed if appropriate support is to be provided.

The dyslexic students who attend the Dyslexia Support Service are often in a state of crisis by the time they arrive. Undergraduate and post-graduate studies require more sophisticated organisational skills. The production of written work for these students, in particular doctoral science students, is problematic. These science students often start at a disadvantage in that they have less experience of extended writing because of the methods of assessing science at 'A' level – which are often in the form of short, factual answers, brief reports and mathematical responses which are less demanding of linguistic structures. Thus, for these students, writing becomes a major dilemma and results in a sense of global disorganisation. The only way Isolde, in particular, could keep on top of her written assignments was to try to revert to a linear approach to the writing process which had been advocated by her English teachers at school – what I called the tripartite approach to the essay (the beginning, middle and end). In a sense this put her in a straight-jacket which actually added to her difficulties in trying to control the process because she found that her dyslexic, cognitive profile got in the way of sequencing and verbal articulation. The intervention model which has been developed at the Dyslexia Support Service hinges upon organisation of thinking and focuses upon the HOW of this aspect of organisation. There is a shift from the bottom-up decoding and encoding focus to the top-down focus on the whole writing process. A shift from literacy skills teaching augmented by study skills to higher order skills acquisition teaching linked to the complexities of organisation of academic written work was needed. However, working with Isolde demonstrated clearly to me that it was important that she understood the learning process in order to take control of the writing process – i.e. the development of metacognition and an understanding of the learning process.

The reactive intervention programme is designed to harness the holistic, right-brained approach to study and to make use of the dyslexic students' random, creative thought structures while at the same time providing mechanisms to organise their thoughts into an eventual linear format which demonstrates sequential, analytical and serial processes.

The inclusion of metacognitive strategies is pivotal in the intervention programme. If the student has an understanding of the learning process and can monitor progress throughout, there will be greater efficiency and quality in the written outcome. Metacognitive strategies provide a barometer of success for the student and attempt to change the student from 'passive and anxious' (Brown, 1992) to the student as an active learner. Flavell described metacognition as follows:

> "Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them, e.g., the learning-relevant properties of information or data."
>
> Flavell, 1979 p.232

Many dyslexic students, prior to entry to HE, have been provided with what is a serialist's approach to essay writing, the sort of approach which suits the person who is a predominant left-brain thinker (see Fig. 3): a paragraph plan within a broad frame of an introduction, a 'middle bit' and a conclusion. Such 'study skills' support pre-supposes that students are able to manipulate and control language within this structure, and that the use of abstract language is fairly well developed.

Hemispheric organisation may be a crucial factor in understanding the difficulties experienced by the dyslexic student in HE with particular regard to research reading and writing. Brain-side functioning linked with cognitive style may be a significant feature in the identification process which ultimately can inform teaching methodology for those who support dyslexic students in HE. Research findings suggest that for dyslexic people the 'balance of skills is unusual' (Miles, 1994). Closer examination of brain functioning in relation to research and writing may provide explanations for difficulties encountered in HE by these students.

Hemispheric specialisation has been shown to relate to academic skills and processes (Caine *et al.*, 1990, Entwistle, 1988, Iaccino, 1993, Pask *et al.*, 1972).

Brain & Cognitive Style	
LEFT HEMISPHERE	RIGHT HEMISPHERE
Analytical	Gestalt frame of reference
Sequential	Holistic
Logical	Visuo-spatial
Rational	Shapes and patterns
Verbal	Colour
Serial processing	Music
Temporal ordering	Random Processes
Linear Processes	

Fig. 3 Hemispheric Style: summarised from Caine *et al.*, 1990

Clearly, an examination of these attributes helped to explain the way the dyslexic student tackles the writing process and in some way changed the slant of my question.

> " Serialists learn, remember and recapitulate a body of information in terms of string-like cognitive structures where items are related by simple data links..... Holists, on the other hand, learn, remember and recapitulate as a whole."
>
> Pask *et al.*, 1972, p. 218

The Gestalt frame of reference preferred by dyslexic students, who often are right-brain thinkers, presents difficulties for them in the writing process. Manipulating concepts, placing themselves in the argument/discussion and communicating their ideas in an essay format calls for sequencing, temporal ordering and organising

the structure of the micro (sentence and paragraph levels) and macro (the relationship of paragraphs to the whole) elements.

The dyslexic students are able to talk about 'essay plans' and hang on to these as a way of getting started with their writing. However, planning is not the crux of the difficulty for the dyslexic student and may mask misconceptions which are crucial to the writing process. Planning and organisation are one and the same thing to many dyslexic writers. Planning is concerned with the systematic arrangement of detail; whereas, organisation is the orderly structure of the whole process. Often dyslexic students do not differentiate between planning and organisation which become one amorphous mass, difficult to control. The essay 'plan' is often their 'organisation'. If we are to help dyslexic students achieve success, it is essential that they recognise these different elements and learn efficient methods for managing their organisation. In simple terms, it is important for the students to differentiate between the WHAT (content) and the HOW (process) of essay writing and to be aware when these separate elements are paramount.

As suggested earlier, lack of automaticity of operation is a significant factor which can affect dyslexic students' study and often results in unacceptable written work. Observing the dyslexic students during the writing process, it became apparent that, in terms of proportional use of time, the dyslexic writer differed from my own experiences as a writer, and that the dyslexic writers appeared to approach the whole process in a different way to a non-dyslexic writer. In a sense the transparent difficulties which Isolde was experiencing – her disappointingly low assignment marks – demonstrated her very real problems: firstly in gathering information from 'difficult' texts and journal articles and secondly, in the manipulation of ideas to produce a coherent and acceptable written product. It became apparent that the dyslexic student in HE required an 'interactive-compensatory' approach (Stanovich, 1980) which combined the bottom-up and top-down models. This approach takes into account the complexity a) of the writing process from research reading to production at this level of study; and b) the dyslexic writer with her cognitive 'tools' which appeared to operate in a different way from the non-dyslexic writer. The interactive-compensatory model would thus enable me to

build upon the preferred method of working yet at the same time provide opportunities for developing a metacognitive approach to a process which was obviously inherently difficult given the dyslexic cognitive profile.

A typical dyslexic profile with working memory deficits, sequencing difficulties, phonological weaknesses, organisational problems and lexical, processing problems has a direct effect upon the writing process, and the resulting lack of automaticity of lower-order cognitive tasks puts pressure upon an already weak working memory. The intervention programme devised had to take into account the current research findings and the practical needs of the student in an HE context. It was vital to develop systems which supported lexical difficulties while handing over the control to the learner. Thus, techniques which would produce order and at the same time allow for random generation of ideas needed to be invented. It is not the generation of ideas but rather the control and order which seemed to be most time consuming for Isolde and put most stress on the working memory.

Many students have commented that, in the Dyslexia Support Service, the emphasis is on differences in learning and that we seem to advocate systems for dyslexic people first and foremost rather than expecting the dyslexic thinker to fit into a serialist's mode. In a sense the DSS works with the student at the 'zone of proximal knowledge' (Vygotsky, 1962)

In working with Isolde I noticed a shift in my emphasis, not in terms of pedagogy but in terms of what it was that I wanted to find out. A cursory glance at a dyslexic script and a poor writer's script demonstrates similar, surface secretarial inaccuracies together with weaknesses in paragraph and essay structure. Thus, an examination of the product would not answer my question: are dyslexic writers different from poor writers. There has to be another factor which needs to be taken into account: does the dyslexic, cognitive profile have an impact upon the writing process. This begs the question: are the writing strategies of dyslexic writers different from those of poor writers in HE?

Chapter Two: Language, Dyslexia and Writing

2.1 The Research Context

Although primarily an educational field of study, this research is reliant upon a range of research issues and debates. The major thrust of the research is to examine the *dyslexic* writer. Educationalists in the dyslexia domain are influenced by psychology: either from the behaviourist or the cognitive perspective. As a practitioner, I have always adopted a pragmatic position in determining the most appropriate teaching methods, drawing upon behaviourist and cognitive approaches. However, as an educational assessor, the principles of cognitive psychology have informed my interpretations of data in the identification process. To help me to understand the anomalies with which I was presented in schools and in Higher Education, knowledge of information processing was vital – the sphere of the cognitive psychologist. The often refreshingly different ways of learning of the dyslexic and the frequent difficulties encountered by the dyslexic learner in academic situations result in the need to examine the dyslexic, cognitive profile in the context of the writing process. In this sense my research is a hybrid. A study of this kind, therefore, draws together aspects of cognitive psychology – in particular the cognitive dynamics of the writing process – and the theories of dyslexia. Because the research is placed within the context of Higher Education, it is vital to explore research on adult writers and in particular *dyslexic*, adult writers. This latter will serve as an overlay to the literature review.

It is important to clear the ground at the outset and to state what I shall *not* be examining so that the literature review is purposeful and focussed, and so the reader can understand why specific aspects have been carefully selected out of this chapter.

2.2 What can the 'Product' (text analysis) provide?

Writing, in a broad sense, encompasses product and process. This somewhat simplistic view serves to demonstrate the dichotomous aspects of any study of

writing. I have seen many examples of dyslexic writing over the last thirty years and can vouch for the weaknesses of the finished product in terms of sentence and paragraph structure, and, more particularly, the quirky and idiosyncratic use dyslexic writers make of language as an expression of their thoughts and ideas. The difficulties faced by dyslexic students when writing are such that the manipulation of words and structures is often greatly curtailed. In a sense this is the essence of what it is to be dyslexic in a literate society.

Language is often viewed as a medium for *social* development and, if analysed in Hallidayan terms as the 'relation of language to social man' (Halliday, 1978), would exclude much of the dyslexic aspect of the cognitive dynamics of their writing. The dyslexic writers' language would not be a strong indicator of how they interact with the environment because of their specific language processing problems. A sociolinguistic study, whereby language is placed within the cultural arena, places emphasis upon the study of language from the outside, i.e. from the position of the society, in a Durkheimian perspective, looking at the individual's use of it. A study of the dyslexic 'product' would show an inability to reflect cultural written codes, perhaps as a result of deficits in the processing of language. The emphasis on the social context, as opposed to the individual, does not fit well with this research where the individual is at the heart and in particular the specific cognitive profile of a dyslexic writer. An analysis of the dyslexic writer's use of language would only serve to demonstrate the inability to use linguistic forms and codes. Are we, therefore, to draw from this that the socialisation process for the dyslexic is incomplete or flawed?

> " ..... the form of the social relation, or more generally, the social structure generates distinct linguistic forms or codes and these codes essentially transmit the culture and so constrain behaviour."
>
> Bernstein, 1971, p. 122

This is not the focus of this research and for these reasons I will not review this literature.

Another field of study which focuses on the product is descriptive linguistics, studying language for the purpose of throwing light on language and providing terminology and categories for researchers into the nature of language. If linguists restricted their study to the writing of dyslexic people and *their* use of language, a skewed interpretation of language would emerge! However, text analysis can provide insight into the stage of the writer within a writing developmental continuum. A study of the correlations within a written text would not necessarily inform me of the dynamics of the writing *process* experienced by the dyslexic writer. However, text analysis using Hunt's T-unit structure, for example, would provide evidence of the lack of maturity of a dyslexic writer in Higher Education compared with his/her peers' writing (Hunt, 1983). If I wished to examine developmental features of dyslexic writing, text analysis of grammatical structures, number of words per T-unit, number of T-units per sentence and number of clauses would give rich data. The study of the control of syntactic complexity would not totally furnish me with information about the cognitive processes and the nature of text construction in relation to the dyslexic cognitive profile.

A study of text (product) at the interpersonal level of text construction would certainly enable me to analyse the writer's attitude to the reader and to the content/subject matter. It would give the language parameters the writer uses to manipulate texts for various purposes and would demonstrate personal style of the writer (Biber, 1988, Dillon, 1981). To some extent this pre-supposes an ability to manipulate text to some effect: an underlying difficulty of the dyslexic writer. Thus, such study would offer little in terms of this research.

Although a strong case can be made for the study of the writing process in the context of this research, it would be foolish, nonetheless, to ignore the product which will, hopefully, shed further light on the dyslexic writer's ability to manipulate language in the context of writing in Higher Education.

2.3 What is Dyslexia?

> " The definitions of 'dyslexia' seem to be variations on a physiological theme, each variation being composed by a different specialist."
>
> Ravenette, 1968 in Young *et al.*, 1983, p.18

As mentioned in chapter one, defining dyslexia has always been fraught with difficulties because the dyslexia research community is so disparate. Members of this community come from various fields of psychology, neurology, genetics, optometry, opthalmology and, of course, education, each with their own set of terminology; practitioners, such as teachers and speech therapists; policy makers, for example the Department for Education and Skills (DfES) and Local Education Authorities (LEAs); parents of dyslexic children and not forgetting the dyslexic person. It could be argued that a definition is not necessary and merely serves to deflect the real issues of developing a theory of dyslexia. However, the development of a single theory would appear to be difficult, if not impossible, given the various fields of study.

> "..... apparent differences of view in this area may sometimes arise not primarily because the facts are obscure and controversial (though this may be) but because different theorists have different objectives."
>
> Henry *et al.*, 2000, p.38

I have chosen to use the term 'dyslexia' because of its impartiality to some extent.

> " The advantage of the label 'dyslexia' is that it has no intrinsic meaning – it says nothing about the underlying cause, and is neutral as to whether the cause is visual, phonological, motor or some combination."
>
> Nicolson, R. in Fawcett, 2001, p. 5

The main theories of the causes of dyslexia which will be reviewed are:

- **IQ Discrepancy**
- **Phonological Core Theory**
- **Vision-based**
  - Visual Perceptual Problems
  - Vergence Control
  - Binocular Stability
  - Magnocellular Theory
- **Sensory Processing**
  - Rapid Auditory Processing (RAP)
  - Motion Sensitivity
- **Working Memory**
- **Automaticity**
  - Rapid Automatic Naming (RAN)
  - Dyslexic Automatisation Deficit (DAD)
- **Brain-based**
  - Cerebellum - Balance
  - Hemisphere Dominance
  - Wernicke-Geschwind Model
- **Biological**
  - Hereditary
  - Genetics

2.4 Historical Context of Current Research

To understand the current theories which abound in this field, it is necessary to take a brief look at the research before Frith's causal model of dyslexia which I

will take not only as a landmark but also as a confluence of ideas and knowledge (Frith, 1985).

Questions such as:

- Why do some children have difficulty learning to read and write, despite adequate intelligence?
- Are dyslexic readers different from other readers?
- Is dyslexia more than a question of reading and spelling?

have proved difficult to answer and conceptualise. The very existence of dyslexia has been punctuated by controversy, not least about definition, aetiology, criteria for identification, assessment, remediation and teaching methodology. Inability to acquire the basic literacy skills of reading and writing have linked dyslexia research to other fields such as the study of reading and reading development and the study of language communication, both oral and written. The outward behaviours of dyslexia (for example, slow, hesitant decoding in reading and difficulties with spelling) have spawned a number of hypotheses which have taken routes leading to biological, neurological and cognitive theories.

The medical model provided the starting point, where causes, symptoms and treatment were examined. It should be noted that herein lay the beginnings of the essential conceptual differences and controversies surrounding dyslexia: the practitioner seeks the most appropriate way of teaching the dyslexic (treatment); the psychologist is interested in identification of dyslexia (symptoms); and theorists endeavour to discover the underlying reasons for dyslexia (causes). Hinshelwood's observations of young Percy initiated the **visual deficit hypotheses** which suggested that dyslexia was the result of deficits in the visual processing systems: that it was a visual perceptual problem; and that it was a visual sequential memory problem.

The factor which drove early research was to find out why children were failing to learn to read, despite having received instruction and having eliminated brain damage. One hypothesis was that dyslexia was the cause. Early, detailed studies

of young children who had difficulty learning to read noted behaviours such as inability to store a visual 'picture' of a word, reversals with specific letters, viz. b/d, p/d, and with letters making up words, viz. was/saw. Orton, who resisted Hinshelwood's visual-perceptual theory, described this phenomenon as strephosymbolia, or twisting of symbols (Orton, 1925). Orton's theory rested upon an ambivalent cerebral dominance which inhibited accurate word retrieval. Thus, the dyslexic processed visual representations sometimes with the right and sometimes with the left hemisphere which resulted in reversed images. However, this was to lead the way to current thinking and research into neurological functioning and dyslexia.

Much of the early research established the relationship between visual memory and reading skills and this was used to identify specific reading retardation (Kass, 1966, Morrison *et al.*, 1977, Rudel *et al.*, 1976). It was suggested that the dyslexic iconic memory, the area where visual material, such as the sequence and shape of letters and words is stored for a short time, was different from that of a non-dyslexic. Consequently, the storage of visual information over a period of time was incomplete and resulted in reading failure(Stanley, 1975). This work has been discredited because orthographic materials were used to measure visual memory. This avenue of theoretical investigation was closed for many years but has recently gained credence with Stein's work which will be discussed later in this chapter.

2.5 The IQ-Reading Discrepancy Debate

Closely allied to the work of Hinshelwood and Orton was the 'IQ-Reading Discrepancy' notion – that children who exhibited reading failure had no vision difficulties (or at least they had been remediated by the use of spectacles) and were of average intellectual ability (**despite discrepancies in ability to acquire literacy skills**).

> " By the term congenital word blindness, we mean a congenital defect occurring in children with *otherwise*

> *normal and undamaged brains*[*] characterised by a difficulty in learning to read, so great that it is manifestly due to a pathological condition, and where attempts to teach the child by the ordinary methods have completely failed."
>
> Hinshelwood, 1917, p. 40

Much of the early work up to the 1960s was dominated by clinical studies and was punctuated by a desire to study the cognitive causes of dyslexia, in order to 'diagnose'. The study of reading and spelling behaviours has fascinated researchers and provided controversy and debate. For example, the notion of linking dyslexia with letter reversals was an example of this and was soon challenged when it was discovered that many young children, up to the age of seven, display difficulties with b/d recognition but would not be classified as dyslexic. Researchers turned their attention to the examination of the systematic differences between dyslexic and good/normal readers. Rutter and Yule's Isle of Wight study was an influential epidemiological work, making the distinction between children with specific reading problems and those with general reading difficulties (Rutter *et al.*, 1975). A pivotal feature of the research was the relationship between reading skill and intelligence. By taking account of this correlation, and using regression analysis, they posited that it was possible to predict, given their IQ and chronological age, the expected reading age for any child in that population. A comparison of expected reading age and actual reading age was then scrutinised. The specific reading problems were thus defined if there was a discrepancy between the actual and the expected attainment. They also showed that some children, whose reading age was significantly below age-related attainment, were not discrepant because of their low IQ: these children were classified as the general reading difficulties category. It can been seen that there are links between Rutter's 'retarded readers' (ibid.) and Critchley's definition of dyslexia (Critchley, 1970), shown in the first chapter, section 1.2.

Subsequent research has cast doubts on correlations between reading attainment and IQ. Rutter and Yule's work has also been criticised on the grounds of

[*] My italics for emphasis

methodological flaws. The reading test, namely the Neale Analysis of Reading Ability, has a ceiling of twelve years which many of the children in the study had reached. Use of this test, it has been claimed, would produce a negative skew to the results – the higher achieving children would not, therefore, be properly accounted for in a regression analysis (Rodgers, 1983, van der Wessel *et al.*, 1985).

To this day, many teachers adhere to the IQ-Reading discrepancy definition of dyslexia as a means of identification. The exclusionary criteria, referred to in the first chapter, are still used to quantify the existence of dyslexia in school children with reading difficulties – i.e. the requirement that if the child does not fall within the average intelligence band, then they do not qualify for the dyslexia label. This emphasises the mismatch between low literacy attainment and high IQ. It is the *unexpected* poor attainment in literacy which is the crucial aspect by which many teachers set store (Frankenberger *et al.*, 1987, Kavale, 1987, Reynolds, 1985).

The regression analysis approach fell from favour when the whole notion of IQ testing was questioned. This debate was fired in the 1990s when Stanovich's article questioned the use of intelligence as an aptitude benchmark in the definition of dyslexia (Stanovich, 1991). His proposal was to utilise verbal comprehension skills as a benchmark. The antagonistic bipolarisation of the 1970s and 1980s appeared to be revived. Stanovich's condemnation of the IQ-Reading discrepancy approach to identification of dyslexia was supported by Frederickson and Reason (Frederickson *et al.*, 1995) who put forward yet another alternative which examined the role of phonology in determining dyslexic readers which will be reviewed later in the chapter. However, Ashton mounted a cleverly constructed response to these proposals (Ashton, 1996). His discussion of Stanovich's arguments demonstrated the need to move on and not to be deflected by stale debate which leads nowhere. Instead, his pragmatic reconciliation changes Stanovich's rejection of IQ testing as a determining approach to dyslexia identification into a way of joining opposing factions together. His suggestions that aptitude testing (IQ tests) could be used to

measure *severity* rather than *differential* may well bring together many of the debates in current research regarding the IQ-Reading discrepancy field. Indeed, Miles' defence of the use of IQ tests was warmly welcomed by Special Education teachers who concurred with his view that such tests could provide a comprehensive cognitive profile which informs teaching methods and helps schools to identify dyslexic children (Miles, 1996).

The general rejection of the IQ-Reading discrepancy model paved the way for research into other types of discrepancy which will be dealt with later in the chapter. While the behaviourist approach, which takes account of surface behaviour and performance, now appears to have less importance in the research arena, it should not be discredited. By quantifying IQ and Reading Age (RA) and the unexpectedness of performance, this initiated further discussion of dyslexia 'from an unspecified complaint that may be in the mind of the beholder to a reality that is there for all to see' (Frith, 1997 in Hulme *et al.*, 1997), p. 1.

2.6 The existence of sub-types

In the quest to identify factors which would indicate dyslexia, a checklist mentality emerged in the 1970s which gave rise to much debate in the search to define dyslexia. Questions such as how many signs/symptoms must be present before it is determined that the person is diagnosed as dyslexic were prevalent. Clinicians found it difficult to decide whether a specific constellation of difficulties was atypical of the population, taking into account chronological age, intellectual ability and reading levels. However, teachers welcomed the notion of differentiating sub-groups of dyslexic children according to the types of problems they experienced because of the implications for differential intervention.

2.6.1 Routes to Reading and sub-type theories

> "Laboratory research indicates that the most critical factor beneath fluent word reading is the ability to recognise letters, spelling patterns, and whole words effortlessly, automatically and visually."
>
> Adams, 1990, p.11

Sub-type theories have been formulated on the ability to read and spell, and the research base in this field has been developed by examining the underlying skills of these two activities. The examination of reading difficulties was based on the **Dual-Route** theory of reading. This theory provided an explanation for how skilled readers recognise words in print by suggesting that skilled readers recognise words through either of two distinct and independent routes or processes: the **direct route** (Fig. 4) which relies upon visual recognition or the **indirect route** (Fig. 5) which utilises sound blending, phonemic awareness and knowledge and articulation.

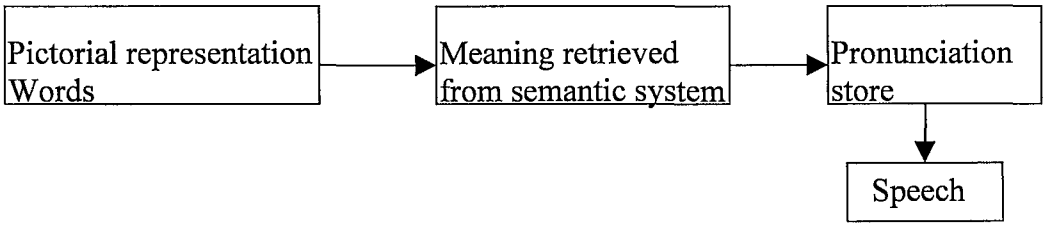


Fig. 4 Direct Route to Reading

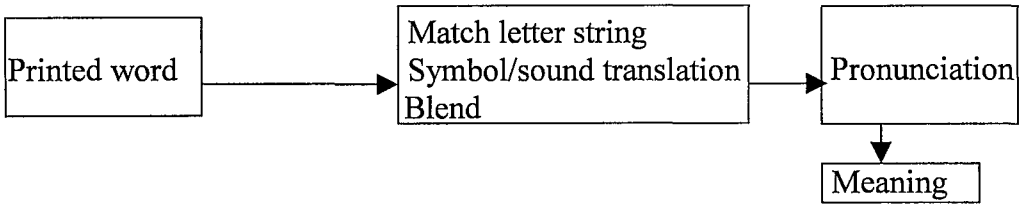


Fig. 5 Indirect Route to Reading

Many of the studies into sub-types have concentrated upon the auditory/visual dichotomy which has led to the two most prevalent sub-type theories in cognitive psychology of dyslexia: the phonological and the visual. These have often been regarded as mutually exclusive, and proponents and antagonists have fiercely stated claims for supremacy. Sub-type theory, however, has enabled researchers to examine not only the differences *between* groups but also the differences *within* groups. What is interesting is that, on examination of the literature in this field, the incidence of 'visual' dyslexia is less compared with the 'auditory' sub-types, as can be seen by diagrammatic overview of the most influential research in this area.

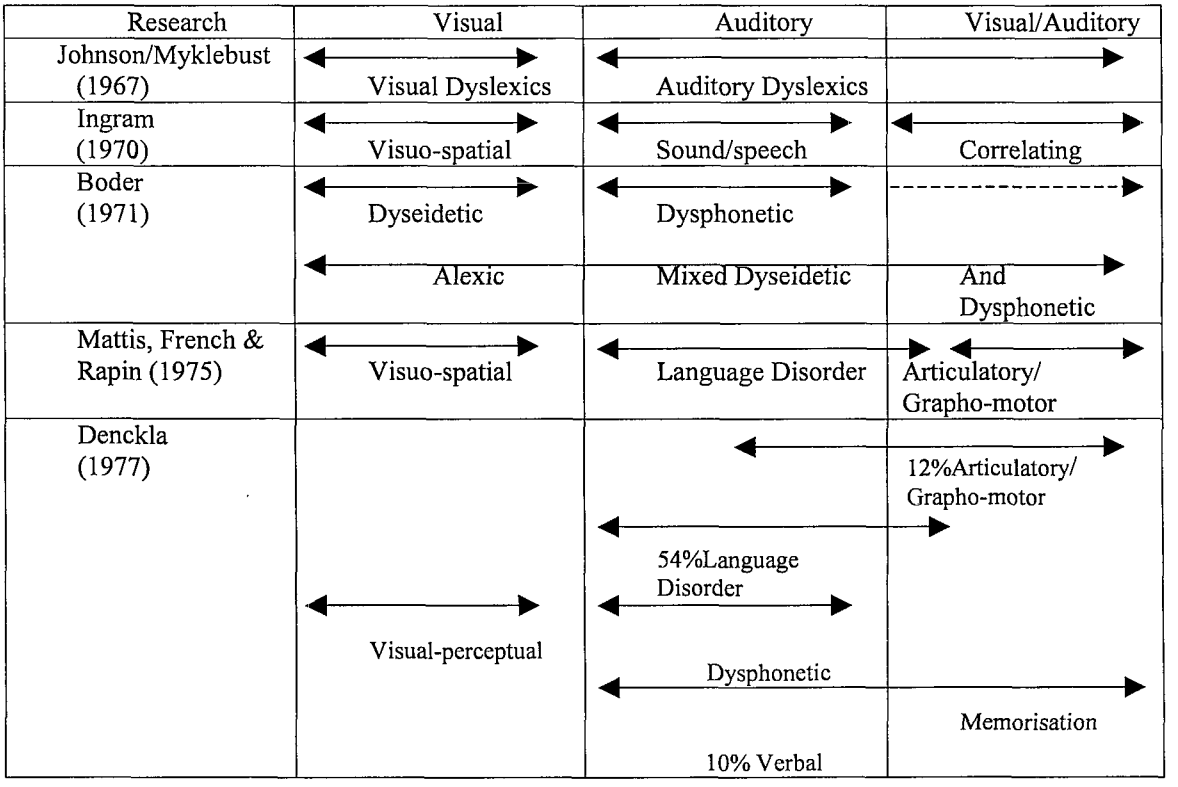


Fig. 6 Compilation of Studies into Sub-Groups

One of the earliest groupings was that described by Johnson and Myklebust and that of the work of Ingram, who argued for two sub-types of dyslexia: 'auditory' and 'visual' dyslexia (Johnson *et al.*, 1967, Ingram *et al.*, 1970). Although there are variations in the fine detail of the descriptions of the

makeup of the sub-types (within-group differentiations), researchers were in agreement that the following cognitive features mainly constitute the auditory dyslexic difficulties and the visual dyslexic difficulties:

AUDITORY (difficulties with the sound system)	VISUAL (difficulties with the visual system)
Auditory discrimination sound patterns	Visual discrimination of size & form
Sound blending	Visual perception
Sound naming	Left and right scanning
Auditory sequential memory	Visual sequential memory

Fig. 7 Auditory and Visual Dyslexic Deficits

Children experiencing difficulties which were auditory in nature had problems synthesising sounds in words; recognising where one word finishes and another begins in sentences; and in word retrieval for sentence construction. Typically, these children experienced difficulties with a phonic approach to reading and spelling. Whereas those displaying the symptoms of visual dyslexia had difficulties remembering the sequence of letters in words; had difficulty with whole word recognition or perceiving words as gestalts (Boder, 1973); transposed letters and syllables; and demonstrated persistent difficulties with reversals of letters, such as b/d etc. Such children could not cope with a 'look and say' approach to reading, for example.

Subsequent studies did not indicate such a black and white division between auditory and visual dyslexia. Rather, shades of grey were introduced such that there was a blurring of the edges between the two sub-types, producing a sliding scale which reflected the growing complexity of the field. It also exemplified the complexity of the reading and spelling processes. Thus, Ingram et al. (ibid.) discuss auditory and visual dyslexia but also recognise that within

these two types there was a group of dyslexic children who experienced difficulties with the sound system which were linked to a visual problem. This latter group they named as a 'correlating' group. This equates to Boder's 'mixed' groups (Boder, 1971, 1973). Boder, however, argued that the three categories – dysphonetic 63% (auditory), dyseidetic 9% (visual) and mixed 22% - were not due to intelligence, emotional difficulties or environmental factors (Boder, 1973). Mattis, French and Rapin also suggest three sub-types, the auditory group being the largest (38%) and the smallest group being that of the visual type (16%) (Mattis *et al.*, 1975, Mattis, 1978). Their third sub-type (about 37%) had various motor dysfunctions which affected both the production of speech and accurate articulation and the visuo-motor problems associated with handwriting.

Denckla's research also suggested three main sub-types, with the visual-perceptual type, once again, constituting the smallest group (4%) (Denckla, 1977). Her research fine-tuned the groupings. The 'auditory' grouping is interesting in that she highlights phonetic dysfunctions – specifically at the phonemic level of processing sequentially; and auditory memory difficulties – particularly in naming and retrieval. Her 'verbal memorisation disorder' (ibid.) group displayed difficulties with repeating sentences and word associations which would lead the way to theories connecting memory and dyslexia. This latter group (12%) showed no difficulties with any other language skills and their problems appeared to be very specific.

Sub-type theory has its critics, both in terms of the methodology and in terms of what has been considered its narrow approach to formulating theory for dyslexia. Let us take Boder's research. Although seminal work in the field, both the procedures and the interpretations have been criticised. Children were shown lists of words (flashcards), often taken from standardised tests, in timed and untimed conditions. She argued that the timed data would identify visual skills – a look and say method; while the untimed procedure exemplified the child's ability to analyse words phonologically. Words, which the child read, were divided into known and unknown words and then given as a spelling test.

If the child could spell an 'unknown' word, she postulated that this demonstrated a phonological ability; while mis-spelled words from the 'known' group showed weak visualisation or visual-spatial/perceptual difficulties. Her interpretations of spelling errors have been questioned. 'Rember' for 'remember' could, for example, be the result of a visual memory difficulty (dyseidetic) or could be the result of articulatory/auditory processing problems.

Thus, simple classification has its critics but a more serious criticism could be that such research does not answer the question of whether the dyslexic reader/speller is different from the non-dyslexic. Such clinical research was small-scale and does not provide sufficiently strong evidence to relate cognitive skills and clear-cut sub-types. Once again, there appears to be no absolute categorisation for each of the various sub-types. It has been suggested that the so-called visual/auditory dyslexia is an artificial distinction (Ellis, 1993, Miles, 1991). Nevertheless, as stated previously, the clusters of cognitive difficulties were useful to teachers, and had implications for the classroom. It is useful to link cognitive neuropsychological theories of reading with sub-type to provide differential intervention programmes.

Recent research into sub-types has provided very different perspectives. Snowling's categorisation is two-fold: the Phonological Dyslexic and the Surface (Morphemic) Dyslexic (Snowling, 1987). While Bakker discusses the p-type (perceptual) and the l-type (linguistic) (Bakker *et al.*, 1990), Snowling's work paralleled the work of Coltheart who applied psycholinguistic models to the analysis of acquired dyslexia in adults (Coltheart *et al.*, 1980). Acquired dyslexia refers to adults who originally had no problems learning to read but who later, because of an accident which caused damage to specific part(s) of the brain, lost the ability to read. They are a distinct group but their literacy behaviour is important to dyslexia theory in providing analogies and common difficulties. Snowling's phonological sub-type (ibid.) related closely to the dysphonetic types of Boder but Snowling further qualified her categorisation by reference to the dyslexic use of orthographic rules to aid reading. The surface sub-type, a term coined by Marshall and Newcombe (Marshall *et al.*, 1973), has

difficulties with word meanings, hence the label, morphemic dyslexia. These dyslexics find homophones difficult to remember and recognise. Thus, they would mix up words such as 'soar' and 'saw' which sound the same (indicating phonological ability) but stem from different roots and meanings. It is not suggested that Snowling's research points to simplistic purity in categorisation but rather that often dyslexic behaviour would suggest traces of both types – a view which is held by many (Seymour, 1986, Seymour *et al.*, 1984, Ellis, 1993, Wilding, 1990). Some have suggested that surface dyslexia may be a milder form of phonological deficit linked to inadequate reading experience (Snowling *et al.*, 1996, Manis *et al.*, 1996, Stanovich, 1993).

The Dual-Route to reading success upon which the above research is based was to be challenged to some extent by Bakker's work (ibid.). His theory proposed a **Balanced Model of Reading** and took account of developmental changes in reading with young children and adults (Bakker *et al.*, 1990). He posited that there are differential task demands upon the right and left hemisphere during reading according to a developmental change. Drawing upon Licht's longitudinal studies of seventy-four Dutch children, he demonstrated specific hemispheric changes over time in reading tasks whereby the balance of activity is transferred from the right to the left hemisphere, Bakker suggested that if this change does not take place, (which links with current research into the dyslexic brain activities), the result can be two distinct sub-types: the linguistic (l) and the perceptual (p). The l-type dyslexic would appear to use the left hemisphere prematurely with resultant reading difficulties. This type of dyslexic can read at speed but with many inaccuracies due to inattention to the surface features (visual representations) of the text. They typically demonstrate the behaviour observed by Boder and other researchers, which results in reversals, not only of single letters but of the sequence of letters in words (saw for was) but also of reversals of phrases in sentences. While the p-type is equally disadvantaged, though differently: this type begins by using the 'normal' right hemisphere in reading acquisition but fails to transfer the activity to left hemisphere functions involved in the reading process and thus relies too heavily upon right hemisphere processing. This results in slow and hesitant decoding with a heavy

reliance upon sounding out each letter in turn in words. They are using the Indirect-Route, relying upon the auditory channel. The impact upon comprehension is greater for the p-type than for the l-type.

Much research would counter the findings of the sub-type theories, stating that the differences are merely quantitative and provide evidence for severity and nothing else (Stanovich, 1991, Bryant *et al.*, 1990, Metsala *et al.*, 1998). Nevertheless, research in this field has most certainly contributed to knowledge of dyslexic learners.

2.7 A Shared Theoretical Framework?

As can be seen by the research commented upon so far, deficit theories of dyslexia are common, and each deficit theory has been argued to be *the* fundamental deficit in dyslexia. Frith's complementary model from cognitive neuroscience provided me with a means of mapping the various 'levels' of theory (Frith, 1985).

Causal links to reading difficulties and learning differences are attractive to the practitioner. Frith's theoretical model was a watershed in the development of thinking about dyslexia: she wove into a theoretical framework many of the threads which were an integral part of current research (Frith, 1985, 1995). She developed a causal model of dyslexia which embraced observable behaviour, the classroom context; cognitive deficits, the identification and diagnostic process; and the biological factors which included genetic and neuro-anatomical features, information to which teachers had no access but which could be examined from observable behaviour. The over-arching factor in her model was the environmental influence which could affect any or all of the three causal levels.

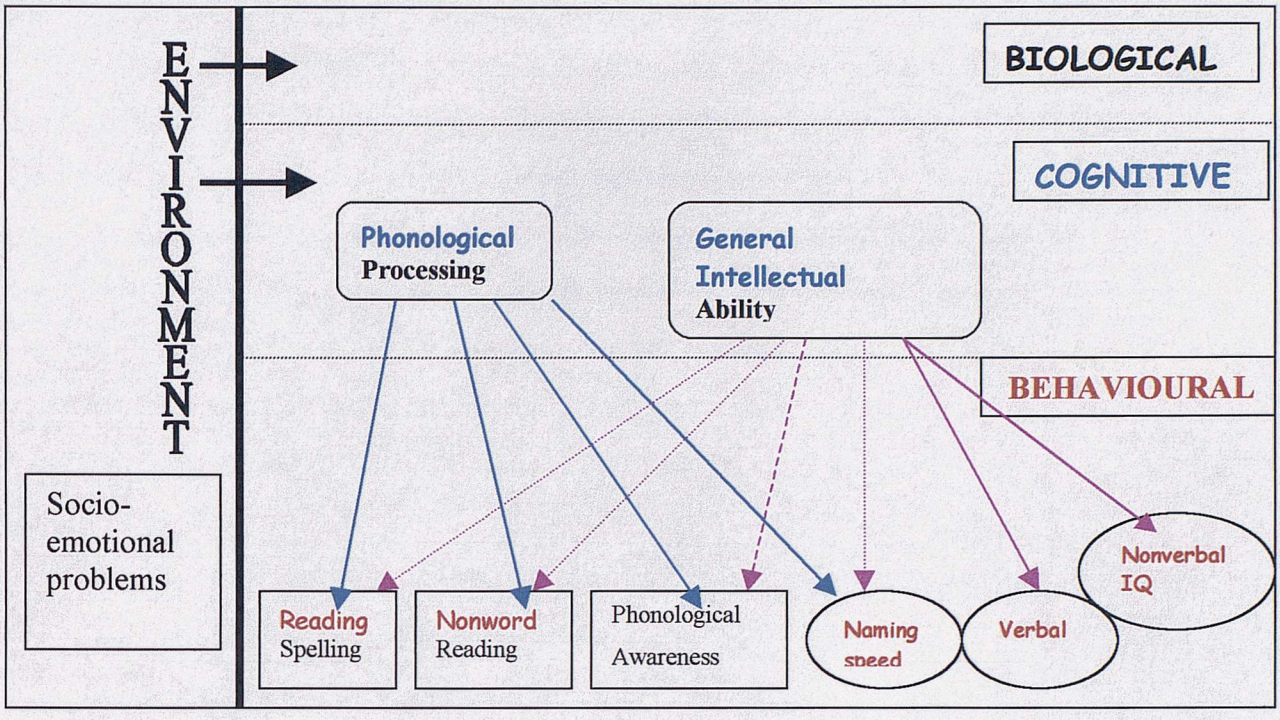


Fig. 8 Frith's Causal Model of Developmental Dyslexia

This framework could account for the performance of dyslexic pupils and students when acquiring literacy skills. If there are differences in their brain anatomy, it might result in certain difficulties in processing information, such as that needed for learning the writing system and organising the writing processes. This could explain why dyslexic people have intractable difficulties with literacy.

I shall use this causal model to map the current research and to draw together, hopefully, many, apparently, disparate theories.

2.8 Biological Theories of Dyslexia

> " Dyslexia is a neurologically-based, often familial disorder, which interferes with the acquisition of language."
>
> Reid Lyon, 1995, p. 4

The physical science theories of dyslexia emanate understandably from the biological/physiological research. Brain researchers and geneticists have now joined the quest to attempt to answer the question of the underlying problem which causes dyslexia. Could it be that the anatomical structure of a dyslexic brain is different from that of a non-dyslexic and thus reading, spelling and language processing are affected? Perhaps, the cause of dyslexia is hereditary and genetic in origin? Many theories are being tested:

- Heritability factors
- Genetic factors
- Brain symmetry
- The brain and language functioning
- The brain and visual perception
- The brain and auditory processing
- The role of the cerebellum and early diagnosis

In order that the above avenues can be considered it may be necessary at this point to give a brief and simple overview of the different parts of the brain which are related to certain aspects of behaviour. This is necessary to help us understand many of the neurological explanations for dysfunction present in some dyslexic learners.

2.8.1 The Brain

The **cortex,** which accounts for 80% of the brain, is a wrinkled structure with clefts and ridges, increasing the total surface area. This is divided into two hemispheres: the right and the left. Each hemisphere is further divided into four lobes which have specific functions.

The rear **occipital** lobe is responsible for visual processing; the **parietal** lobe manages movement, orientation, calculation and body senses; the **temporal** lobe deals with auditory perception, sound and speech comprehension; while the **frontal** lobes are thought to be responsible for higher order thinking, conceptualising and planning. The **cerebellum** is located at the rear, base of the brain and is said, in addition to the management of motor behaviour, to be responsible for higher level

cognitive functioning, such as linguistic processing. Many areas of the brain are considered to be **bilateral** which means that they are found in both hemispheres.

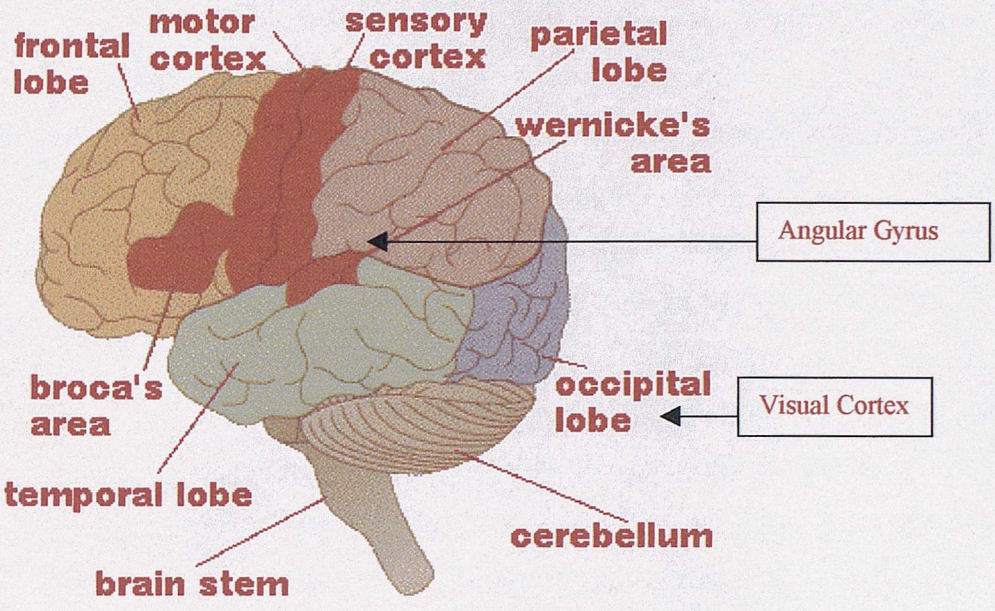


Fig 9 Main Language Areas of the Brain
Adapted from Robertson (2000)

2.8.2 The main language areas of the brain

In the study of reading and language processing, certain areas of the brain are significant: Broca's area; Wernicke's area; the corpus callosum; the angular gyrus; the visual cortex; the cerebellum; and the insular cortex.

- **Broca's** area plays a part in speech articulation and production.
- **Wernicke's** area is involved in speech comprehension.
- **Corpus Callosum** is a fibre system which connects the two hemispheres and is necessary for smooth transfer of information from one hemisphere to the other.
- **Angular Gyrus** is positioned at the edge of parts of the brain which deal with vision and spatial skills. Thus, it is significant for passing information from the visual word recognition system to the phonological or sound system.

- **Visual Cortex** deals with all types of visual processing.
- **Cerebellum** is also referred to as the 'little brain' (Robertson, 2000). It is used for balance, co-ordination and some language functioning.
- **Insular Cortex** is thought to act as a bridge for different brain area activities.

Much of the early evidence of brain functioning was built up from post-mortem studies and from patients who had suffered brain injury. Broca's work, from twenty-five post-mortem studies of patients with aphasic problems, demonstrated that damage to the frontal lobe region of the brain resulted in a defect or loss of the ability to express one's self by speech, writing, or comprehension of the spoken or written word. Broca's work led to the theory of localisation whereby specific areas of the brain were solely responsible for certain activities: he concluded from his research that speech control was located in the left hemisphere only. Several theorists have refuted this theory, in particular Wernicke who suggested that there were several areas of the brain which controlled language and that deficits or damage in one area would not inevitably result in total language impairment. However, building up theory of dyslexia only from post-mortem studies and from those with brain damage does not strengthen a *pure* research base. Techniques for non-invasive scanning of the brains of dyslexics have widened the research. Indeed, evidence from dyslexic families is growing and work with extended families and siblings will, no doubt, throw further light upon whether dyslexia is hereditary.

2.8.3 Hereditary Factors

The question of whether some people are more at risk of dyslexia than others and whether there is a gender bias have interested not only parents, teachers but also scientists. Recent studies would suggest that a male off-spring of a dyslexic father has a 40% chance of dyslexia. If the male off-spring is the product of a dyslexic mother then there is only a 36% chance of dyslexia. If the off-spring is female, and either parent is dyslexic, the chance of dyslexia is further reduced (20%) (Gilger *et al.*, 1991). However, there is much work to be done in this area. Critics have argued that environmental factors may be

significant in these assumptions: indeed, all the families shared similar environments, and this could be interpreted as the causal factor rather than heritability (Snowling, 2000). Others have posited that links between neuronal growth and dyslexia could demonstrate the cause of dyslexia, which would link to environmental features which would be evident in family patterns. It has been suggested that hormonal levels at the developmental period of the foetus (significant if two foetus are carried) can cause early damage to specific parts of the nervous systems, and this, in turn, could have an effect upon some areas of the brain which are hormone-sensitive – such as those regions which control language learning (Bjargen *et al.*, 1987, Rae *et al.*, 1998).

However, studies of twins provide stronger evidence for heritability. If dyslexia is hereditary, then monozygotic twins (identical) would always be affected while the rate of occurrence amongst dizygotic twins (fraternal) would be 50%. Studies in this field have once again used reading skills as the basis for the research methodology and subsequent examination (DeFries *et al.*, 1987). Similar findings were noted when spelling was taken as the methodological basis for the studies in a UK sample of 13 year old twins (Stevenson *et al.*, 1987); while the famous Colorado group's investigations used phonological decoding skills (Olson *et al.*, 1985). Recent work in this area is examining heritability according to speed of processing (Olson *et al.*, 1999).

2.8.4 Genetic Causal Factors

The question of whether a 'dyslexic gene' could be identified has initiated much ethical debate and spawned a number of research studies. Increased knowledge of DNA through human genome research has assisted work in this area. One line of research has been examining a single-gene theory, using Mendelian theory. A human body consists of forty-six chromosomes: twenty-three from the mother and twenty-three from the father. Because of the complexity of chromosome locations, looking for one single factor could be like 'looking for a needle in a haystack' (Snowling, 2000), p. 145. Examination of DNA sequences for the transmission of diseases is well advanced and

demonstrates that using markers on chromosomes can provide clues. Cytogenetic techniques can now map the break-points of chromosome arrangements to provide evidence for a dyslexia gene. A number of recent studies have located three chromosomes which could predispose a person to dyslexia: chromosomes 15, 6 and 2. The first gene markers were found on chromosome 15 (Smith *et al.*, 1983), and further replications of this work provided evidence that these markers were present in 30% of families studied (Gringorenko *et al.*, 1997). Further studies have identified markers on chromosome 6 in certain families (Cardon *et al.*, 1994, Gayan *et al.*, 1995) and chromosome 2 (Fagerheim *et al.*, 1999). However, this area of research is in its infancy and has many sceptics. It will take further replications on a larger scale to convince some that a brave new world could scan for dyslexia. Does this mean that dyslexia could be eradicated in the future? There is still much to be done in this field before conclusions can be drawn.

2.8.5 Brain Symmetry

Much store has been placed on the learning differences of dyslexics. This has been attributed to physiological and cognitive differences. I shall examine the biological differences in this section and take a look at the cognitive aspects later. Studies into the changes in brain structure at the prenatal stage have provided us with different and interlinked evidence.

Galaburda's work on the measurement of dyslexic brains (Galaburda *et al.*, 1985) built upon the pioneering work of Geschwind whose studies demonstrated that human brains were asymmetrical (Geschwind *et al.*, 1968). In his post-mortem studies, Galaburda and his colleagues revealed not only abnormalities in the dyslexic brains (ectopias or scars in the brain at certain points) but also showed that the brain symmetry was different. New imaging techniques have made it possible to take this work further. In a study examining the correlationship between brain structure and phonological deficits, it was found that the plana temporale, the area of the brain involved with speech, of a group of normal readers was asymmetrical, with the left planum being

significantly larger than the right. Reading-disabled boys who had been identified as dyslexic, however, had symmetrical structures. Although the study does not state why or how this unexpected symmetry has occurred, it has been implied that this must have occurred during very early development of the nervous system during the foetal stage (Lundberg, 1999).

Magnetic resonance imaging (MRI) can replicate findings (Larsen *et al.*, 1990, Hynd *et al.*, 1997). This suggests that the symmetry is the result of increased development in the right hemisphere rather than an underdevelopment in the left. The larger right development may be the consequence of a failure to eliminate certain cells during normal development. Nevertheless, this work is in its early stages, and it is not yet possible to say whether this holds true for a significant proportion of dyslexic people.

2.8.6 Rapid Processing Pathways

An examination of the structural working of the brain may help us to understand the processing differences of the dyslexic. The brain is a dynamic organ which is constantly changing. The nervous system of the brain develops during pregnancy and a network of some 10 billion cells with 1 billion connections forms. How this complex neural system grows could be a crucial factor in determining dyslexia and the anatomical differences between dyslexic and non-dyslexic brains.

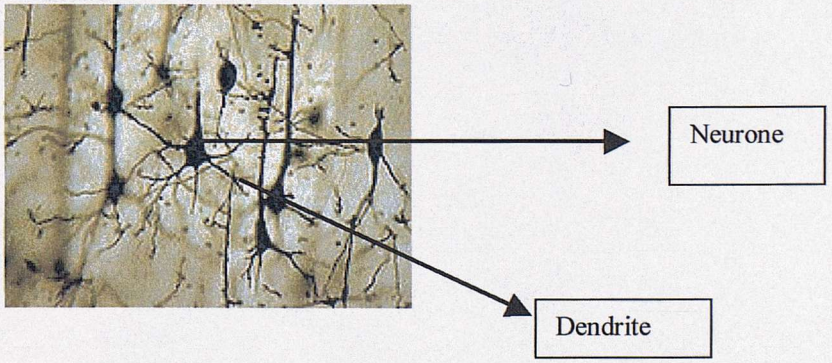


Fig. 10 Brain Structure: Neurones & Dendrites: http:\\www.synapses.bu.edu

The nerve cells or neurones transfer signals from one part of the nervous system to the other. Each neurone consists of a cell body and tiny branches called dendrites. The dendrites receive and transmit messages (electrical currents) so that as one neurone fires up it passes information to another neurone along the line. There is a one-way system in the brain so electrical impulses move in one direction via bridge-like structures (synapses) which link one neurone to another. As these systems grow in the pre-natal stage of development, millions of pathways are formed. During the first few months of life, many of these cells and pathways die as the brain starts the selection process, i.e. it decides upon the most efficient pathways to achieve specific behaviours. A baby will reach out and grasp a toy or a finger which is placed near it. This movement is the result of messages being transmitted along the neuronal pathways. If the baby successfully grasps the object, the brain learns the route of the connections, and thus a highway route is developed as the synapses become stronger. Gradually, other pathways die off because the brain does not use them. In a sense a motorway route or fast-track is developed. This can be likened to the operating system developed by Acorn for its computers, RISC-OS. This worked on the principle that the most frequently needed sequences of instructions for the processor were more quickly available to the system. Thus, it did not have to trawl through routes to find the best pathway to take in order to perform an operation. This is well illustrated by the development of neural pathways of a baby when grasping an object.

Fig 11 **Neural Pathways at Six Weeks**

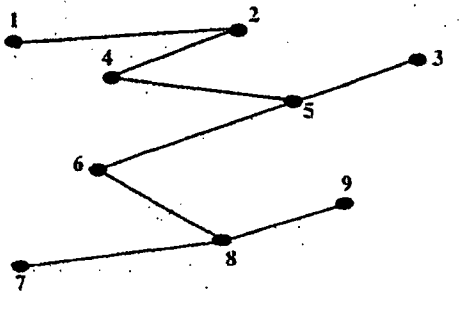
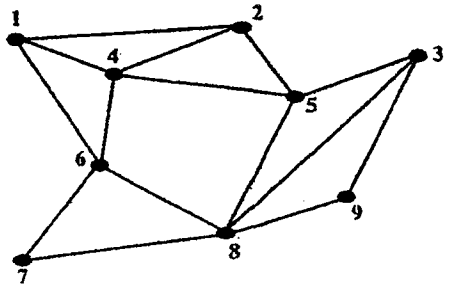


Fig 12 **Neural Pathways at Six Months**



The message has to go from 1 and end up at 7. At six weeks old the pathway is quite circuitous: 1-2-4-5-6-8-7. By six months there are only three stages: 1-6-7. The rapid route has been found and is then established as the most efficient one for carrying out that specific operation. Thus, the developing brain sees that the scenic route of the six week old baby is not so effective and the blood supply to the synapses is strengthened via the shortest, most rapid, route.

Positron-emission tomography (PET) scans provide visible evidence of neural activity in the brain, and the development of blood flow pathways can be seen. When comparing dyslexic and non-dyslexic processing, by measuring the neural activity during the performance of an activity, e.g. a spelling test, it can be shown that dyslexic pathways fire up differently and take longer to process i.e. they may not have developed the rapid access route to certain types of activities. This would suggest that the dyslexic brain still contains billions of connections which have died off during development of a fast processor in the non-dyslexic brain.

PET scans can also highlight the differences between the dyslexic and non-dyslexic brain while conducting a reading task. It is interesting to note that the dyslexic brain relies upon less areas for processing text as can be seen in Fig 13 below.

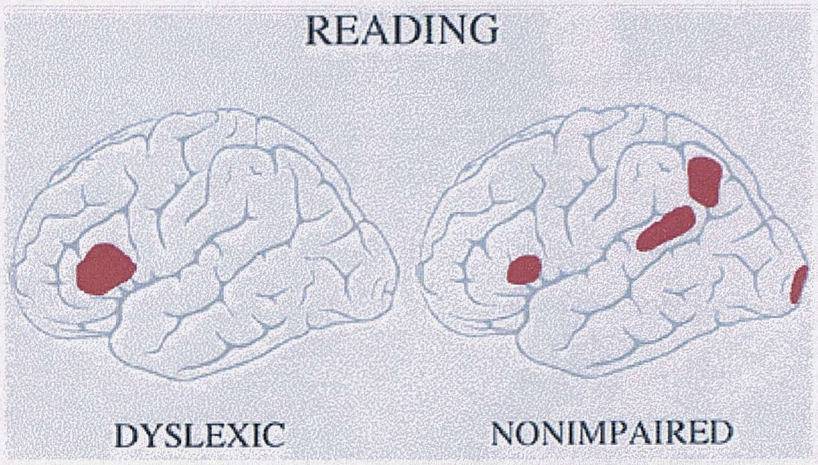


Fig 13 Comparison of dyslexic and non-dyslexic brain functioning when reading: Taken from Shaywitz *et al.*, 1998

Two additional theories currently lie at the heart of the *biological basis* of dyslexia: the role of the cerebellum and magnocellular theory.

2.8.7 The role of the cerebellum

Fawcett and Nicolson have presented a convincing argument for a cerebellar deficit hypothesis as the causal basis of dyslexia (Fawcett, 2001). They claim to bring together biological, cognitive and behavioural aspects by demonstrating that an abnormal cerebellar functioning is the cause of dyslexia. This is a highly controversial area. For many years the cerebellum was considered to be the part of the brain which controls rapid, skilled movements (Eccles *et al.*, 1967, Stein *et al.*, 1992) and was involved in the automatisation of motor skills in learning (Ito, 1984). However, Leiner's work indicates that the cerebellum is linked to the frontal areas of the brain, in particular Broca's area, which is central for the acquisition of 'language dexterity' (Leiner *et al.*, 1993). Fawcett and Nicolson posit that the key role of the cerebellum is in automaticity, be it motor or cognitive. There is a growing body of evidence to show that the cerebellum is

important not only in language development but also in reading (Fulbright *et al.*, 1999).

Unlike the above evidence for the role of the cerebellum in learning, which drew upon a 'normal' population, Fawcett and Nicolson's research compared dyslexic children with matched age controls (Fawcett *et al.*, 1999). The dyslexic performance on the tasks was significantly worse. Thus, they postulate that the dyslexic groups do not perform at an automatic level on the tasks because they bypassed cerebellar activity (because of dysfunction in this area) and used the frontal lobe in new learning tasks, relying on *conscious* strategies instead. This work could have great implications for schools and intervention research. Cerebellar impairment would cause difficulties in writing because of lack of normal control of the motor functions; it would also have an impact upon reading development because the motor aspects of language articulation would be impaired and therefore the dyslexic infant would be slower to start talking and developing automatic motor skills for language development; and this, in turn, would lead to phonological difficulties in processing auditory and phonemic structures. (see Fig. 14)

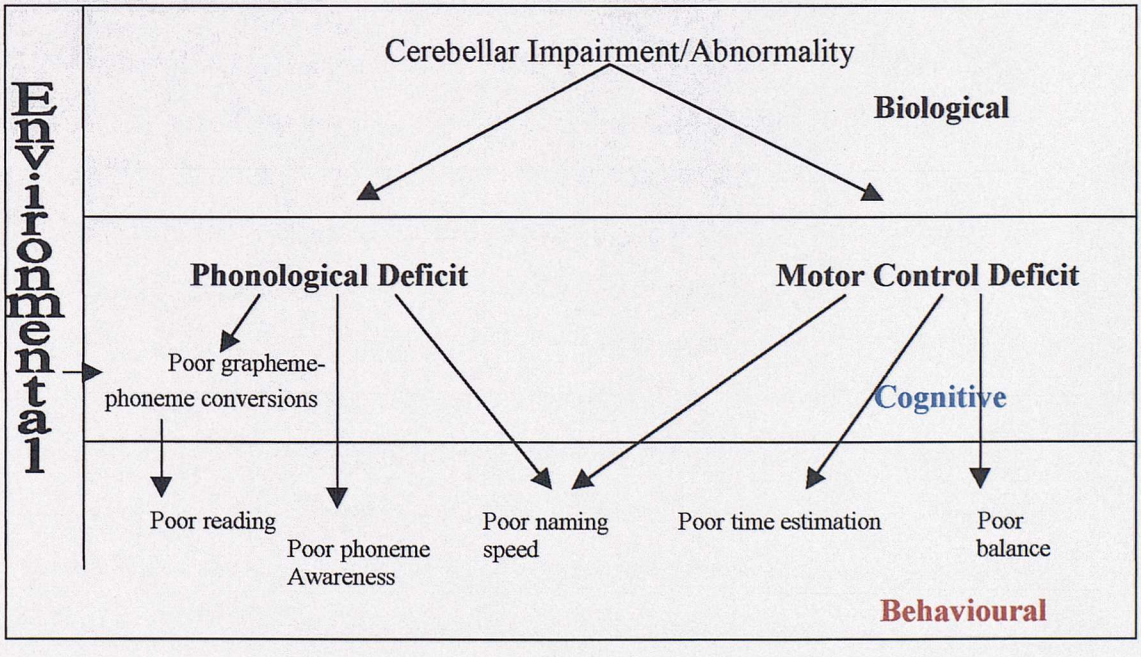


Fig. 14 Cerebellar Impairment Theory in Frith's Causal Model

2.9 Vision and Magnocellular Theories of Dyslexia

The most contentious area of dyslexia research is the school of thought which states that visual difficulties are the cause of dyslexia. Despite the strength of the consensus that phonological deficit is the cause of dyslexia, the role of vision has received constant attention over the years.

Visual processing is reliant upon many complex systems and various theories have been proposed to explain dyslexic difficulties in visual processing: binocular instability and the development of a dominant eye; and difficulties in the transient, magnocellular system. It is recognised that visual processing plays a part in the reading and writing processes, and, therefore, any deficits or dysfunctions will result in difficulties.

Pavlides' early work concluded that dyslexia stemmed from binocular instability, that is, an inability to control rapid eye movements and lack of eye convergence when reading (Pavlides, 1981). Stein and Fowler's work explored this idea (Stein *et al.*, 1982). Indeed, their research gained popularity in schools with teachers and parents who spoke of 'cross laterality' as one of the significant indicators of a dyslexic child. This refers to someone whose dominant eye is the opposite to their dominant hand, for example, left eye/right hand dominance. Stein and Fowler found in their study that the dyslexic readers had not developed a *consistent* dominance of one eye and that when focusing on letters in words, their eyes did not converge accurately, demonstrating binocular instability (Stein *et al.*, 1982). These dyslexic readers often complain of blurring of the words and letters jumping around. The reliability of this work has been criticised over the years mainly because of the research design – the use of the Dunlop Test and the fact that the dyslexic subjects chosen had all been referred through the eye clinic in London. Researchers have attempted to replicate this early work (Newman *et al.*, 1985). Their research design drew upon the IQ-Discrepancy model rather than the reading age matched groups of Stein and Fowler's work. The analysis of their results revealed that there was "no association found between reading and spelling difficulty and fixed and

unfixed reference eye," (Newman *et al.*, 1985). Similarly, Goulandris and her colleagues found that orthographic difficulties were no more prevalent in the dyslexic group compared with the controls (Goulandris *et al.*, 1998). Indeed, some research suggests that binocular stability improves with age (Riddle *et al.*, 1990), and this should be taken into account in the research design. However, Cornelissen et al. found a positive correlation between non-word reading errors and binocular instability (Cornelissen *et al.*, 1997), demonstrating that the controversy still rages.

A different visual hypothesis was proposed in the 1980s by Lovegrove and his colleagues who stated that dyslexic readers have visual impairment affecting the transient visual system (Lovegrove *et al.*, 1986). This seminal work has led to important findings and the development of the magnocellular theory of dyslexia.

Reading utilises both the magno- and parvo- cellular systems. Thus, different visual information is processed discretely by these systems. As discussed earlier, reading uses both the lexical (direct route for whole word recognition) and the sub-lexical (indirect route for new/non-word recognition where separate sounds are analysed phonologically) (Castles *et al.*, 1993, Manis *et al.*, 1996). Both systems rely on visual analysis, although the role of vision is more significant when faster, more automatic responses are needed as in whole word reading via the direct route. The parvo cells deal with the fine detail information and colour, for example, shapes, and direction of letters; while the magno cells are responsible for processing the timing of events in the fixation process. (As the reader absorbs the information visually, eye movements or saccades can be observed and analysed. These saccades are usually quick and recursive in normal readers.) Hence the importance of the magno cells for detecting visual motion during saccadic movements. Impairment in this system would produce inaccurate information for the brain to process. It has been suggested that if "reading requires the spatial location of letters while the eyes move across texts", (Snowling, 2000), then impairment in the magnocellular and parvocellular systems may be the causal factor for dyslexic readers' letter

reversals and visual inaccuracies which ultimately affect spelling ability. An example of what text looks like to someone with magno and parvo cell deficits demonstrates the theory clearly:

> Thew ord sare n otsp aced cor rect ly. This shows lack of spatial location of letters.
> Sometimesthewordsareallpushedtogether. This shows how deficits in these two systems produces inaccurate information going to the brain.

Stein's recent research, drawing upon Galaburda's findings (Galaburda, 1999), demonstrates that visual motion sensitivity (VMS) is crucial in developing any theory of dyslexia (Stein *et al.*, 1999). Many dyslexics have reduced VMS as shown by Galaburda's measurements of dyslexic brains which had smaller magnocellular systems. VMS impairment affects signals to the brain resulting in reversals and poor orthographic ability.

Motion sensitivity → steady eye fixation → visual stability → identification of letter order → orthographic ability.

Stein's work is particularly exciting because it appears to draw together many previously separate theories of dyslexia. He postulates that magnocellular neurones are found in various parts of the brain and are linked to various systems – not only the visual processing but also play a significant role in auditory stimuli systems (reviewed later in the chapter). Evidence now suggests that the visual and auditory sensitivity systems are more interlinked than was previously realised (Baldeweg *et al.*, 1999, Stein *et al.*, 1999, Witton *et al.*, 1998). Thus, impairment in sensitivity to these systems would explain that dyslexia is not just a problem with reading and writing. Indicators of which teachers are only too well aware – unpunctuality, inability to distinguish between left and right and ambidexterity to name but a few – could be caused by impairment or dysfunction of the magnocellular system. Perhaps this work will enable researchers to come together and to resolve some of the differences.

2.10 Phonological Deficit Hypothesis

The widely accepted cognitive explanation of dyslexia is that it stems from a phonological deficit. In order to examine this theory it is necessary to consider the role of phonology in reading and spelling and to consider why it is regarded as the core deficit.

Put simply, phonology is the manipulation of sounds, and phonological awareness is needed to 'map speech sounds to units of meaning' (p.34), (Snowling, 2000). In Frith's causal model (op.cit.) at the behavioural level, dyslexic children exhibit difficulties in reading and spelling *generally* and in sound/symbol relationships, non-word reading and segmentation *in particular*. Characteristic indicators of phonological difficulties used by teachers to help to identify dyslexic children are:

- Problems in segmenting words into phonemes;
- Problems in manipulating strings of sounds in short-term memory;
- Problems with the reading and articulation of non-words;
- Problems in the sequencing of sound units in speech which results in spoonerisms;
- Problems in playing word games where manipulation of sounds at the phoneme level is required.

Thus, it can be seen that phonological ability is closely allied to phonemic awareness, rhyme, short-term memory and verbal repetition.

Vellutino's seminal work in 1970s, which resulted in his verbal deficit hypothesis for dyslexia, provided researchers with a platform to develop the phonological deficit theory (Vellutino, 1979). This theory posits that dyslexics have difficulties with a range of tasks which rely upon phonological skills, and that phonological impairment accounts for problems in the complex underlying subsystems of reading and spelling (Frith, 1985, Stanovich *et al.*, 1994, Plaza *et al.*, 1997, Frith *et al.*, 1995). An impressive body of empirical evidence has

given strength to this theory (Bradley *et al.*, 1978, Bradley *et al.*, 1983, Snowling, 1987, Stanovich, 1988, Rack, 1995, Martin *et al.*, 2000), demonstrating the association between reading and phonological processing difficulties experienced by dyslexic readers compared with matched groups of non-dyslexic readers for age and reading.

Although the body of evidence is strong, there are many who suggest that the theory does not answer all questions. For example, are all children who exhibit phonological difficulties dyslexic? Perhaps, the complex underlying cognitive components are the root cause and difficulties with phonological tasks are merely the consequence?

Some would argue that difficulties could be traced to deficits in the auditory system or sensitivity to modulation in sounds (Tallal *et al.*, 1973b, McAnally *et al.*, 1996, Witton *et al.*, 1998). This hypothesis has developed from the work of Tallal and her colleagues in 1970s (Tallal *et al.*, 1973a) which looked at language-impaired children rather than dyslexic children. The work of McArthur et al. (op. cit.) and Witton showed rapid auditory processing (RAP) differences between those with language processing impairments and controls. The control group was able to differentiate between tones given in rapid succession while those with language processing difficulties fared worse. However, others suggest that there is inconsistent evidence for RAP deficits in dyslexic groups (Heath *et al.*, 1999).

The above selection of current research highlights the complexity of this field. The dyslexic profile now begins to emerge. I have selected *specific* theories because of their relevance to writing. As has been shown, weaknesses in phonological skills and magno-cellular deficits can affect the reading-for-writing aspect of academic work. Cognitive capacity, allied to a reduction in the ability to process information rapidly – a lack of automaticity - may have implications for performance in the academic context. It is important to establish the role of cognitive processing in writing in order to consider the impact of cognitive resource deficits.

2.11 What is Writing?

Judging by the number of books which line our library shelves and the number of journals and magazines which are published, it would appear that writing is not only valued by society but that it is the translation of ideas into print. It is an activity which seems to be instinctive and almost innate. Much to the frustration of their parents, toddlers can be observed scribbling their 'thoughts' on walls, treasured books or scraps of paper. They appear to derive much enjoyment from this activity. Perhaps they are mimicking the behaviours of their parents and siblings? It may be a wish to communicate in a more permanent modality. It may be considered one of the first acts of creativity. In the acquisition of many skills, the progression from difficulty to ease is often overcome by practice. As the old adage says: Practice makes perfect. Learning to ride a bicycle becomes much easier with practice. What is interesting with writing is that this is not so.

> "The crucial notion is that writing is not a natural ability
> that automatically accompanies maturation."
> Liberman *et al.*, 1990 in Grabe *et al.*, 1996, p. 6

Writing can be examined on various levels: low level operations or higher order skills. Handwriting skills and the ability to spell could be considered to be the mechanical skills required for writing; whereas the ability to manipulate language in a structured form of sentences and paragraphs to express ideas and thought might be termed the use of higher order skills. For the purpose of this research, the mechanical level of operation will not be examined in depth and will only be referred to when it impinges upon the composition process. The higher order skills are encompassed in composition which can be defined as 'shaping at the point of utterance' (Britton, 1983 in Grabe *et al.*, 1996), p.5, whereby ideas and concepts are created with due regard for the hierarchical structure of text, the differences laid down by genre and the manipulation of appropriate subject-specific terminology and vocabulary.

Any attempt to define what writing is reveals as much about the author as it does about writing because the explanations chosen reflect beliefs and theoretical allegiance. Can writing be considered as merely a set of meta-components? Can it be delimited by a simple process? Can it be defined in terms of the quest to express self and the position of the writer's voice in writing? Throughout history the study of writing has interested researchers and practitioners from a variety of disciplines – cognitive psychology, educational psychology, linguistics, educational ethnography and education. The aim of this section is to try to resolve some of the apparent contradictions and to place writing firmly in the context of the dyslexic writer in HE.

Having recently conducted an extensive survey of academic study skills with all departments in the University, there is surprising agreement amongst academic tutors and across departments concerning the perceptions of writing in HE and the generic skills required by undergraduate and postgraduate students (Price, 2001). The survey revealed that student writing is concerned with problem-solving and is, to a large extent, genre-specific.

> " The academic essay..... is a kind of game in which the writer, according to the extent to which he or she is familiar with the rules and is able to use them, seeks to satisfy the demands of the reader/marker."
>
> Houghton, D. 1984 cited in James, 1984, p. 21

Writing is a highly complex set of procedures involving many cognitive processes. Most of what is considered writing in academic terms in HE is composition (Grabe *et al.*, 1996). The writer has to operate on various levels. Students are expected to be 'expert' writers, and the mark of a good student is the ability to use writing as a tool for thinking. On the one hand they are expected to 'transform' information (Bereiter *et al.*, 1987) from a variety of sources; to wrestle with the ideas; to develop personal constructs, synthesising information from study; while on the other hand this cognitive network is

overlaid with the conventions of writing: knowledge of language and linguistic structures such as sentence and paragraph construction; genre; syntax and semantics. Some students seem better equipped than others and appear to tackle written assignments in their stride with a minimum of conscious effort of 'executive control'. Not only do they have the ability to move from the simple 'knowledge-telling' model of written composition to a 'knowledge-transforming' model (Bereiter *et al.*, 1987) but they can do so within harsh schedules, demonstrating automaticity and fluency of operation. Writing in this context is a 'multi-dimensional construct' (Grabe *et al.*, 1996) with a hierarchical structure of complex structured and rhetorical dimensions. Many theories of writing have, therefore, evolved.

2.11.1 Written versus oral communication

Writing is a social act (Faigley, 1986, Cooper, 1989, Witte, 1992, Hayes, 1996) and is one of many forms of communication. It is a means by which the writer can share information and thought with others. It is essentially social in that it is conducted in a social context and is shaped by social conventions. The social context embodies the interchange between writer, reader and audience. It relies upon social conventions such as grammar, syntax and form. Indeed, rhetoricians claim that writing is a collaborative act even though at the time of text production it is a solitary act (Grabe *et al.*, 1996). Writing differs from oral communication as a social activity in that oral communication is reciprocal and spontaneous, often resorting to short-cuts in language because of the immediacy of the communication, the shared values of the participants and the part played by tone of voice, facial expressions and body language in making thought explicit and in communicating information. Writing differs from speech because written text must be fully explained and thoughts made explicit to ensure that misinterpretations and misunderstanding of the writer's intent do not occur. Thus, the dynamics of dialogue in oral communication are distanced in the production of written text. Oral communication, on the other hand, provides instant prompts which enable explicitness to emerge.

2.11.2 The Social Context of Writing in HE.

The increasing trend towards quality assurance and teaching quality audits in HE has excited interest in student writing. From the 1980s the social context of writing has generated differing views and emergent theories from the Hallidayan functional linguistics and academic literacies to the notion of discourse communities in HE.

Writing is seen by some as a social practice which reflects the values, relationships and discourses of academic disciplines (Street, 1993, Lankshear, 1997). Cooper rejected the 'writing as thinking' model because it suggested that writing was conducted in isolation without recourse to the social context.

> " writing is a social activity, dependent on social structures."
>
> Cooper, 1986, p.366

For Cooper, writers take on a role which is defined by social context and reconstruct information, changing its direction. In this tradition, writers take on the role assigned by the context of the writing or the genre but can be considered as part of an ecological process in that they are responsible for the production of new systems by reconstructing meaning.

> " (writing) is an activity through which a person is continually engaged with a variety of socially constituted systems."
>
> Cooper, 1986, p. 367

2.11.3 Academic Literacies

The Academic Literacies Movement is also concerned with the social aspects of writing. This is a controversial area and has gained much ground in the research into writing practices in HE. The Academic Literacies (AC) model has developed from 'new literacies' studies and is concerned with the 'social practices (of writing) embedded in networks of culture and power' (Stierer, 2000). It is more than knowledge of genre, for example, and provides a framework for the examination of student writing in the context of the power struggle experienced by students trying to reconcile their own identity in writing and the control of the institution (Ivanovic, 1998). Much of the research in this field examines writing practices in HE and as such takes account of the cultural and contextual components of writing. The approach is very different from cognitive psychology theories of writing whereby studies have examined what constitutes good and bad writers or novice and expert writers. The AC model seeks to gain insights into what constitutes literacy in an academic environment and in doing so encompasses the concepts of student socialisation into academic writing as well as the skills which are needed in the act of writing. Both these strands are taken in the light of institutional practices and the inevitable power struggles between tutor and student. Thus, student socialisation into writing in an accepted way, within conventions which have evolved within disciplines, is considered not to be simply an issue of genre familiarity but one of identity (Ivanovic, 1998, Lea *et al.*, 1998) and student empowerment in the learning process (Martin, 1989). It is concerned with imersing students into a new writing culture. How students engage in this process and how they reconcile 'self' in this practice could be likened to Bereiter and Scardamalia's cognitive psychological knowledge transforming model. In both, the student 'voices' his thoughts by restructuring and synthesising knowledge gained. Both examine the difficulties experienced by writers. The AC model regards these difficulties as a result of conflict between the student writer and the institutional/disciplinary practices, whereas the cognitivist theoretical model discusses them in terms of the skill (or lack of) of the writers.

The study of writing practices will most certainly help us to understand the social context of writing for our HE students and will enable us to make judgements about what constitutes good or bad writing in this context. In studying writing practices, writing demands and institutional constraints in writing, it may be necessary to examine the task environment within an academic community. The task environment of the Flower and Hayes theory of writing process is subordinated to the mental processing components (Flower *et al.*, 1981). The notion of task performance in a writing community is clearly rooted in the social contexts of writing.

2.11.4 Discourse Communities and the Social Context of Writing

> " The student who is asked to write like a sociologist must find a way to insert himself into a discourse defined by this complex and diffuse conjunction of objects, methods, rules definitions, techniques and tools..... In addition he must be in control of specific field conventions, a set of rules and methods which marks the discourse as belonging to a certain discipline."
>
> Ball *et al.*, 1990, p.357

The centrality of using language in particular ways in subject disciplines is at the heart of the sociolinguistic theory relating to discourse. Each discipline relies upon use of technical, subject-specific language within the boundaries or conventions of a system of rules for written expression. Composition for our HE students is viewed within a social constructivist paradigm. Subject matter, audience expectation and rhetorical organisation of text are determined by the writing community within which the HE students operate.

> " the reality, knowledge, thought, facts, texts, selves and so on ..... are generated by a community of like-minded peers."
>
> Bruffee, p.774 cited in Grabe *et al.*, 1996

Thus, reality of thought is 'constructed' out of the social relations within the research community or subject disciplines. The social context of composition,

therefore, takes on a crucial importance for the student (Kress, 1989, Olsen, 1993, Bizzell, 1993). Such communities make use of genre which is concerned with form. Research into writing instruction with children has emphasised the need to teach emerging writers frameworks for factual writing which enable children to learn how to manipulate content through effective use of the correct genre (Martin, 1989, Derewianka, 1990). This echoes the functionalist approach (Halliday, 1978). The integration of language and form is essential in understanding the importance of genre. A genre approach to composition has been criticised because it is considered to be mechanistic. It could also be argued that concentration upon the components of text construction does not develop thinkers as writers. Grabe and Kaplan's seven basic components of text construction reduce writing to a mechanistic exercise (Grabe *et al.*, 1996) and are at odds with the social interactionist approach detailed below.

The criticism of genre as a mechanistic approach would be true if learning a genre was only about learning a pattern of forms and was an end in itself. The social interactionist approach to writing makes genre implicit in writing development because it helps the writer to participate more fully in the actions of the discourse community. Indeed, one of the reasons why dyslexic writers in HE are considered unskilled or poor is because of their lack of genre knowledge (Price, 1998). They are not aware of the frameworks and have had insufficient practice in the different types of writing. The need to focus on more basic components of literacy has often resulted in gaps in their genre knowledge. Not only have these students experienced reduced opportunities for developing different writing frameworks but they have not been exposed to critical analysis of text which deconstruction and reconstruction practices would have provided.

Thus, discourse communities provide an environment for the development of thought while at the same time giving dyslexic writers boundaries and security in their writing.

> " to produce language which is functional in some context of use ..... skilfully negotiate key text points with appropriate text options....."
>
> Nystrand, 1986, p.177

The 'choices' open to student writers are not infinite but rather are defined by the discourse community in which they are writing. Consequently, attention and cognitive resources can be focussed upon the graphic, orthographic and formal features of the text; the substantive features, such as introductions and conclusions; and the functional parts, such as purpose, whilst the writer is learning to mean. In this way mastery of concept is closely associated with linguistic development and text knowledge.

However, Baynham challenges the view of the homogeneity of the discourse community, using the 'practice-based' disciplines of nursing as an example. He suggests that the breadth of this new discipline results in complex writing traditions which produce a heterogeneity rather than homogeneity (Baynham, 2000).

Nevertheless, the evidence for the social context of writing for HE students is strong but should be taken alongside cognitive contexts. Some suggest that any theory of writing which does not incorporate these two components – social and cognitive – is inadequate (Nystrand, 1989, Witte, 1992).

2.12 Working Memory Model

It may not at first appear obvious why working memory theory is relevant to a discussion of writing process. However, it is necessary to examine the role of the working memory in written task production in order to provide clarity to the section on cognitive processing models of writing and to consider the deficit hypotheses of dyslexia in conjunction with these. There are two current theoretical models which have gained attention, (Kellogg, 1996, Grabowski, 1996).

Most of the current research into working memory is derived from Baddeley's theoretical model, with its executive control, phonological loop and visuo-spatial sketchpad systems (Baddeley, 1986). In my early days in teaching, we looked at short term memory as one of the key indicators for dyslexia. Over the years, research has demonstrated that this is but one aspect of a larger component - working memory. It is necessary to define the subtle differences between short term memory (STM) and working memory (WM). STM is part of the *storage function* of WM and deals with low level skills, 'the passive storage buffer of working memory', (Daneman *et al.*, 1980), p. 450. For example, in writing, it will be responsible for the transcription skills of handwriting or typing. Tests for STM, the typical digit span tests used by teachers and educational psychologists, demonstrate the simple capacity system. The person being tested is given a set of digits to repeat forwards. They have to listen to the increasing string of digits, store these sequential items in STM and then produce the digits verbally. This enables assessors to find out the capacity of short term memory with regard to the storage of sequential information (forward digit span test). When the person is requested to repeat the string of digits in reverse order, this places more pressure on STM in that it has to manipulate the information as well as storing it. Thus, the processing aspect is introduced. It has been suggested that this aspect of the test (Backwards Digit Span Tests) is exploring WM capacity. Therefore, WM has a dual function: it is not only a storage but a processing system and as such can be used for the higher order skills during planning, organising and text generation.

Much of the early research examined the role of WM during the reading process and conclusions about its role in the acquisition of language skills were drawn (Kintsch *et al.*, 1978, Daneman *et al.*, 1980, Just *et al.*, 1987, Baddeley, 1986, and Gathercole *et al.*, 1993). Recent research has been interested in developing this theory in connection with writing in particular. Drawing upon Baddeley's theoretical model (Baddeley, 1986), Kellogg provides a model for WM and writing (Kellogg, 1996). His model uses Baddeley's three WM systems: The central executive system and the two

'slave' systems – the phonological loop and the visuo-spatial sketchpad. These three work in harmony and independently during reading, each dedicated to specific sub-skill tasks. The central executive is the overarching component and is said to deal with reasoning, problem-solving and decision-making; while the phonological loop stores and processes auditory and verbal information. Thus, the reader is able to decipher phonemes and decode text, tapping into knowledge stored in the phonological loop. The visuo-spatial sketchpad is concerned with visual and spatial information and deals with transcription in writing and symbol recognition in reading.

Knowledge of how these components interact may be vital in helping us to understand how the dyslexic writer copes with writing in the HE context. However, WM paradigms need also be taken in the context of Dyslexia Automatisation Deficit (DAD) theory, mentioned earlier in this chapter (Nicolson *et al.*, 1990). The human brain has the ability and capacity to store vast amounts of information but it can only *actively* work on a small amount of information at any given time. This is the difference between long term and working memory (Logie, 1996, Torrance *et al.*, 1999). The brain has the ability to multi-task but this is seen as a balancing act between the central executive resources and specialised, 'slave' resources (Kellogg, 1994). Torrance and Jeffery draw an analogy between cognitive capacity and the Random Access Memory (RAM) in a computer (Torrance *et al.*, 1999). The size of the RAM dictates the speed at which everything operates. If RAM is exceeded certain programs are unable to operate or may even crash. How the brain processes certain simultaneous operations or activities is therefore crucial, and it is important to understand the dual processing role of many of the 'slave' system which are used for specific tasks.

The amount of capacity, both storage and processing, seems to vary between novice and experienced readers and writers, (Daneman *et al.*, 1980) and (Jeffery *et al.*, 1995). This may be due to the way in which information has been stored and is accessed by the cognitive structure. This suggests that automaticity plays an important role and could explain individual differences in

operation. In this way experienced readers and writers store routine schemata for specific tasks in a well-ordered and well-associated way. This leads to what I call a Rapid Access Route (RAR) which is based on the Rapid Processing Pathways research, mentioned in Chapter 2, section 2.8.6. Thus, all that is kept in the active store is a label which can be activated by a fast track system rather like the RISCOS (Reduced Instruction Set Computer Operating System) system developed by Acorn Computers which limits the number of operations needed and also places less tension on the storage capacity. It is, therefore, a much more efficient system. For example, expert writers, when composing, need to gain access to and bring information for conscious processing in WM from linguistic resources which are stored in long term memory. For greater efficiency the expert has to have the information coded in a hierarchical way to enable speed of access (Bereiter *et al.*, 1987). The generation of top-down short-cuts differentiates the novice from the expert as will be shown in the following section in current theories of the writing process. It is as if only the tip of the iceberg is available in WM and once activated the hidden depths are drawn to the surface (Logie, 1996, Ericsson *et al.*, 1995).

Using Baddeley's WM theory, Kellogg posits that the central executive and its two slave systems are used for different aspects of the writing process.

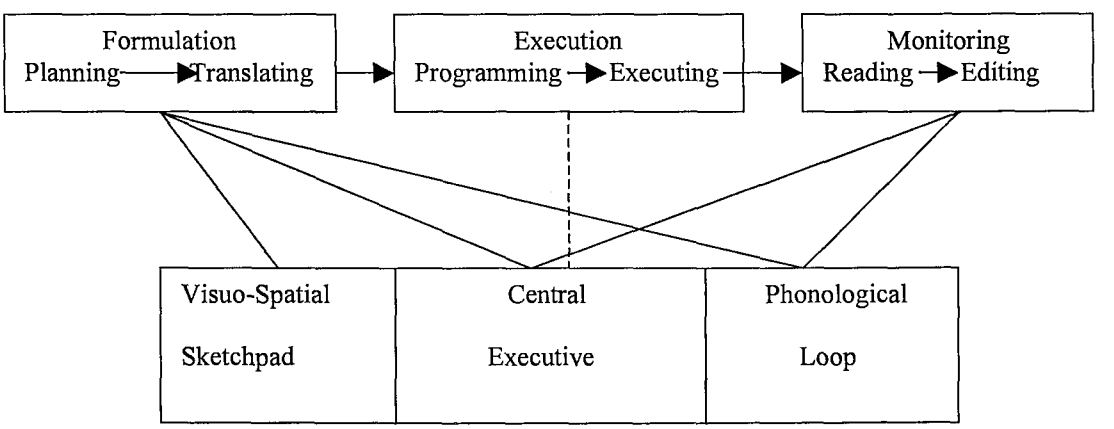


Fig. 15 WM Resources during the writing process, Kellogg, 1996, in Levy *et al.*, 1996, p. 59

A question which has dogged many researchers is whether WM can be used as a predictor of writing skill. Some studies have examined the individual

differences in children's working memory and writing skills (Swanson *et al.*, 1996). Although school children were used in this research, it may be possible to use the findings with the dyslexic writers in HE because there is no suggestion that maturation makes a significant difference to the results. This study examined phonological STM, verbal WM span, executive processing and visual-spatial WM span and concluded that STM was used for transcription processes and reading recognition during the writing process. Thus, this storage capacity was engaged in handwriting and decoding. In HE writing to a large extent, the handwriting is a loose term covering word processing and handwriting. On the other hand, WM was used for text generation and reading comprehension. In other words, it was used mainly for the problem-solving/knowledge-transforming aspects of the writing process and for higher-order language skills. Interestingly, this study demonstrated that writing draws upon a very specific capacity system. My question is: if there are deficits in this specific capacity system, in what way does this alter or affect the process?

In order to appreciate the role of this WM it is necessary to examine writing process theories.

2.13 Why is writing difficult?

In earlier sections of this chapter, it has been demonstrated that the cognitive profile of the dyslexic student is complex and different. The way in which the dyslexic writer processes language, the speed at which this is performed and the way in which executive controls are used may make a difference to performance and production. If this is the case, it is vital to examine cognitive models of the writing process to establish if the dyslexic writer approaches the task differently. Cognitive models of writing are concerned with the mental activities which are involved in the process. The writing process is sometimes viewed simplistically, especially in the Primary and Secondary classroom, as a linear process and as a number of different activities, each of which have different cognitive demands. After all, surely writing consists of three main activities: planning what is going to be said; changing the plans into continuous

prose and then editing and reviewing what has been written. Consequently, teachers often make the assumption that the stages of writing can be compartmentalised and teach children how to become good writers accordingly. This will be discussed in the final chapter. In a sense, each of the activities involved in the writing process could be examined discreetly, and the cognitive resources needed could be listed. It would then be possible to map the cognitive demands for each successive stage of the process. However, as the research will demonstrate, the human brain is much more complex than this two-dimensional approach and a multi-layered system operates during the writing process.

2.13.1 A Cognitive Model of Writing

Research into writing as a process began in the early 1980s and was triggered by a number of factors. The interest in writing was well developed in USA. As early as 1964 composition instruction was included in studies at Harvard. Concerns about attrition levels and lowering standards led, in the 1960s, to writing instruction programmes gaining ground. These were designed to meet the needs of tertiary college students. This tradition has continued to this day, and most American universities have widely developed programmes. The early programmes focussed upon product, genre instruction and writing strategies rather than on process: i.e. the 'what' not the 'how' of writing. The natural extension of this was the need to examine the complex and interactive skills needed for the production of text.

The development of a cognitive model of writing is elaborate not only because of individual differences in processing but because the product in question is a 'multi-dimensional construct' (Grabe *et al.*, 1996), p. 61. Texts have a hierarchical structure which is based on logical relationships. Grabe and Kaplan list seven basic components of text construction:

- Syntactic structures;
- Semantic senses and mappings;
- Cohesion signalling;

- Genre and organisational structuring to support coherence interpretations;
- Lexical forms and relationships;
- Stylistic and register dimensions of text structure;
- Non-linguistic knowledge bases.

Grabe *et al.*, 1996, p. 62

Cognitive psychologists are interested in how the brain copes with these features and the demands placed upon executive controls and cognitive resources.

The problem-solving paradigm as the architecture or structure for cognition is of paramount importance in cognitive psychology (Newell, 1990, Hayes *et al.*, 1980). Cognitive models are concerned with the cognitive sub-processes and how these work, and how they are linked during the act of writing. Research has emerged since the early 1970s and was based upon Piagetian theory of writers emerging from 'egocentric' to an 'abstract' level of functioning. This places emphasis on the concept of 'novice' and 'expert' writers (Hayes *et al.*, 1980, Hayes, 1996, Bereiter *et al.*, 1987).

In order to situate this research in the writing process arena, it is pertinent to examine the seminal work of Hayes and Flower and Bereiter and Scardamalia's subsequent writing process model (Hayes *et al.*, 1980, Bereiter *et al.*, 1987). Both of these models draw heavily upon cognitive psychology and working memory theory. If the deficit hypotheses of dyslexia are taken into account, it is important to consider the types of writing tasks undertaken in HE together with an understanding of cognitive resource capacity during the writing process and the overload or constraints which this places upon the dyslexic writer in HE.

2.13.2 Hayes and Flower Model of the Writing Process (1980)

> " The translation of complex networks of relationships..... into linear pieces of written English."
>
> Flower *et al.*, 1981, p.373

Hayes and Flower produced a Social-Cognitive model of writing which has been used as the basis for much research and, like much seminal work,

provided a vehicle for criticism. The notion of problem-solving in writing was taken as the main basis for the framework which they produced, and the writing process was presented as a goal-directed activity whereby the composing processes are interactive and potentially simultaneous. This reflects the Vygotskian definition of writing as '(a) deliberate structuring of the web of meaning' (Vygotsky, 1962), p. 100. Vygotsky's deliberation could be likened to the decision-making and goal-setting of the Hayes and Flower model.

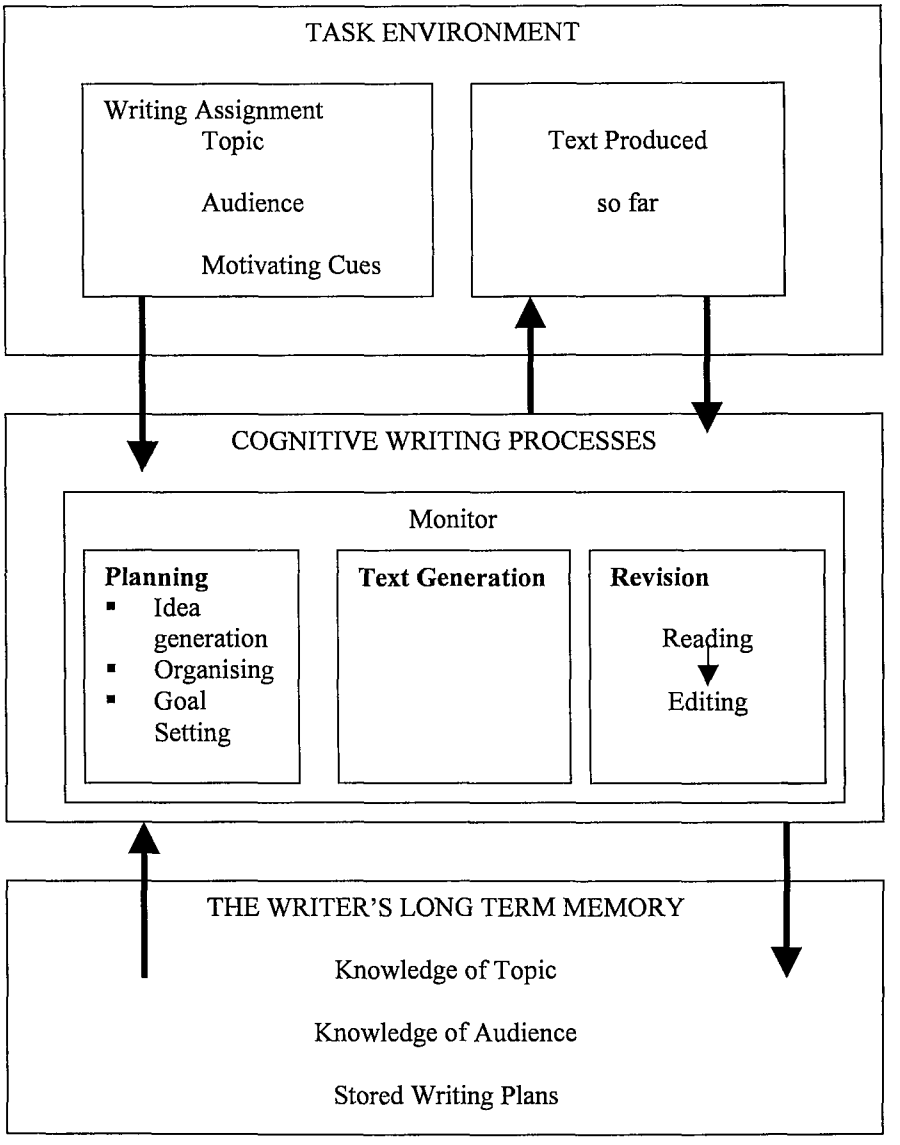


Fig16 Drawn from the Hayes and Flower Model 1980

The model has three components. The 'task environment' is concerned with an essay title, for example, which is given to students by tutors. The topic and the genre (audience) are outside the control of the student because they are defined

implicitly or explicitly by the tutor. The other element of the task environment is the text which is produced by the student in response to the written assignment task. This was described as the social element of the process in that it involved student and tutor. The second component is the one which is the cognitive element and is the most complex, being divided into three with sub-processes described. 'Planning', consisting of generating ideas, organising and goal-setting, is involved with decisions about what to say and how to structure this. The 'text generation' entails drafting and composing of written text or turning the plans into written format; while the final component, revision, results in the student having to evaluate what he has written, and improve the text by editing. The writer's long-term memory works with all the sub-processes in the cognitive component so that when a student is planning the structure (organisation) of his essay, he will draw upon knowledge of genre and topic content to support his goal-setting and decision-making. Similarly, when at the stage of text production and revision he will draw upon resources from long-term memory to help produce coherent sentences and to identify errors.

Each of the elements of the cognitive component are not worked upon sequentially, though they could be. But rather, Hayes and Flower posit that planning and goal-setting take place during all the sub-processes to a greater or lesser extent, and that this involves constant re-definitions and new decision-making and goal-setting as the student writes his essay. They presented a dichotomous writing population of novice and expert writers.

Research in the late 1980s examined some of the sub-processes in more detail and they looked in particular at how writers tackle revision. The resulting theory of revision with its four processes of:

Task definition
Evaluation
Strategy selection
Text modification

demonstrated how writers revise, and how there are differences in this process between novice and expert writers in this process (Hayes *et al.*, 1987).

Similarly, another set of studies focussed upon the relationship between reading and writing (Flower *et al.*, 1990). This research showed how students use reading to inform their writing. It also demonstrated the links between task context and reading and writing activities. The close relationship between the two (reading to write) exemplified that even in these sub-processes the theme of problem-solving was pivotal, so that students had to make decisions about what to read to inform the task and to build up a store of content knowledge as part of text generation. Thus, this research strengthened the 1980 writing model by providing evidence of clear links between the cognitive component and contextual constraints while writing. It stressed the role of goal-formation constrained by rhetorical structures.

> " For the student,..... the classroom content, the teacher's concern with content, and the role of the paper as a tool in the grading process.... are likely to fit a familiar schema for theme writing. But what is important in college is not the apparent genre or conventions, but the goals. The goals of self-directed critical inquiry, of using writing to think through genuine problems and issues, and of writing to an imagined community of peers with a personal rhetorical purpose – these distinguish academic writing from a more limited comprehension and response."
>
> Flower *et al.*, 1990, p. 251

At the heart of their research is the notion that writers develop through their ability to make decisions and choices (problem-solving) at all stages in the writing process and that these are placed against a set of defined multiple and often competing goals (goal-setting), but that goal-setting transcends much of this recursive process. The student is, therefore, constantly setting and re-setting goals as part of :

Task definition;

The selection process during reading;

The drafting (translating) process;

On-going cognitive activity.

The model they present is of a linear, developmental continuum with writers moving from novice to expert with practice and instruction. What is significant, and different from some other models, is the idea that *all* writers go through the *same process* but at different levels of operation. Thus, the novice writer brings a certain naivety to the same process: his goal-setting and decision-making will be simpler. Although taking a more social-interactive stance, Nystrand's research reinforced the developmental continuum (Nystrand, 1986). For example, the young child in Primary school, the novice, is able to write but the decisions about text organisation, for example, would be simpler because his knowledge of linguistic structures, genre, writing for an audience etc. is considerably less. Nystrand's studies showed that young writers go through well defined stages of planning:

Drawings ⟶ drawings + logos (logographic stage) ⟶
drawings + letters (beginning of alphabetic stage) ⟶
Drawings + words (early orthographic stage) ⟶ drawings + sentences.

As the writer develops knowledge, orthographic decisions become more complex and further decisions are required. Parallels can be drawn in this planning/decision-making aspect of writing with Frith's reading model of logographic, alphabetic and orthographic stages.

The developmental continuum, therefore, suggests that expert writers have a global picture of the rhetorical problem as they analyse the task and are able to re-assess their goal-setting as they are drafting and revising. Before they start writing, they are mindful of such factors as audience and genre to help them conceptualise the essay structure. In a sense they are aware of what the finished product should be and can set goals to achieve this by careful consideration of line of discussion or argument; the thread or themes running throughout and how these may shift and change the interlocking parts. This ensures an unconscious cohesion and coherence to the writing. In this way expert writers consider more and in greater depth than the novice writer in the same process. Not only does the expert writer have explicit rhetorical goals but he uses these to generate text, drawing upon more elaborate plans and more extensive

revision. For example, the novice writer will plan but focuses upon the planning of the content rather than the rhetorical structure. The essential difference between 'planning to do' and 'planning to say' (Hayes *et al.*, 1980,Carey *et al.*, 1989).

> "Good writers are, in effect, creative in their problem finding and in their problem solving."
>
> Hayes *et al.*, 1980, p. 116

However, this model does not fit with empirical evidence which suggests that the more you know the more difficult the writing task becomes.

Hayes and Flower were not without their critics. Their emphasis on cognitive processes and resources – a top down model for the account of writing – does not take into account how the writer turns thought into text, and North argues that the application of the theoretical model to the writer is weak and given little explanation by Hayes and Flower's 1980 work (Torrance *et al.*, 1999, North, 1987). However, their work spawned much further research which has led to Hayes revising the model, bringing it up to date with current evidence.

2.13.3 Hayes new Framework for the Writing Process

This new framework can be seen as a response to criticisms of the early model and comes 15 years after the Hayes and Flower ground-breaking model of 1980. Many of the changes are in response to empirical research during the intervening years. The 1996 framework places greater emphasis upon the role of working memory in the writing process and positions this more centrally than before. The three sub-components of the cognitive area remain essentially the same, and 'planning', 'translating' and 'reviewing' are regarded as parts of the writing process. However, the significance of their role has shifted within the new framework. There is a re-definition of the 'revision' component, with the role of reading elaborated. Consequently, there is a shift in the emphasis of goal-setting and problem-solving which were the key features of the earlier model. Because of the intervening research into planning, this aspect does not

feature so significantly in the framework. Hayes suggests that the revised model is an 'individual-environmental' model (Hayes, 1996), p. 5.

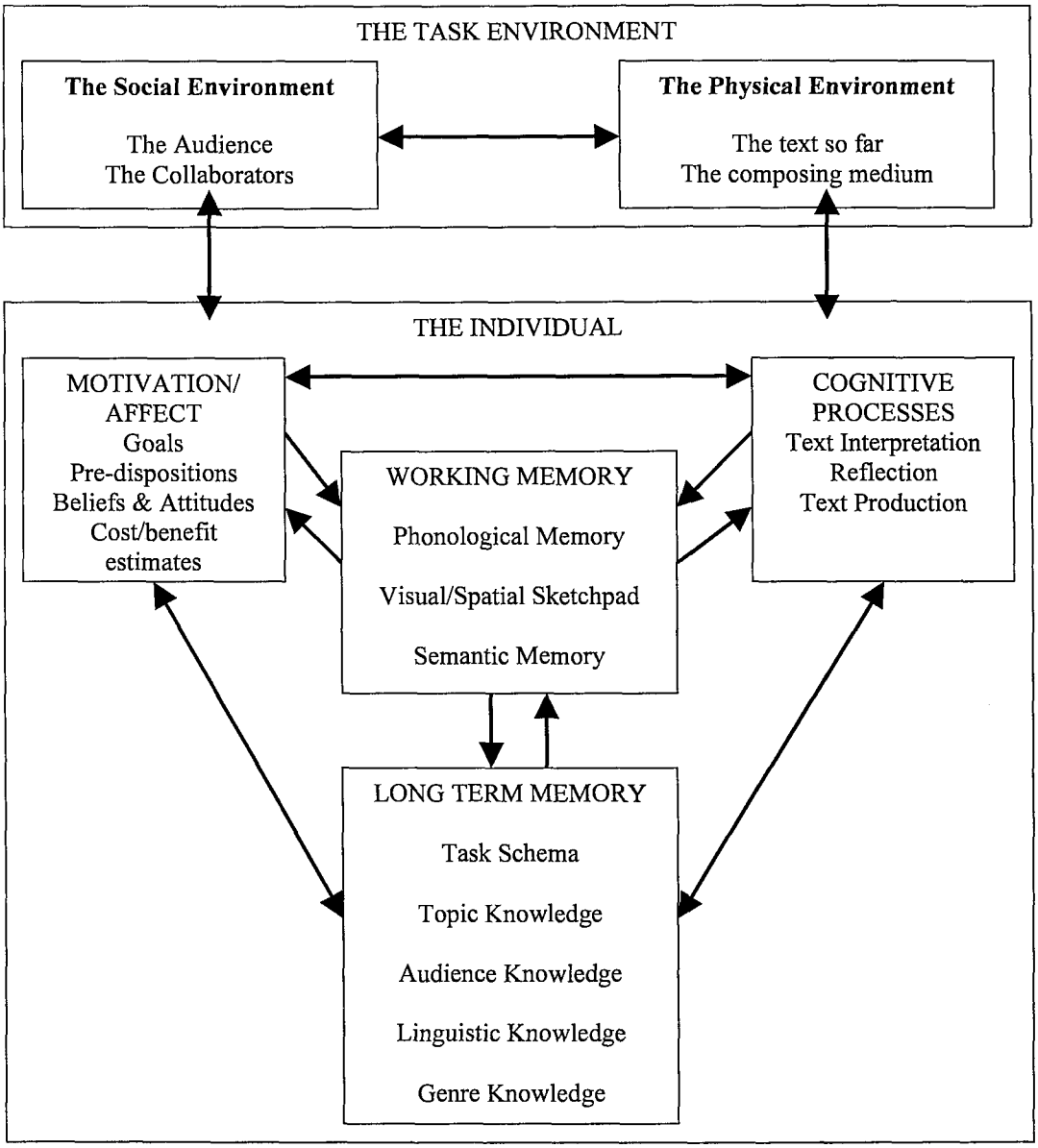


Fig 17 Drawn from Hayes New Model 1996

The hub of this model is the working memory and how this interacts with the other cognitive components, 'symbolising its central importance in the writing activity' (Hayes, 1996) p.8. Hayes has drawn heavily upon Baddeley's work here (Baddeley, 1986). Gestalt theory on motivation and affect is evident in the inclusion of this component within the new model. It ties in with the goal-setting of the 1980 model but develops this further to cover the way specific

types of goal-setting can shape courses of action. Research with college students in the late 1980s and early 1990s provided evidence that self image and writing affected motivation and resulted in different courses of action (Dweck, 1986, Hayes *et al.*, 1990, Palmquist *et al.*, 1992). Anxiety and beliefs about writing shaped students' attitudes to improvement. Some students felt that writing was a gift and that this belief affected performance when writing essays. Another interesting piece of research which helped to re-define goal-setting was conducted with old people. They were given arithmetic tasks, and the research produced evidence of how decision-making about the strategy used to complete the tasks changed – the complexity of the task determined a specific choice of actions (Siegler *et al.*, 1995, cited in Hayes, 1996), p.10. Thus, Hayes posited that writers will set goals and make decisions by 'estimating the cost/benefit' of the actions. This has implications for working memory capacity which in turn will have a knock-on effect for spare capacity to deal with aspects of writing. The new framework does re-iterate the linear, developmental continuum approach to writing in that decision-making and course of action are affected by knowledge and skill but that all writers fit into the same theoretical model.

Reading, in all its aspects, is given much greater status in the 1996 framework and better reflects the students' experience of the writing process in HE, for instance. The interaction of reading and writing in the whole process is more effectively described in this model and is more closely linked to empirical studies. The notion that reading is used to evaluate text as part of the process of synthesising information (background reading) in order to 'translate' into the writer's own text is a significant development in Hayes' thinking. Hayes also elaborates upon the way reading is used to detect errors during the composing process. He draws analogies with work which had been carried out in the intervening years on the reading comprehension process and the cognitive capacity (Just *et al.*, 1992). Hayes takes the Just and Carpenter model of working memory during reading comprehension a step further. He posits that when reading text for comprehension we do not pay attention to stylistic features but that when reading text for revision purposes, although still

concerned with the message of the text, the writer is also paying attention to the language chosen, the way it is used, to sentence construction and to organisation (Hayes *et al.*, 1987). This in turn affects goal-setting. He demonstrates that when a student is carrying out background reading he will have different goals than when he is reading for revision purposes during the writing process and that different sets of problems arise during these 'reading' activities. During reading for revision, the problems are not simply problems of text generation but go beyond to problems of how to rectify and improve text. Of course how novice and expert writers tackle this aspect is different in that the latter are able to adopt a more sophisticated application of the model. For example, novice writers tend to concentrate upon surface features when revising and will restrict their problem-solving to sentence-level and word-level whereas expert writers take this a step further by looking not just at a sentence-by-sentence revision but how local changes affect the structure as a whole. In this way they are adjusting the global shape and trying to keep everything balanced. His model of revision, therefore, opens up the decision-making and goal-setting aspects of the previous theoretical framework.

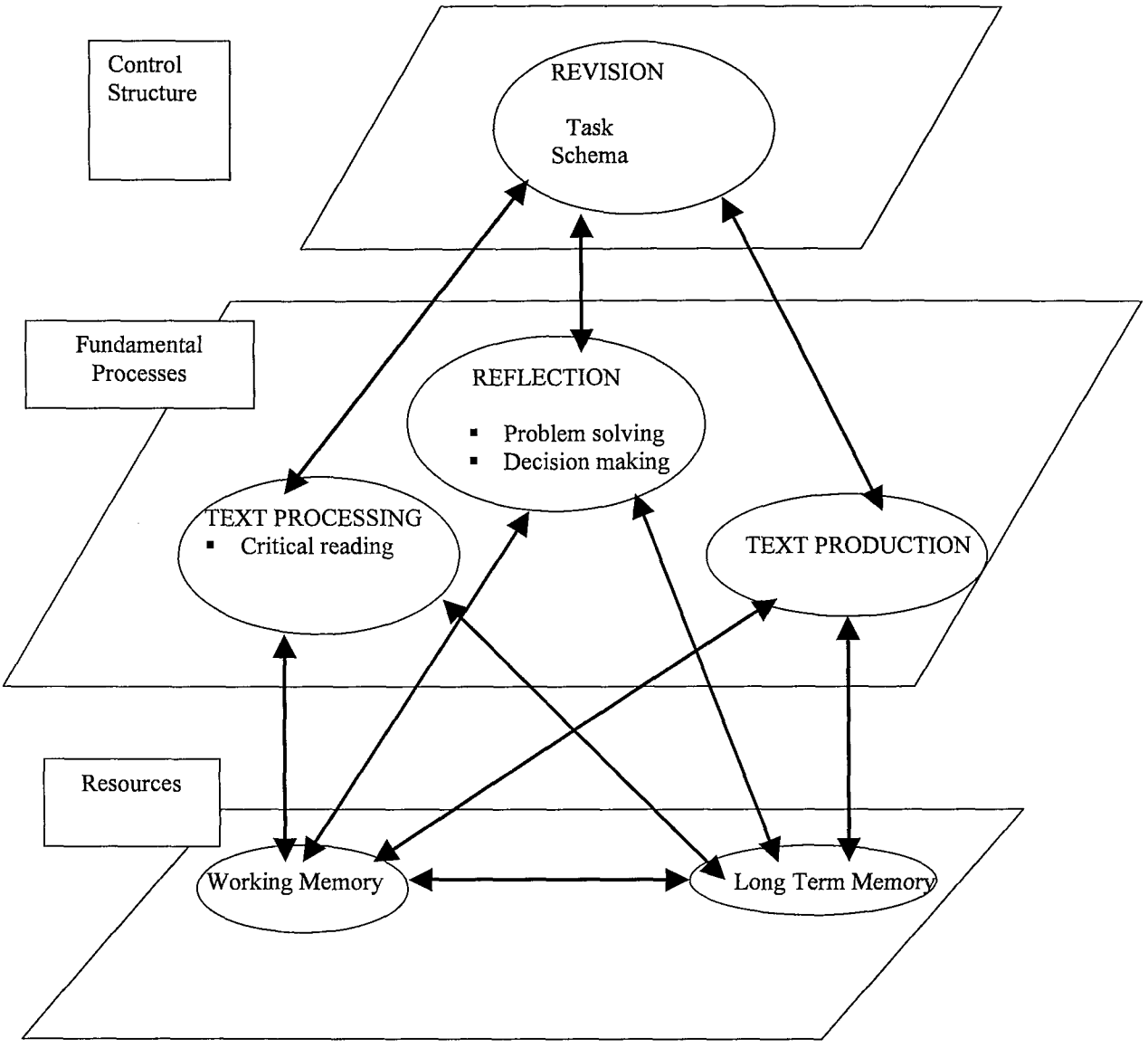


Fig 18 Drawn from Hayes Model of Revision in (Hayes *et al.*, 1987), p. 17

Planning does not feature so prominently as it did in the 1980 model, and this is because intervening research showed that the correlation between planning and text quality is statistically insignificant. It is difficult to construct a research method which will demonstrate this cleanly and without the data being contaminated by extraneous factors ('confounding variables' (Hayes *et al.*, 1996), p.49). With this in mind Hayes and Nash make a strong case for showing 'partial correlationships' and developed a methodological construct to examine data (Spivey *et al.*, 1987, Nelson, 1988, Carey *et al.*, 1989). They posit that time-on-task may be a crucial factor and may therefore make a statistically significant difference to the correlation between planning and text quality. In

the 1996 model, they distinguish between planning which is conducted when it has a direct effect upon process and that which affects the development of the text. Thus they talk about planning-to-do and planning-to-say which reflects the 'content planning' and 'rhetorical planning' of Carey et al.(Carey *et al.*, 1989).

What is interesting is the introduction within the physical environment of the medium used for writing. Since the first model, there have been many studies in the use of technology and in particular the word processor in the writing process. As a result, the type of editing and when it occurs has changed, and the way in which students plan, particularly in the pre-writing stage, has undergone significant changes because of the writing medium (Haas, 1989, Gould *et al.*, 1984). This is important when considering what dyslexic writers do when composing because many HE dyslexic students are sophisticated technology users, as will be seen in later chapters, and demonstrate different patterns of planning and editing.

The changes outlined here in some way go to answer the criticisms that the 1980 model did not account for the affective domain (Brand, 1989). It is doubtful that Nystrand will be totally satisfied, for his criticism that the social dimension was overlooked in the first model may to some extent hold true in the 1996 model (Nystrand, 1989).

2.13.4 Bereiter and Scardamalia's Theoretical Model of the Writing Process.

Any study of writing process with HE students would not be complete without examining the work of Bereiter and Scardamalia. Their research is of particular interest because it is closely linked to empirical studies. The two-model theory which they have devised could be said to describe the good and the poor writers as described by many tutors in Higher Education Institutions (HEIs).

Bereiter and Scardamalia provided a different emphasis from the Hayes and Flower model of the process of writing (Bereiter *et al.*, 1987). Like Hayes and Flower, they place great emphasis on problem-setting and stress the iterative

nature of writing. Another similarity is the fusion of analysis and synthesis in the writing process whereby the writer brings together ideas and concepts in the construction of text (synthesis) and this process is interrupted by on-going analysis, especially during the editing process. The analogy between this process and software design is most apt:

> "During analysis we test the design to determine whether it is meeting our targets for usability and software quality. During synthesis we shape the design, drawing on fresh ideas and on solutions to similar problems that have worked well."
>
> Newman *et al.*, 1995, p. 11

Their research examines how young (novice) and skilled (expert) writers approach the process. They set out to answer many of the paradoxical and conflicting questions which often accompany discussions about the process of writing. A question many teachers frequently ask is why is it that young writers can often produce many pages of text in response to a writing task yet the quality of the text is immature and variable? However, it would seem that these writers appear to find writing easy. Yet University tutors often are puzzled by some students who, despite practice and long educational experience, never seem to develop mature writing skills! Where Bereiter and Scardamalia differ is that they do not believe that there is a *single process* and that all writers use this same model, according to developmental factors. Rather they propose two distinct models which are clearly extensions of the early research by Hayes and Flower: the knowledge-telling model and the knowledge-transforming model.

2.13.5 Knowledge-Telling Model

This model has been assigned to novice or young writers and represents a 'think-say' or 'what comes next' approach to writing. It emphasises the retrieval of knowledge, using a known discourse schema or genre framework and the final written product represents the structure of knowledge in the writer's mind. Problem-solving is thus reduced during this writing process because the writer is primarily concerned with generating content during

composition rather than re-setting goals and redefining plans. This results in simple text which often describes or gives a simple explanation of the content. It is often seen in young children's writing where they move from one event to the next and often use such features as 'and so', 'then next', 'then this happened' and so on. Often this type of writing reflects a time order to relating the content. The description of this process by a 12 year old aptly sums up the process:

> " I have a whole bunch of ideas and write down until my supply of ideas is exhausted. Then I might try to think of more ideas up to the point when you can't get any more ideas that are worth putting down on paper and then I would end it."
>
> Bereiter *et al.*, 1987, p. 9

As can be seen the problem and the decisions are simple and revolved around the content to be written about. In HE this type of writing is to be found and is criticised because the student is simply retelling the knowledge he has amassed and lacks critical analysis. It is often the sort of work produced by students who obtain a third or lower second classification.

However, this approach to writing can be analysed in terms of the cognitive structures involved and is presented here in Bereiter and Scardamalia's structure of the knowledge-telling model:

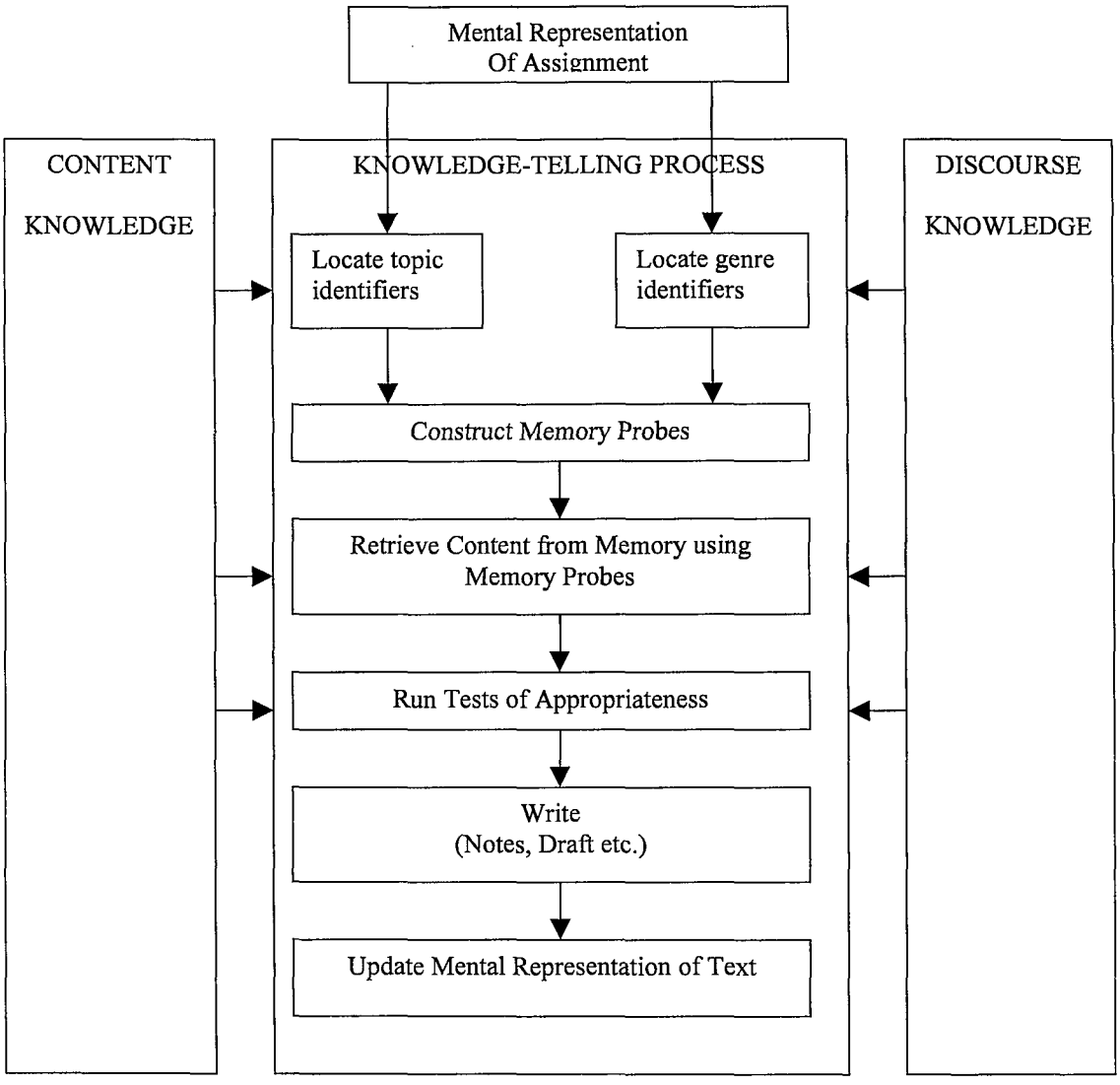


Fig19 Knowledge-Telling Model (Bereiter *et al.*, 1987), p.8

This model incorporates three domains: the content knowledge, the discourse knowledge and the cognitive processes. It contains many of the elements of the early Hayes and Flower model. It differs in that it is a retrieval, trial and error model which is fed by content knowledge and discourse knowledge. Content is 'subjected to tests of appropriateness' (Bereiter *et al.*, 1987), p.9 according to the task set and then this same process is used when composing, to ensure that the correct linguistic structures are adhered to. In other words, the discourse knowledge function is applied. In this model the significant factor is that these two domains – content and discourse – are operated independently of each other and therefore decision-making and problem-solving will be reduced. In a

sense this model suggests that this type of writing is only forward moving and is concerned with what comes next. Planning can also be simplified and stated at the beginning of the task. In a sense this model reflects pedagogy. Young writers in primary and secondary education are given an essay title and are then expected to do a structural plan which elaborates the content. They are then expected to follow this plan as they compose. It is a much more linear process and goes forward from one idea/paragraph to the next. Bereiter and Scardamalia posit that what goes on in the mind closely resembles what is in print, with often simple, surface revisions.

2.13.6 Knowledge-Transforming Model

In order to demonstrate that expert writers are not only different in print but also differ in cognitive functioning, Bereiter and Scardamalia devised the Knowledge-Transforming Model.

> " The (knowledge-transforming) process is one in which the thoughts come into existence through the composing process itself, beginning as inchoate entities and gradually, by dint of much rethinking and restating, taking the form of fully developed thoughts."
>
> Bereiter *et al.*, 1987, p.10

This model reflects the recursiveness of this type of writing. These writers are constantly re-assessing their writing in the light of *global* goals (Martlew, 1983, Bereiter *et al.*, 1987). It is similar to Hayes and Flower's expert writers. Knowledge-transformers may have an idea of the rhetorical structure they are aiming for but the initial plan does not drive the composing in the way it does for the knowledge-teller. Rather, the text evolves and with this growing entity new problems emerge in the light of what has been read.

> " For example, a writer in the process of composing a book may experience the conflict between unity and complexity very intensely. On the one hand, she feels compelled to be faithful to the highly differentiated and complicated subject matter with which she has to deal, and

> on the other hand, she wants to present her understanding of this in the most coherent way she can. So for her a controlling value is unity – complexity and conflict. As she proceeds, it is evident that she is making definite progress in reducing incoherence to coherence, inconsistencies to consistencies, and disunity to unity."
>
> Kellogg, 1994, p. 208-9

These 'knowledge transformer' writers take content from different sources and re-shape this so that their finished product is a new representation. This type of writing is what academic tutors in HE want all their students to produce so that they, the students, demonstrate understanding of the content but are critical and analytical of it. Those with a first classification are deemed those who have the ability to re-shape or transform the body of knowledge and take it a step further.

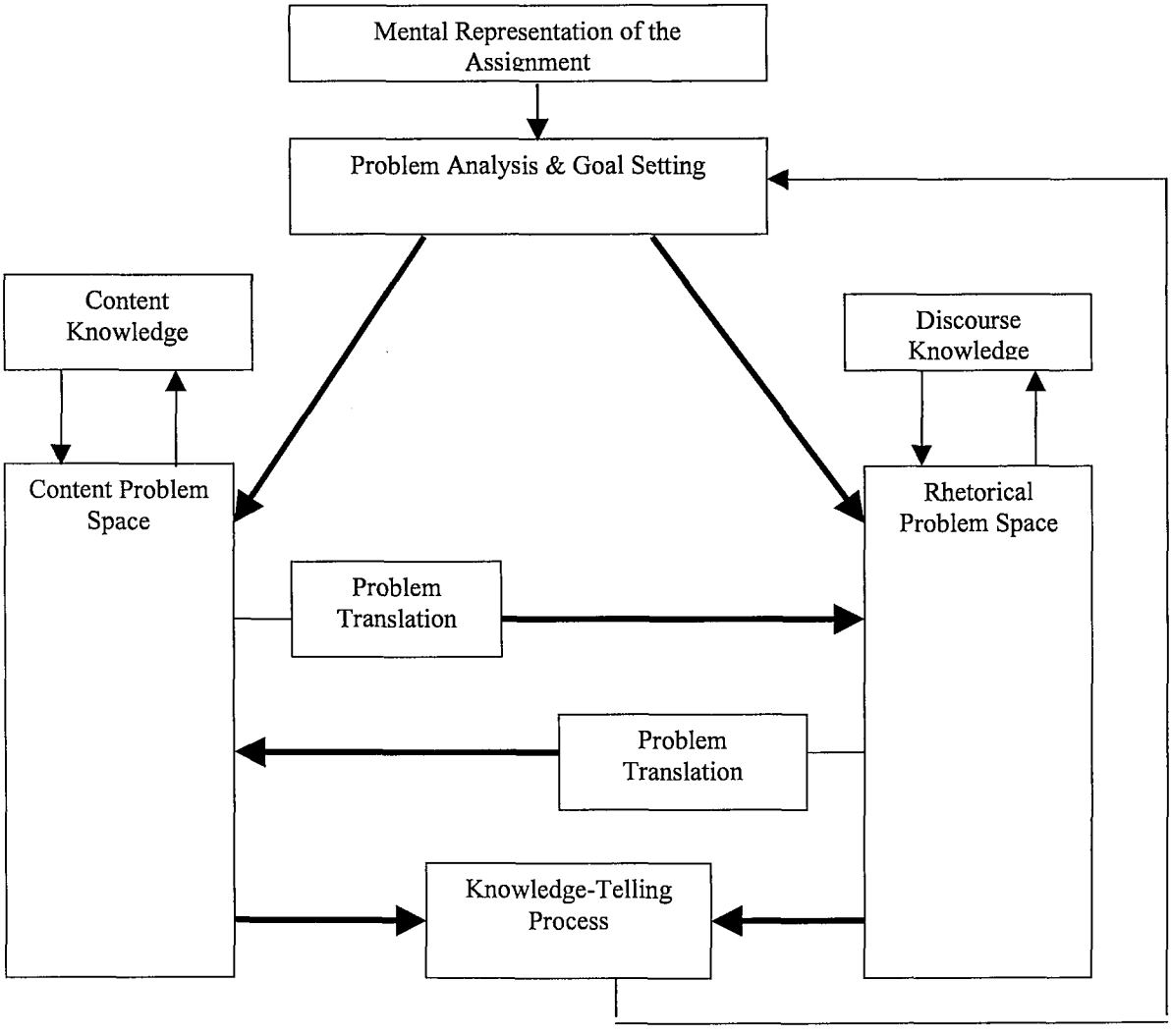


Fig20 Knowledge-Transforming Model (Bereiter *et al.*, 1987), p. 12

As can be seen this model is different from the knowledge-telling model and is not an extension of the knowledge-telling framework, or a development of expertise. They present us with a cognitive structure in which the whole of the knowledge-telling model is but one part of the process. Not only are the planning, problem-solving and decision-making components more complex but the content and discourse (rhetorical problem space) are interlinked whereby the output for one becomes the input for the other.

The development of this two-model paradigm would seem to answer the question of whether more skilled writers do something different. They argue the case most convincingly. If writing was simply about complex problem-solving and novice writers had not developed all the skills then surely the novice writing would break down? Yet this is not the case. Young writers can produce coherent and cohesive writing, albeit on a simplistic level in terms of text production. It does what it sets out to do – describe or explain in a simple, sequential manner. However, it does not draw together a number of threads and arguments and make a different shape. Thus, Bereiter and Scardamalia have reversed the theoretical model presented in 1980 by Hayes and Flower of a developmental continuum.

Bereiter and Scardamalia's models may be more convincing in the HE context where all students can write to a greater or lesser extent but not all students, with practice and instruction, reach the more complex level of knowledge-transforming. Both the Hayes and Flower and the Bereiter and Scardamalia models focus upon poor and good writers. Dyslexic writers in HE are remarkable in that they find writing difficult, possibly because of specific cognitive deficits, but are capable of good degree classifications. Do they, in fact, fit in with Bereiter and Scardamalia's contention that writing does not get easier as one reaches higher levels of writing but that the writer is tackling harder and more complex problems. Do these dyslexic writers fit the knowledge-transforming model or are they moving through the continuum set

out by Hayes and Flower? Or perhaps they sit in a more grey area which is a combination of elements from both?

2.13.7 Conclusion

If writing was a linear process, it would place considerable demands on the cognitive deficits allied to dyslexia. As research has demonstrated, writing is much more complex and is not a matter of completing one stage before going on to the next in a 'do this, do that', manner. It is a recursive activity. This results in starting points being constantly modified in the light of new and in-coming information and ideas. It also results in an accumulation of the process whereby the cumulative aspects of the different parts of the process are constantly changed and revised.

This type of process is more demanding of cognitive capacity and puts greater strain upon working memory. Therefore it is even more important that some of the low-level activity operates on automatic pilot. Thus, the chunking/labelling of information for storage and processing needs to be organised in a 'Rapid Access Route' (RAR) to facilitate the writing process.

As has been noted earlier, reduced storage capacity (STM), processing capacity (WM), together with deficits in automaticity, particularly in relation to language processing, may have profound consequences for the dyslexic writer in the HE context.

I suggest that because of these complexities and the possible multiple cognitive deficits, writing is *exponentially* more difficult for dyslexic students in HE.

Chapter Three - Research Methodology

3.1 Introduction

In research terms dyslexia could well be considered a hybrid. The development of knowledge bases for dyslexia is constructed by researchers in many different fields as has been seen in the previous chapter: genetics, neurology, cognitive psychology, language and, of course, education. Dyslexia, as a research field, is therefore necessarily an amalgamation of sometimes conflicting interests and, more significantly, tensions between positivism and constructivism.

The research methods employed by the various disciplines are fundamentally different and encompass most methodologies in the quantitative/qualitative debates. Questions of validity and reliability in this field take on a complexity which is more alive than if one was working within a single discipline.

If research from such disparate fields is to converge in order to build upon and develop a knowledge base, each approach has to demonstrate to others that the research has credibility and transferability. Perhaps this is an impossible task but it is with this in mind that research into dyslexia has to operate. Thus, the debates about the dichotomies of research are not merely philosophical but vital deliberations in the quest for a coherent account of a necessarily multi-disciplinary phenomenon. To narrow the discussion into an 'either/or' debate may close many doors and may not allow for the breadth of research cultures involved with dyslexia. The influential position which posivitist/empirical approaches to dyslexia hold should not exclude the hermeneutic/interpretive epistemology. It may be necessary to demonstrate that *fusion of horizons* has much to offer research in the field of dyslexia because it can bring together different points of view to achieve inter-disciplinary harmony (Gadamer, 1975).

Dichotomies, by their very nature, create exclusion, which is unacceptable in the field of special educational needs. Social inclusion and inclusive learning and teaching environments reflect a deep-rooted belief in the acceptance of 'diversity'

(DfEE, 1997). This view exemplifies a response to the 'specific' needs of the individual, e.g. the specific learning needs of the dyslexic writer. In a sense, dyslexia reflects, in these contexts, a confluence of thought and belief. It would seem appropriate, therefore, for the research methodology to recognise the multiple, contributory factors and the diverse procedures needed to explore them.

Nevertheless, the move to a mixed methodological approach and the relaxing of the strict boundaries has its problems. I concur with Scott who posits that the current détente, the live and let live approach, actually sustains the idea of dichotomy (Scott, 1995). Such approaches still maintain, at heart, separate roads with data sets treated differently, according to the respective paradigm. The data are then analysed to see how they complement or contradict one another.

3.2 An interactive continuum: a solution for dyslexia research?

Perhaps one should consider that these dichotomous arguments are stale and stultifying. Rather than argue the rights or wrongs of the quantitative or qualitative paradigms, I would prefer to consider an interactive continuum where a true mixed methodology is given credence. Such a continuum would provide *equal status* for quantitative and qualitative paradigms; would demonstrate a flexibility of approach; and would provide a philosophical framework for those whose research has a footing in both the social sciences and the scientific arenas.

This thesis brings together findings in education and cognitive psychology. An interactive continuum methodology would enable me to place this research within recognised boundaries and, at the same time, would enable me to explain the epistemological and theoretical foundations of movement within the continuum. Perhaps the issue is not so much about data collection *methods* but about *methodological* framework.

3.3 Mixed Methodology Models

My dilemma in conducting any research is that, as an educationalist, I lean towards qualitative methodology because I wish to explore the *experiences* of the dyslexic writer in order to inform pedagogy. Having worked with dyslexic students for many years, I am aware of their differences and have gathered much anecdotal commentary from the students about the experience of academic writing as a dyslexic writer. However, the people I want to research fall into a unique category in that two of the fundamental factors, i.e. working memory deficits and the effect of reduced automaticity on language production (both of which have been shown to be crucial in composition) are the domains of cognitive psychology. Hence my dilemma and the tension between two masters. If I am to find out whether the dyslexic cognitive profile makes a difference during the writing process, I need to compare my findings with current research in this area. Therefore, I must consider testing current theory of writing process which places the research more firmly in the deductive, hypothesis-testing paradigm.

Because cognitive processing is an essential element of this research, I could have chosen to replicate *exclusively* a research paradigm which Torrance and his colleagues used to examine the individual differences in writing behaviour with undergraduates (Torrance *et al.*, 1999). However, this statistical analysis of the writing process of students would only tell part of the story. In a sense it denies what educational research has to offer and would only give one layer of the picture. Surely, it is essential to take into account ***all*** the variables and not to isolate (for examination) elements which can be easily quantified? Thus, an interactive continuum would echo the spirit of Frith's model of dyslexia whereby she draws together the disparate threads into a cohesive whole.

It has been stated that often the practice of social research is governed not by theory alone but by the adoption of a pragmatic approach (Brannen, 1992). The combination of quantitative and qualitative methods may be the resolution needed to provide answers to the research questions and may not reflect allegiance.

> "There seems, then, to be a tendency for many writers to shuttle uneasily back and forth between epistemological and technical levels of discourse. While much of the exposition of the epistemological debates of qualitative research helped to afford it some credibility, a great many decisions about whether and when to use qualitative methods seems to have little, if any, recourse to these broader intellectual issues."
>
> Bryman, 1988, p. 108

Critics of mixed methodology have referred to it as 'opportunist eclecticism' (Bullock *et al.*, 1992) as if eclectic approaches are somehow inferior and ad hoc and have been chosen without any recourse to principle. However, others would define eclectic as adopting the best parts of a range of methods to suit the complexities of the situation – in other words to achieve a 'best fit' to answer the research questions.

The 'duality of structure' suggested by Giddens would seem pertinent to this research, (Giddens, 1976). This 'duality of structure' refers to the macro- and micro- elements of study. While some would argue that these macro- and micro-elements cannot be addressed by the same method (Cicourel, 1981), others suggest that it is possible to examine one element within the other. Sociological investigation of social relationships in social situations examines the micro- (individual relationships) within the macro- level of societal phenomena. (Fielding, 1988).

In terms of this research, 'duality of structure' relates to the macro- study of cognitive processing and its relationship to the dyslexic individual (micro-element). Thus, dyslexic language processing in the writing process will be examined in relation to the general writing process theory. The juxtaposition of macro and micro elements is indeed crucial to the multi-dimensional approach to this study. Throughout the study, the macro and micro elements emerge as different layers.

One way of achieving a deeper understanding of the cognitive functioning of the dyslexic writer is to use a research paradigm which quantifies aspects of processing and in particular examines the 'fundamental processes' (Hayes *et al.*,

1987) of text production, text processing and the concomitant problem-solving and decision-making aspects which the Torrance design affords; while at the same time facilitating explanations of the experience of this process by providing glimpses of the reality of academic writing through the students' eyes.

3.4 The Research Question

Causal theory of dyslexia points to specific deficits in cognitive functioning in conjunction with a reduction in the rapid processing systems associated with verbal and written language production. This may be significant in the context of academic writing in HE. Yet, if this is so, how do our dyslexic students achieve good degree classifications? This puzzling contradiction has led to this research project.

Research into the behaviours manifested by the dyslexic condition has focussed upon younger dyslexic pupils and the lower order skill difficulty in decoding and encoding. Thus, teachers in schools, driven to some extent by such research, have been pressurised into developing reading and spelling schemes to the detriment of higher order skill acquisition.

The surge in interest in the writing process has shifted the focus to higher order skills and, as pointed out in the previous chapter, a growing body of research is emerging within the HE context. However, none of the current studies has given consideration to the writing process per se and the dyslexic student. With the influx of dyslexic students in HE, (Gilroy, 1996), there is even more urgency to examine this particular phenomenon and to see if it is possible to draw together a number of research issues:

- Does the cognitive architecture make a difference to how the process model works?

- Is there a dyslexic, cognitive process model which accounts for the compensatory strategies which occur during the writing process to accommodate working memory and automaticity deficits?
- Do dyslexic students, in fact, present a different writing profile and is this because of their specific dyslexic deficits?

In a sense, these questions are closely interlinked. The answer to the final question may alter the framework within which empirical research can be contextualised. Of course, such questions bring with them my personal assumptions which will have to be taken into account in the analysis of the findings. The following hypotheses will adhere:

- Dyslexic writers in HE have difficulties retrieving the language they wish to use to satisfy rhetorical rules and conventions, and this affects the problem-solving and decision-making which occurs during the process;
- Dyslexic writers will spend more time than non-dyslexic writers on drafting because of working memory deficits and language retrieval difficulties;
- Working memory deficits have a significant effect upon the ability to perform as a 'knowledge-transformer' which is a requirement of academic writing in HE.
- Dyslexic adult writers will compensate for deficits by the adoption of strategies to maximise problem-solving during the writing process.

3.5 The Research Design – Issues and Considerations

Working in a School of Education in HE, my roots are firmly in the qualitative paradigms of the ethnographer whereby 'actors are studied in their natural settings', (Scott, 1995), p.107. As a social scientist, I shall adopt an interpretive approach to try to understand the difficulties and differences *experienced* by the dyslexic student in the academic writing. Thus, the project is influenced by phenomenological research which explores direct experience and which has been used effectively in student learning research (Marton *et al.*, 1976, Marton *et al.*, 1997). I believe that it is even more vital at this current time to ensure that the

student voice is not overlooked. Only in the last seven years have dyslexic people felt confident enough about declaring their condition and to state that they have some sort of special educational need – a term which has often been linked with weak intellectual ability. Thus, it has taken much courage to admit to any intellectual deficiency in the rarefied academic atmosphere of the university environment. Added to this is the fact that the dyslexic student body is no longer the minority it used to be. For example, at a University in 1992, four dyslexic students received support from me for academic skills tuition. By 2002, the number of students registered with the Dyslexia Support Services (DSS) had risen to 642. This increase is a reflection of national trends. HESA statistics have demonstrated that those declaring dyslexia on entry to HE have risen steadily:

> "the number of dyslexic students had increased from 0.44% in 1994/95 to 0.97 % in 1998/99"
>
> Farmer *et al.*, 2002, p. viii

It is suggested that these figures are now closer to 2% which is in line with the figure quoted for statementing purposes in compulsory education (Singleton *et al.*, 2001). There are many contributory factors for this rise. A greater understanding and acceptance of dyslexia; together with changes in entry criteria and widening participation have encouraged dyslexic people to consider HE studies (Gilroy, 1996, Hetherington *et al.*, 2001, Farmer *et al.*, 2002). Thus, these increases make it essential to ensure that the student voice is heard.

The 'study of direct experience taken at face value' (Cohen *et al.*, 1998), p. 29, will inform one part of the research design, drawing from a phenomenological theoretical perspective. The centrality of the dyslexic students' voice will provide evidence to question many of the 'taken-for-granted assumptions', (Cohen *et al.*, 1998), p. 30, and preconceptions of academic writing in the HE sector. Through the students' voice, I hope to bring meaning to the dyslexic writing experience. This will enable me to demonstrate the meaning which the dyslexic students construct about the reality of the writing process. This theoretical stance pre-supposes that theory will emerge: i.e. it will be 'grounded' in the data and will become 'sets of meanings which yield insight and understanding of people's

behaviour' (Cohen *et al.*, 1998), p. 37. Nevertheless, to some extent the research will be probing and clarifying cognitive psychology theory. I am particularly attracted to the 'problem-solving, question-asking, hunch-encouraging function' of posivitism as described by Maslow in (Cohen *et al.*, 1998), p. 15. I need to quantify the time spent by the dyslexic writers on various aspects of the writing process if I am to make any comparisons with other research, and if I am to analyse the robustness of theory in relation to this category of writers.

I must collect my data in such a way to enable this type of analysis to take place. This approach will enable me to examine not only the whole process but also to sift through and deconstruct this process to find out a) if there are similarities of experience which could be accounted for by the dyslexic profile; and b) if there is a pattern in the writing which could provide an alternative categorisation to that given by Torrance in his research (Torrance *et al.*, 1994).

3.6 Cognitive Psychology Methodology – Considerations

My research design has to attempt to utilise some of the many methods favoured by posivitists if the results are to be considered reliable and valid and if the research is to have an impact upon current writing process theory. The traditional methods frequently used in research about the writing process are:

- Think Aloud protocols
- Clinical-experimental design
- Retrospective reports
- Video observation, now frequently linked to computer-stroke measurement
- Pause duration measurement
- Case study
- Writer's notes/outlines

The majority of the above tools will furnish the researcher with *measurable* data which will enable him/her to test the stated hypothesis. However, often this type of research has been questioned because of criticisms about the construction of

the research design. The question 'do students who read good literature, write well' is fraught with difficulties and open to much debate because it is essential for the cognitive psychologist to devise a valid and reliable procedure for measuring 'writing *well*'. Similarly, how does one devise a tool to measure '*good* literature'? Obviously, this is not an insurmountable problem but is particularly difficult when defining such variables. Research findings are sometimes contentious. This is the case with Nicolson and Fawcett's theory of DAD. This has recently been questioned because they used a dual task paradigm and not a single task paradigm, which has given opposing results and therefore has the potential for disproving Nicolson and Fawcett's theory (Kelly *et al.*, 2002). This demonstrates the pitfalls of this type of research if the statistical control of variables is weak. This type of research is often open to criticism because of 'combinatorial explosion' (Bereiter *et al.*, 1987), p. 39 which makes it difficult to account for the many combinations of variables in the dual task paradigm, which could affect the conclusions. Another example of this is when Scardamalia and her colleagues presented research which demonstrated that children write best about what they know best (Scardamalia *et al.*, 1980). Many criticised the conclusions because of the clinical-experimental design whereby the researchers determined the writing task and did not leave this open for the children to choose.

3.6.1 Think Aloud Protocols

This type of data collection has been most frequently used in writing process research. This tool has been used because it is believed to provide evidence of the mental processes used during composition. Thus, the person studied is expected to 'say whatever comes into mind as they perform a task' (Bereiter *et al.*, 1987), p. 44. It is a way of analysing the psychological processes involved in planning and revision (Bereiter *et al.*, 1987, Hayes *et al.*, 1980, Hayes *et al.*, 1987, Gregg *et al.*, 1980). There are two types of Think Aloud Protocols: Synchronous and Asynchronous. The former takes place *during* the writing process while the latter consists of observations *after* the task performance.

Proponents of the Think Aloud method relied upon Ericsson and Simon's theory that verbalisation is simply what is going on in the head (Ericsson *et al.*, 1980) and that concurrent verbalisation (synchronous protocols) does not affect writing or cognitive processes. However, they concede that it may slow down task performance slightly. I would wish to challenge this theory with regard to dyslexic writers on the grounds that Ericsson and Simon's research relates indirectly to working memory capacity, and I suggest that if this is compromised in any way, for example because of dyslexia, the theory may be disproved.

There are many critics of this method. Several researchers have questioned the validity of the findings mainly on the grounds of 'reactivity' (Janssen *et al.*, 1996), i.e when a writer's cognitive processes are disrupted by having to verbalise thoughts about writing at the same time as manipulating the writing process with all its concomitant demands. They suggest that there is a significant change in performance when verbalisation has to take place (Cooper *et al.*, 1983 and Russo *et al.*, 1989). However, I find Stratman and Hamp-Lyons' research more applicable to the dyslexic situation whereby they question the assumption that working memory has the information in a *verbal format* which can be retrieved easily during concurrent verbalisation.

> " researchers interested in composing processes have assumed that when subjects engage in a text-revision or text-analysis task, their 'reportable' short-memory contents are in an orally compatible form, fairly easy to verbalise, and therefore that reactivity effects will be slight."
>
> Stratman *et al.*, 1994. p.96

Many dyslexic people conceptualise by visualisation and do not rely heavily on maintaining *verbal* information in memory (Crombie *et al.* 2001).

In Ericsson and Simon's extensive review there is no reference to studies which have considered this (Ericsson *et al.*, 1993). No research findings explicitly mention the use of dyslexic writers in the cohorts. Nevertheless, a study by Levy and Ransdell with ten undergraduates over a twelve-week period, using bleeps on

an audio tape to prompt students to verbalise cognitive processes, has shown that there are negligible effects of concurrent verbalisation (Levy *et al.*, 1995). It is hoped that the current research design will shed some light on this fascinating question.

It is because of the working memory deficit theory associated with dyslexia that I decided not to use Think Aloud Protocols for measuring the writing process of the dyslexic writer. There were also ethical issues to be addressed. It would not be appropriate to place these vulnerable students in an even more difficult situation by placing pressure points unnecessarily upon them while they were writing assignments which contributed to their degree classification.

3.6.2 Clinical-experimental design

This type of design is used frequently in writing process research. It has the advantage of being able to gather quantitative evidence from large numbers and is an excellent method of proving that X causes Y. Although it suggests a sterile artificiality, it can be engineered to gather relevant data in a semi-clinical setting. Many of the studies of writing process have been conducted with psychology undergraduates whereby the researcher has determined the writing task (clinical, controlled environment) or has utilised termly assignments in a controlled, time-related environment for production (Torrance *et al.*, 1994, Torrance *et al.*, 1999, Waes, 1992, Branthwaite *et al.*, 1980, Levy *et al.*, 1996). The difficulty with the written task determined by the researcher is that the findings could be open to criticism as to the correlation of the complexity of the task with that carried out in the natural setting.

In order that I do not place extra pressure on the dyslexic student, I intend to make use of the assignments which are set by the academic tutor as the basis for the examination of the writing process. In this way, the student is conducting a 'real' task which is contextualised for them and which contributes to the overall degree assessment.

3.6.3 Retrospective Reports

Retrospective reports are a method of asking writers to comment on the writing process after the event. While these are a source of rich data, they are heavily reliant upon the respondent's memory and could be prone to distortion over time. The premise that many of us view events through rose-tinted glasses springs to mind! In the case of dyslexic students there are two reasons why this type of data collection has been rejected. Firstly, their working memory may be faulty and the results would be unreliable; and secondly, negative self-image as a writer may also have an effect upon what is recalled.

3.6.4 Pause Analysis

This has been used to analyse the planning which takes place during the writing process (Gould, 1980, Matsuhashi, 1981, Schumacher *et al.*, 1984). It is conducted by using video tape and measuring the pauses while writing. The research posits that the pauses indicate planning during writing. It has the advantage over Think Aloud protocols in that the writer does not have to talk and write at the same time and can concentrate upon the generation of text. On the other hand, the pauses do not prove that the writer is planning – they could simply be day-dreaming! My assumption is that dyslexic writers may pause frequently and that it will be necessary to itemise these in some way. Thus, this is a consideration in my research design. However, as will be seen in the critical analysis of the design, I have adopted an alternative approach for pragmatic reasons.

3.6.5 Writer's Notes/Outlines

These were used by Hayes and Flower to collect evidence of proof of planning during the writing process (Hayes *et al.*, 1980). They are useful as direct visible products and the dyslexic students in this research were encouraged to collect this type of evidence so that I could examine how they go about this part of the writing process. However, I am aware that the hard copy is not the only time that planning

occurs and that I must be vigilant in teasing out whether this has occurred, albeit in a non-written format.

3.6.6 Computer Analysis

Technological improvements and the advent of sophisticated software have greatly increased the power of the researcher to analyse the writing process. Automatic logging of computer key strokes in conjunction with the analysis of text can help the researcher determine the stages of the writing process. S-notation has been used as a method of examining revision in the writing process. This method traces the writer's changes to text online and is a way of analysing the recursive nature of writing and how the writer uses revision in the generation of the final copy (Eklundh *et al.*, 1996).

This method provides impartial, statistical data but would not enable me to examine the feelings and personal commentary which I wish to include in this research.

3.7 Relevant methods of the social scientist

The choice of appropriate methods is crucial to the research design. The tradition of the social scientist is to use one or more of the following methods:

Case Study
Interviews
Participant observation
Questionnaires

3.7.1 Case Studies with interviews

> "an in-depth study of all pertinent aspects of a person, thing, situation, institution, community and so on."
>
> Newman *et al.*, 1998, p. 193

This encapsulates many of the aspects which the research aims to examine: the dyslexic writer (person), the product (thing) in the context of academic writing in HE communities (institution and community).

The case study has long been used by researchers as a method of providing in-depth data. Emig's research used ground-breaking methods: that of the case study to examine the writing process (Emig, 1971). It appeals to me because of its eclectic approach and because it will provide me with an understanding of the dyslexic writer in a natural setting.

As stated earlier, at the heart of this research is the dyslexic student experience. One of the ways in which I can gather this type of data is to use the interview.

> " Social phenomena cannot be properly understood
> without reference to the accounts given by the participants
> in those social settings."
>
> Scott, 1995, p. 10

This method will furnish me with phenomenological data and insights into the dyslexic perspective of writing. I have decided upon a semi-structured interview approach to allow for latitude of student response but within a carefully structured framework. This will permit the elaboration and flexibility of response required when examining both undergraduate and postgraduate students' writing experiences. A full discussion of the structure of the interview is to be found in the next chapter.

3.7.2 Participant Observation

This is a method whereby the researcher takes an active part in the activity being observed. It is not appropriate nor is it practical for me to participate in the students' writing activities. Each student will be tackling an assignment set by his/her tutor as part of the degree. Each student will be assessed and graded. For this reason it is inappropriate for me to participate actively because of the danger of skewing the grades by any help which I would give. I concur with Hammersley

that case study does not have to involve participant observation (Hammersley, 1992). It would be detrimental in this research because the presence of a researcher would act as a distraction for students whose levels of distractibility may already be high.

For this reason, I also eliminated the use of video to record the students while they were involved in their written assignment. Whilst this is an excellent and impartial record of what people do during the writing process, and can, therefore, be considered more objective than some methods, it is, in a sense, looking from the outside and would not provide me with the evidence to examine the feelings and decisions made by the students while writing. In addition, it would not be practical because the students do not remain in one location while writing their essays.

3.7.3 Questionnaires

These are used by posivitist and constructionist researchers. The questionnaire would provide me with an insight into the student voice. Apart from the usual concerns expressed about questionnaire surveys, my main concern with this method of data collection is that it is inappropriate for the category of student whom I am researching. Dyslexic students do not respond well to questionnaires (even with incentives to maximise response rate) and tend to ignore them, so the response rate would be lower than that of the usual population enquiry. Dyslexic students' opinions were informally gathered by the use of questionnaires when a survey of the Disabled Students' Allowance (DSA) was conducted at University in 1999 by the Adviser to Dyslexic Students (myself) and the Disability Co-ordinator and a disappointingly low response rate was registered. (This was despite the offer of an accompanying audio tape to overcome any difficulties experienced because of the student's 'disability'.) The postal questionnaire was dismissed by many dyslexic students on two accounts:

- Low priority reading material and time factors – 'I have so much to read for my courses that I do not have time for anything extra.'

- Inaccuracies in decoding ability – 'I often misread the questions because my reading is poor.'

Obviously, the reliability of the data would be compromised because I am dealing with dyslexic students whose reading ability is such that they may misinterpret the question. For these reasons, I did not wish to place extra burdens upon the group I wished to research.

3.8 Research Design

My research design must, therefore, be a multi-dimensional matrix of enquiry, combining a number of elements:

Cognitive Processes Processing Capacity	Writing Process Model Collection and Planning Problem-solving Transcription/drafting Revision/editing	Research Methods Quantitative: Real-time sampling Qualitative: Semi-structured interview
Dyslexic Writer's Experience	Strategies used Strategies to compensate for dyslexic profile deficits	Research Methods Qualitative: Semi-structured interview

Fig. 21 Micro and Macro Elements of the research design

Such a matrix allows for methodological triangulation thus ensuring that personal bias will not distort the findings and results. I also hope that the findings will add a further dimension to the research body in cognitive psychology and education, and that therefore I will not be accused of 'parochialism or ethnocentrism' (Smith 1975 in Cohen *et al.*, 1998), p. 234. As can be seen from the matrix, complex phenomena are being examined in the writing process:

Top Down 	Gestalt/P-Creativity approaches[1] Global frameworks dominating/driving the writing process
Bottom Up	Organic approach to writing Stream of consciousness

Fig. 22 Complex Phenomena of Writing Process

It will be necessary to consider where the dyslexic writer fits into this continuum. There are few studies which have examined the writing process and the dyslexic writer in HE. However, I propose to replicate Torrance's research design for the real-time sampling so that the findings can be placed into current research and to allow for comparative analysis to help me to answer the research questions (Torrance *et al.*, 1999).

For the purposes of this research the writing process is based upon a combination of Flower & Hayes' and Bereiter & Scardamalia's models:

- Planning
  - Related background reading
  - Note generation
  - Note organisation
  - Decisions about content for inclusion
  - Essay structure planning
- Translating
  - Drafting content
  - Note organisation
  - Decisions about content for inclusion
  - Essay structure planning
  - Rhetorical decisions

[1]Term coined by Boden describing the processes which are encapsulated in Bereiter and Scardamalia's 'knowledge-transforming' model. Such an approach involves manipulation of the two slave systems in the executive control which govern knowledge of content and rhetoric
Sharples, M. (Ed.) (1996) *An account of writing as creative design,* Mahwah, N.J., Lawrence Erlbaum Associates.

- Revision — Editing content
  Decisions about content
  Decisions about language

Both the quantitative and qualitative aspects of the research design draw upon this framework and will be discussed in detail in the next chapter.

Chapter Four – The Research Design

4.1 Participants

Seven case studies, three female and four male, have been chosen from the dyslexic population at University. Participants were selected in the following way. Students were invited to participate in the research through the email network of the Dyslexia Support Service (DSS), and this led to an initial meeting of fourteen students at which the rationale and research design was explained. All the students wished to support this research; as one student said, 'the DSS has done so much for me, I would like to be able to give something in return.' But they wished to know the level of participation which would be required in order to help them make decisions about whether they could participate: as dyslexic students, they were fully aware of their course requirements and the work load involved, so they were given a week to consider. Some students felt that they were under some pressure at that particular time and were concerned that they would not be able to take on any additional work. (Although it was stressed that the data collection would fit in with the pattern of academic work for their chosen course.) However, it is a mark of their vulnerability, that embarking upon something new could tip the balance for them: self-confidence and stress are factors which had to be taken into consideration when choosing the case studies. I did not wish to persuade students to participate if I did not feel that they would be able to cope with the data collection, on top of the current work-load.

Identification Tag	Student Type[1] R=Regular M=Mature	Subject studied	Academic Year Grouping	Gender
A	R	Sports Studies	1st Year	M
B	R	Medicine	1st Year (Re-sit)[2]	F
C	R	Archaeology	2nd Year	F
D	R	Biological Sciences	3rd Year	M
E	M	Engineering	3rd Year	M
F	M	Education	Postgraduate – Part/time	F
G	M	Education	Postgraduate – Part/time	M

Fig. 23 Break-down of participants by year and by subject

All the students have been identified and assessed as being dyslexic. Most students have undertaken a full assessment with an educational psychologist. The individual profiles will be discussed in more detail later in the next chapter. However, the most significant common factor with all the students is the deficit in working memory (WM) and short term memory (STM). All students have experienced difficulties at school. Students A, B, D and E received additional support in school for their literacy difficulties; while students B, C, E, F and G were not identified until after they started university. (See Table 2, Chapter 6)

[1] University students are classified as 'Mature' if they are over 25 years of age on entry.

[2] Although this student is officially a 1st year student, she could be considered as a 2nd year because of her previous writing experiences. However, the nature of the academic exercise which she carried out was a 1st year assignment.

4.2 Case Study Data

To facilitate comparisons, it was vital that the data for each of the case studies were similar and that, where possible, standardised information was collected. In this way, more direct comparisons could be made from 'within' the research and from the population norms ('without').

The following was collected from each case study:

- Psychometric data, mainly in the form of the current educational psychologist's report. Where a student did not have such a report, a current cognitive profile would be used. This type of report would contain standardised test data similar to the educational psychologist's data.
- Reading Age – derived from single word recognition and comprehension scores obtained from reading in context. Standardised scores enable me to make 'within' and 'without' comparisons of performance. It is important to utilise the two types of data. A miscue analysis would be carried out on these tests. The former would provide information about the student's decoding and phonological skills; while the latter would demonstrate reading performance which relates more closely to reading experience in the context of the course requirements.
- Spelling Age - derived from single word spelling ability and a sample of free writing. Standardised scores enable me to make 'within' and 'without' comparisons of performance. It is important to utilise the two types of data. A miscue analysis would be carried out on these tests. The former would provide information about the student's encoding and phonological skills; while the latter would demonstrate spelling performance which relates more closely to the student's actual performance during the writing process.
- It was important to examine speed of processing on input and also on output. Processing speed would be derived from a number of sources:
- Analysis of comprehension recall would provide a picture of the student's ability and speed of processing information (input) and would

be used to examine the student's performance in contextualised reading recall and language processing speeds.

- Analysis of writing speed (words per minute) would be compared with typical writing speeds for the HE student population. This would provide information not only about the student's processing speed on output but would also give indications of memory capacity and memory storage when examined in relation to the psychometric data.
- A writing log – real time sampling data for statistical analysis of the writing process.
- Transcriptions of the semi-structured interviews.
- Hard copy of draft written assignment work.
- Hard copy of the final assignment.
- Marks/grades received for the written work.

As can be seen this data provided both the quantitative and qualitative information to construct a multi-dimensional matrix of enquiry.

Quantitative:	standardised test scores
	reading performance scores
	writing performance scores
	real-time sampling - writing log
	assignment mark/grade.
Qualitative:	interviews
	student commentary on strategic performance

In addition to these dimensions, I wished to examine the micro and macro environments on different levels. By examining the students' reflections, the real-time sampling logs and draft and final written work, the micro elements of text generation could be explored – the fine grain image of operation. Sentence-level and word-level decisions would demonstrate micro levels of performance during the writing process. The student's decisions about language use and word retrieval may be restricted to a very localised area with little or no consideration of the impact of these decisions upon the paragraph or whole jigsaw of the assignment.

It would also be possible to explore how the student makes decisions about the global text structure and organisation. This would give an insight into the macro operations of working memory capacity in relation to the student's ability to visualise the whole text. Such global decision-making would demonstrate not only an ability to move smoothly between the cognitive processes as defined in the 'knowledge-transforming' model but would also show whether there is any degree of recursivity in writing with dyslexic writers. At this level of operation, the student is working upon the inter-relationship between paragraphs and the 'wholeness' of the written assignment. In a sense these could be likened to a course grain image of operation.

Thus, text generation and production can be viewed as sequential operations (micro) which eventually build up to make a whole (macro) or simultaneous performance, moving rapidly between micro and macro decision-making. The paradoxes of writing to which Sharples referred become more acute with dyslexic writers in HE (Sharples, 1996). This multi-dimensional matrix of enquiry, therefore, enables me to explore the notion that dyslexic writers are expected to perform as 'knowledge-transformers', yet, because of working memory capacity, speed of processing and language deficits, may be operating cognitively in a 'knowledge-telling' mode.

4.3 Why different year groups and different subject disciplines?

As has been shown in earlier chapters, writing is one of the most complex activities in which HE students engage. The rules of academic communication vary from discipline to discipline, and therefore the pressures placed upon the dyslexic writer may be different for an engineer or a medical student because of the nature of the writing environment and the writing activity. A snap-shot of a specific year group of students in the same department would, however, be too restricting. It would give information about how dyslexic writers in the chosen discipline perform: from this I would be able to draw conclusions about the impact of dyslexia on a specific context. It would not answer my question about

whether the dyslexic cognitive profile affects the writing process per se. It would also restrict the findings because I would not be able to find out if dyslexic writers' ability changes as a result of experience of writing over the years while they are involved in their degree course. The writing demands placed upon students are incremental year by year in terms of the length of the writing task. It could be argued that this represents a developmental continuum in writing. On the other hand, it could be said that the additional writing challenge is one of depth of knowledge and that the tutors' expectations of the writing task are the same: the expectation that students will be able to reflect upon, analyse and reshape information. In addition to this there is the idea that skilled writers do different things from novice writers (Flower *et al.*, 1981). If this is the case it is vital to examine different year groups to analyse where the dyslexic writer sits. One could hypothesise that the first year dyslexic writers go about the process in a different way from the post-graduate dyslexic writers. If there is a writing continuum the examination of different year groups would provide this information. If this is the case then my results will show that there are different patterns, and a rate of divergence between dyslexic writers in different year groups will emerge.

At the heart of this research is the need to peel back the layers to find the truth. Single dimensions will not only distort but will result in a black and white canvas. Comparisons of different year groups and different writing contexts will enable me to find out if the dyslexic cognitive profile is the crucial factor regardless of context and writing experience. In order to inform pedagogy, this research design will also enable me to analyse and compare compensatory strategies developed by dyslexic writers whose experience is accumulating over a period of two or three years.

4.4 Method

As part of any degree course, students are required to produce a number of assignments. 1st Year assignments do not count towards the degree classification, but work in subsequent years forms part of the summative expectations of the chosen course of study. The length and, therefore, the depth of the assignments

varied according to the year group. 1st year assignments tended to be 1,500 words in length while 2nd year assignments varied from 2,000-3,500 words, depending upon the departmental regulations and the task set by individual tutors. 3rd Year assignments and the postgraduate work had an expectation of 4,000+ words. To a varying degree, all students were expected to demonstrate knowledge and understanding of the assignment topic but also critical description and discussion.

The design for the quantitative data collection and analysis is taken from the study conducted by Torrance et al. (Torrance *et al.*, 1999). It ensures a degree of external validity. The informal interview was an additional aspect of this study, and will provide a phenomenological dimension, exploring the students' voice. It has been designed to mirror the quantitative framework and will be discussed in detail later in the chapter.

4.4.1 Quantitative Data Collection

Torrance's study examined only first year students who were all reading for a Psychology degree. The study analysed patterns of working and demonstrated three distinct procedures or types. Torrance's work did not include any dyslexic students, and therefore it was felt important to replicate the methods in order to provide an account of the writing process and to set the data in a context which would give a comparison with the benchmark of typical student behaviour.

Students often regard assignment writing as a linear, sequential process. The dyslexic students, with a history of difficulties and psychological scars, have often been taught by teachers in school to adopt this way of working with a view to overcoming or bypassing organisational difficulties - strategic, rhetorical or linguistic. I wanted to ensure that the research design did not restrict the dyslexic students in their approach to writing, and that the students had the opportunity to work in their natural setting, perhaps employing random, global thinking in the production of the assignment. Thus, the research design needed to take into account flexibility of student operation of the writing process to ensure that the cognitive style was not compromised and to ensure that I did not prescribe a way

of working which would be counter-productive to the individual's way of working. Nevertheless, the disorganisation of dyslexic students, given free rein, could be counterproductive to analysis. To accommodate these concerns, the writing process has been divided into 'discrete phases' and 'manageable components' which are not immediately obvious to the student and consequently do not impinge upon the student's way of working and overall organisation of the task (Torrance *et al.*, 1999), p. 190. The writing log recording sheet tags (see Fig. 24) denote activity but do not indicate components of the writing process.

4.4.2 Real Time Sampling (The Writing Log)

Each student was given a pack which contained:

An audio tape recorder

A random bleep tape

Pre-printed record sheets which contained the writing categories (See Fig.24)

Sample of writing log sheet

WN writing notes **TC** thinking about content **CO** changing outline
RR reading reference books etc **WO** writing outline **TW** deciding on wording
CT changing text **RO** reading outline **WT** writing text **XX** unrelated
NN making neat copy **RT** reading own text
Paper page 1 2 3 4 5 6 7 8 9 10 11 12 other___ Word processor page 1 2 3 4 5 6 7 other___

WN writing notes **TC** thinking about content **CO** changing outline
RR reading reference books etc **WO** writing outline **TW** deciding on wording
CT changing text **RO** reading outline **WT** writing text **XX** unrelated
NN making neat copy **RT** reading own text
Paper page 1 2 3 4 5 6 7 8 9 10 11 12 other___ Word processor page 1 2 3 4 5 6 7 other___

WN writing notes **TC** thinking about content **CO** changing outline
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CT changing text **RO** reading outline **WT** writing text **XX** unrelated
NN making neat copy **RT** reading own text
Paper page 1 2 3 4 5 6 7 8 9 10 11 12 other___ Word processor page 1 2 3 4 5 6 7 other___

Fig. 24 Sample of Writing Log Sheet

Students were asked to log their writing behaviour by means of a real-time sampling procedure. Each student was asked to circle the activity which best described what was being done when the bleep sounded on the audio tape. The list of activities in the log sheet in Figure 24 reflects those denoted in the writing process models of Flower & Hayes and Bereiter & Scardamalia. The electronic bleeps, which the students listened to on the audio tape, occurred at random intervals of between 30 and 150 seconds with a mean of 93 seconds.

The students were given training in how to use the record sheets before they started. They were shown a video of someone going about a writing task. The training video was stopped at different activities, and the students were asked to decide which activity this related to on the record sheet. In this way, discussion about aspects of writing occurred and for the sake of reliability I ensured, through the discussion, that all the students had a shared understanding of the terminology so that there was greater accuracy in recording.

Following the Torrance study, I asked the students to 'keep the bleep tape running and complete the record sheets whenever they considered that they were working on their essay, including when in the library' (Torrance *et al.*, 1999), p. 191. This proved problematic in some ways and was the direct result of the way in which dyslexic students go about a writing task. This will be analysed and discussed in chapter eight.

As in the Torrance study, the students were asked to retain any rough notes, mindmaps or visual planning notes, outlines and examples of drafting which would provide rich data to examine strategies used for planning, language processing difficulties and examples of alternative methods of compensating for the difficulties which the dyslexic cognitive profile influences.

Explanation of Writing Log Categorisation

Activity	Letter Code on Record Sheet	Numeric Code in Data	'Process'	Definition of Task Agreed by Students
Reading reference books	RR	4	Collecting	Reading reference materials – including textbooks, articles, lecture notes, electronic departmental data, own notes
Writing notes	WN	1	Collecting	Making notes from reference books or journal articles but not writing text which will appear in the assignment.
Thinking about content	TC	2	Planning	Thinking of things to say in your assignment (rather than thinking how to say them)
Changing outline	CO	3	Planning	Making alterations to your plan or outline
Writing outline	WO	5	Planning	Writing a plan or outline of the structure of your assignment
Reading outline	RO	8	Planning	Reading your outline or plan
Deciding on wording	TW	6	Translating	Pausing whilst writing your assignment and thinking about how to write the current or next sentence.
Writing text	WT	9	Translating	Writing your assignment – doing a draft.
Changing Text (incorporating Proof Reading)	CT	7	Revising	Making changes to the text your have already written
Reading own text	RT	12	Revising	Reading all or parts of your assignment.
Unrelated	XX	10		Thinking about something unrelated to the assignment

Making neat copy	NN	11	Proofing	Making a copy either by hand or by copying onto a word processor – making no changes to it or only very small corrections.

Fig. 25 Categorisation and Coding of Writing Log

As the 'Process' column demonstrates the categorisations in the writing log are based upon the Hayes and Flower theoretical model and also relate to Bereiter and Scardamalia's definitions of the process.

4.4.3 Semi-structured interviews

One of the aims of the semi-structured interviews was to provide triangulation of data - vital to the phenomenological approach adopted. The semi-structured interviews would provide in-depth understanding of the writing experiences of the dyslexic HE students while at the same time adding rigour. These would provide the 3-dimensional effect, the 'bricolage' mentioned by Denzin and Lincoln ((Denzin *et al.*, 1994). Triangulation could be likened to a large jigsaw puzzle whereby the intricate parts are seen within the whole. i.e. the individual operations of the dyslexic writer are taken in the context of the cognitive model of the writing process.

The theory of the writing process provided me with the boundaries within which I could examine human experience. The questions were designed to augment the quantitative data which the writing log would provide. They were drawn up using the two writing process models already referred to.
In addition, it was important to allow the students the opportunity to explain their individual way of working so that I could explore the compensatory measures they use to overcome the dyslexic cognitive profile. In this way the student voice could be recorded, and the transcriptions would furnish me with yet another dimension to understanding the difficulties experienced by dyslexic writers and, more importantly, to explain how the dyslexic writer processes information.

This data would also enable comparisons to be made between the oral and written structures of English of the dyslexic students to find out if there is differential performance, particularly with the sequencing of information, sentence structure and organisation of thoughts.

4.4.4 The Interview Structure

This was carefully designed to reflect the writing process models for ease of triangulation of data and to draw together the various elements of the research: micro and macro explorations, cognitive and linguistic considerations and of course an opportunity for the student voice to be heard.

Interview Question Categorisation

Interview Questions	'Process' categorisation/Cognitive Performance
1. How did you get on with the writing log?	Research design analysis – 'bleep' tape interference
2. Tell me briefly what the essay was about.	To enable comparisons between written processing and oral explanations
3. What did you find was the most difficult part of writing the essay?	Student voice – self perceptions
4. What do you find most time-consuming - making notes from books; getting your ideas into sentences and paragraphs; finding words to say what you want to say; or anything else?	Student's perception of cognitive processing
5. How do you find the background reading for the essay	Collecting/working memory performance/language processing
6. Do you find choosing the best books difficult?	Collecting

7. How do you find selecting the best bits for your essay?	Collecting/planning/language processing
8. Do you have any problems when different authors give you conflicting advice?	Collecting/language processing/working memory storage and capacity
9. Do you make notes from books/journals?	Collecting
10. How do you do this? Do you have any system for making your notes? Describe.	Strategy
11. Describe to me what it is like when you start writing your essay.	Student voice/translating/
12. Do you hand write and then put onto the computer?	Strategy
13. Do you use any specific software?	Strategy
14. Do you only write in notes at this drafting stage?	Translating/strategy
15. Do you have the text books and dip into them as you are writing?	Translating/strategy
16. Do you use sub-headings and bullet points while drafting?	Translating/strategy
17. Do you have a plan for your essay?	Planning
18. If so, do you write this down or is it in your head?	Planning/working memory capacity/multi-tasking in processing
19. Do you keep referring to your plan while you are writing?	Planning
20. Do you spend a lot of time revising your text?	Revising/student's perceptions

21. Do you have any system for proof-reading/checking your work?	Proof-reading/strategy

Fig. 26 Categorisation linked to research questions and writing process

As can be seen, the complex strands of this research have been carefully interwoven not only in terms of the philosophical issues but also in terms of the need to move constantly between different elements of the research structure. For example, the interaction between the macro elements of text generation in terms of structural organisation, and the micro elements at sentence and even word level of text generation, on the one hand; and, on the other hand, an examination of the individual (micro) within the whole writing process (macro). Never the less, it could be argued that some of the questions are overly directive and pre-suppose a specific answer. However, the research is dealing with ***dyslexic*** students, and this must be taken into account in design. Their ability to retrieval language in a vacuum is faulty, and it would seem appropriate to provide them with a framework for focusing their responses and to ensure tighter data analysis. The more prescriptive elements of the interview framework, viz. questions 6,8,9, and 14-21, are, therefore, prompts to activate memory.

The research design allows for a synergy of ideas. Indeed, the qualitative aspects provide a richness which augments cognitive psychological research.

The next chapter will examine the background data of each of the participants.

Chapter Five: Background Material of Participants

5.1 Introduction:

A sense of the identity of the students will enable me to interpret the findings more sensitively. It is with this in mind that I provide case studies of all those involved in this investigation. This background information will set the scene for an in-depth understanding of the difficulties experienced by each of the students; will help to demonstrate the individuality of the students and will augment the final analysis of the quantitative and qualitative data. The background information on each student is classified into sections:

i. Historical background information about the dyslexic difficulties: This has been collected in part by the semi-structured interviews and by conversations with the students throughout the investigation;

ii. Discussion of the psychometric profile results: all the participants have provided me with a copy of their educational psychologist's report which details overall IQ levels and sub-test scores. This information forms the basis of my interpretation of the individual cognitive profiles of each of the students in the investigation. Copies of these reports can be found in Appendix 2;

iii. Explanations of spelling, reading and writing behaviours: all the participants gave me standardised test scores of their reading and spelling performance. In addition, each student has given me copies of draft essays which enable me to examine writing behaviour. This data is augmented by the student commentary during the semi-structured interviews whereby they explain their individual approach to the writing process and how they have tackled the essay during this process, making explicit their compensatory strategies;

iv. Impact of specific difficulties upon academic studies: this has been gleaned from the semi-structured interviews, an analysis of micro and macro elements of text generation and the real time sampling data;

v. Summary statements have been derived from a compilation of the above data.

The student data for the psychometric profiles and the literacy performance level have been compiled from test information. These have been derived, in the main, from educational psychologists' reports. In common with current assessment

practice, each educational psychologist chooses from a battery of tests for this purpose.

> "Fortunately or unfortunately there is no single test for dyslexia. The assessment process involves building up, in pointilliste fashion, innumerable small bits of data until the picture, one way or another, becomes clear."
>
> Turner, 2000, p. 41

The chosen tests have been designed so that correlations between subtest data can be drawn. This enables greater accuracy when comparing the individual scores.

Any measurement approach to cognitive profile is determined by the beliefs and understanding of the assessor. My interpretation of the psychometric data is based upon the theoretical understanding of dyslexia which has emerged (cf. discussions in Chapters 1 and 2). The notion of 'differential aptitude' (Duane, 1991) and the *unexpectedness* of performance on psychometric tests lie at the heart of understanding the cognitive profiles of the students. The *specificity* of the learning difficulty will be crucial to understanding the functional operations of the students and the impact of the individual cognitive profile on the writing process.

Comparative analysis is complex because of the many variables involved. Thus, it will be necessary to examine in detail the 'inter-subtest scatter' (Turner, 2000), p. 35, both for ipsative and inter-student variation to ascertain whether there is a significant performance differential.

> " Such intra-individual or *ipsative* variation may reveal much of significance in the profile of an individual referred for a learning difficulty."
>
> Turner, 2000, p. 35

Similarly, these individual scores must be set against the student's overall IQ score if they are to make any sense in trying to verify performance in relation to age and standardised population scores.

Patterns of performance (or deficit) have been used in the past by many educational psychologists to demonstrate a specific learning difficulty which could be attributed to dyslexia. The concept of the 'ACID' profile has been popular with teachers for many years, because it is a simple method of identifying discrepancy. Therefore, practitioners have looked at the scores for A (Arithmetic), C (Coding), I (Information) and D (Digit Span). Depressed scores in these subtests of the WISC and WAIS were regarded as important because of the cognitive resources required to perform the tests, and reflected current theories of dyslexia. However, an examination of performance on these items of the WAIS alone would not provide an in-depth breakdown of individual functioning. Therefore, profile analysis will be derived from a discussion of performance of as many of the variables as possible.

Cluster analyses will help to evaluate inter-student performance. The clusters are determined by the structure of the subtests of the WAIS and fall into the following:

Verbal Comprehension Index	- Vocabulary, Similarities and Information
Working Memory Index	- Arithmetic, Digit Span and Letter-Number Sequencing
Perceptual Organisation Index	- Picture Completion, Block Design and Matrix Reasoning
Processing Speed Index	- Coding and Symbol Search.

The concept of cognitive deficit (Frith, 1995) can be explored by comparing the performances of an individual on each of the above indices. This will help to find out if there is any cognitive anomaly and is referred to in the identification of 'spiky' profiles.

Assessment is a dynamic process and is often driven by an hypothesis-testing approach. The administration of the WAIS is left to the discretion of the individual psychologist. Thus, it will be noted that some subtest data is not present for some of the students in the study.

5.2 Student A

5.2.1 Background:

This student was in his first year studying for a Sports Studies degree. He had just returned from a 'gap' year during which he spent time in America working in sports camps with young children. He was well prepared for the type of study he had embarked upon. He enjoyed the practical aspects of his course; was interested in the physiology but accepted that the written aspects of the course were something he had to endure!

He was first assessed for dyslexia at the age of six and was found to have phonological difficulties associated with dyslexia. A further assessment at the age of nine gave a fuller confirmation of his specific learning difficulties. He was given extra support for his learning difficulties throughout his Primary education and an assessment at the age of sixteen demonstrated that, although his reading rate and comprehension levels were good, his spelling was still considerably delayed. Student A commented during his interview that he had been awarded extra time at both GCSE and 'A' level examinations because of his very slow speed of writing.

During interview Student A presented as a confident young man and displayed no secondary emotional difficulties which are often associated with dyslexia. He was out-going, sociable and proud of his sporting achievements. On a superficial level his verbal language skills appeared good, and he was able to express himself with a degree of self assurance. He used a wide and effective vocabulary but spoke in simple sentence structures. It is interesting to note that he had attended a public school and was at ease with adults. His school encouraged his physical abilities and as a result he stated that he was never allowed to feel bad about his specific learning difficulties. His self esteem was good. He is able to accept help for his academic studies as a natural part of his life. He is well motivated to succeed and is fairly competitive in outlook, which again may be a reflection of the type of school environment in which he grew up.

The long history of literacy difficulties is still apparent in his weak literacy performance levels. This demonstrates that his specific difficulties are intractable, despite specialist support and the use of good learning strategies. Student A is able to utilise what he has been taught with some degree of metacognition – in interview he noted clear choices and decisions during the writing process which showed strategic operational functioning which can only have developed as a result of appropriate teaching methods.

All test scores have been derived from his latest educational psychologist's report, which was carried out in the first term of his first year at University when the student was aged 20 years.

5.2.2 Psychometric Profile:

His latest psychological report demonstrates that Student A is of average intelligence (full scale IQ 104 from Wechsler Adult Intelligent Tests - WAIS). His verbal scales overall are higher than his performance IQ scales:

Overall Verbal IQ	111
Overall Performance IQ	94
Overall IQ	104

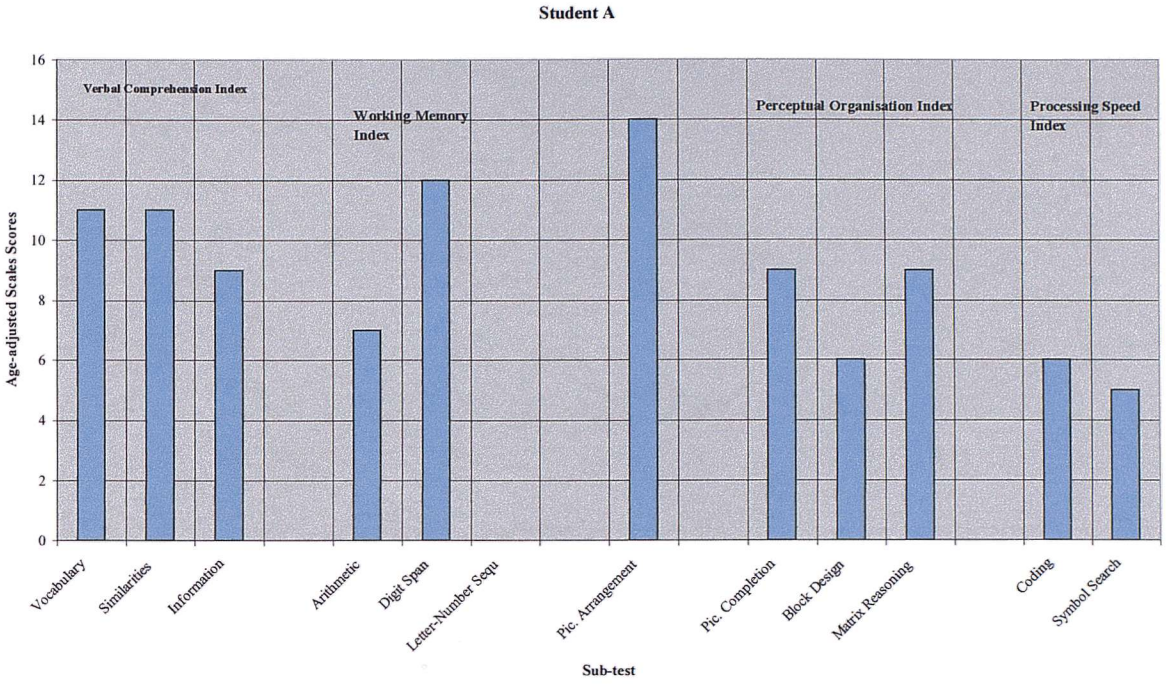


Fig. 27 Psychometric Profile: Student A

Figure 27 demonstrates Student A's uneven profile and one which is of interest in that it does not conform to the 'classic' spiky profile of a dyslexic learner. Low scores on Coding (6) and Block Design (6) are statistically significant when taken in conjunction with Picture Arrangement (14). The former two demonstrate residual difficulties with language processing while the latter shows good non-verbal reasoning ability. In particular it should be noted that two of the three elements which are applicable to **working memory capacity and storage**, Arithmetic, Coding and Digit Span, fall within the below average band and are his weakest components. The unusual score for Digit Span (12) can be explained by the 'smoothed' score for a task which involved some rote ability but also working memory capacity on the reverse digit manipulation which the educational psychologist noted was weaker. He states that he observed a dip in performance when Student A was asked to multi-task, using sequential memory storage and capacity. These scores taken in their entirety, therefore, point to a specific learning difficulty.

5.2.3 Spelling:

12 years 6 months – 14th Percentile. Test: WORD (Wechsler Objective Reading Dimensions) Spelling test

Despite a history of specialist support which was paid for by his parents as an 'extra' at his school, Student A still experiences difficulties which are a direct result of his dyslexia. He is performing ***eight years*** below his chronological age. He continues to be aware that his spelling is not sound, and he admits that he often chooses words in written assignments which are less apt but which are easier to spell. Like many dyslexic students it is often the small words which trip him up. For example, in the assignment which forms part of this current research, the few spelling errors which do occur are those connected with homophones which would not be picked up by a spelling checker – 'too' for 'to'.

5.2.4 Reading:

17 years – 47th Percentile
Test: WORD (Wechsler Objective Reading Dimensions)
Reading speed: 121 words per minute.

His single-word reading is ***four years*** below his chronological age and demonstrates that his decoding skills still reflect the underlying weaknesses in his phonological skills. His reading speed is slow for an HE student. His reading fluency was fair and shows that he uses the context to support his weak decoding skills.

5.2.5 Immediate Speed of Recall: 74th Percentile – on British Ability Scales. Delayed Speed of Recall: 52nd Percentile – on British Ability Scales

This demonstrates that there is a discrepancy between his immediate and delayed speed of recall, and the educational psychologist noted 'unexpected errors'. The 'Immediate' recall speed is dependent upon working memory storage; while the 'Delayed' speed calls upon working memory capacity. The latter will affect his

ability to derive meaning from text and his ability to extract relevant information from text efficiently.

5.2.6 Speed of production of written work:

15 words per minute with 6% error rate

The student was asked to write on a curriculum topic for ten minutes. His handwriting displayed:

- irregular formations of letters;
- frequent crossings out;
- some omissions of final letters in words.

Although the content was relevant and interesting, his sentence construction was weak, with punctuation errors and showed no structure.

5.2.7 Impact upon academic studies:

Strengths	Weaknesses
Expressive language skills	Working memory capacity
Verbal reasoning	Working memory storage
Strong self esteem	Freedom from distractability
Good motivation	Speed of information processing
Non-verbal reasoning	Visual sequential memory
Self discipline	Phonological awareness

It would appear from these results that working memory capacity and the speed at which Student A can process language information will pose considerable difficulties for the type of academic study which is required of him at this level. The speed at which he can extract information from text is slow and when coupled with a severely slow speed of written production will have considerable impact upon the effort needed to perform when engaged in written assignments for his courses. Nevertheless, his personality traits are such that he has the

determination and motivation to succeed. It will be interesting to find out at what cost this is achieved. The way in which he operates and his strategic functioning will be later explored in the discussion of the data and interview transcriptions.

5.3 Student B

5.3.1 Background:

This student is technically a second year student but failed her first year Medicine and is re-sitting her whole year. Thus she is a first year in the School of Medicine. For the purposes of this research she is classed as a second year because she has had experiences of academic work as a first year and is able to draw upon these to help her to cope with her re-sit year. It is felt that because of these experiences it is more appropriate to place her for comparative purposes as a second year student.

Student B reported that she had always experienced literacy difficulties at school and that she noticed these when she attended her Primary school. However, her teachers did not feel that her difficulties were severe enough to warrant any psychometric assessment. Nevertheless, extra spelling provision was organised for her in her Primary school. In interview she noted that despite this help she has always struggled with spelling and that she had some difficulties with hand-eye co-ordination which affects gross motor movements such as catching a ball etc.

She was not identified as being dyslexic until she was well through her first year of studies. Her academic tutor noted that she was struggling and that her grades were low and borderline. He suggested that she might be dyslexic and that it would be useful to have an assessment at the Dyslexia Support Service where a full screening assessment was carried out.

It was clear from these screening procedures that the student had a specific learning difficulty and achieved an At Risk Quotient (ARQ) of 2.4 (where >1 is regarded 'at risk'; maximum ARQ is 3). As a result of these findings Student B was immediately assigned a personal dyslexia tutor to help her to develop more

efficient academic skills in keeping with the needs of a rigorous course. These sessions did not take place until term three of her first year of study.

During her interview Student B presented as a reflective learner who lacked self confidence but who was well motivated and was prepared to learn from the previous year's experience. She was not down-hearted at having to repeat a year and felt that she was now more ready to benefit from the learning environment because she was now aware of what was expected of her at this level of academic study. Interestingly her verbal language skills were fair. However, her sentence structure was at times chaotic and lacked sequential fluency. The following sentence is a description of her use of Inspiration , a mind-mapping software program:

> "I find it-'cause I get really confused trying to work out, like, the written one I did for my tutorial I get all confused, so I like just using it, so that I do sort of like a flow *(chart)*[1], so I know where I'm going."
>
> Appendix 3 (ii)

It is apparent that Student B is typical of the able student who has developed intuitive strategies for coping with academic demands and has, therefore, succeeded in achieving the necessary grades for entry into the School of Medicine. However, she admitted in interview that school work was always a struggle and that she was never satisfied with the final results and felt that they did not reflect the amount of time and effort she put into the work, nor did they reflect her understanding of the subjects. She was aware that she needs to read and re-read texts many times in order to make sure that she has understood the information. A discussion of this will be included in a later chapter. She also noted that multi-tasking presented difficulties, particularly during lectures when she was required to process different types of information **simultaneously** e.g. verbal information and make notes.

[1] My insertion.

5.3.2 Summary of Psychometric Profile:

The following test scores have been derived from her latest educational psychologist's report which was carried out in the second term of her first year at University when the student was 20 years of age.

The psychological report demonstrates that Student B is of average intelligence, based on the test scores of the Wechsler Adult Intelligence Scales (WAIS). The verbal scales are slightly higher than the performance IQ scales.

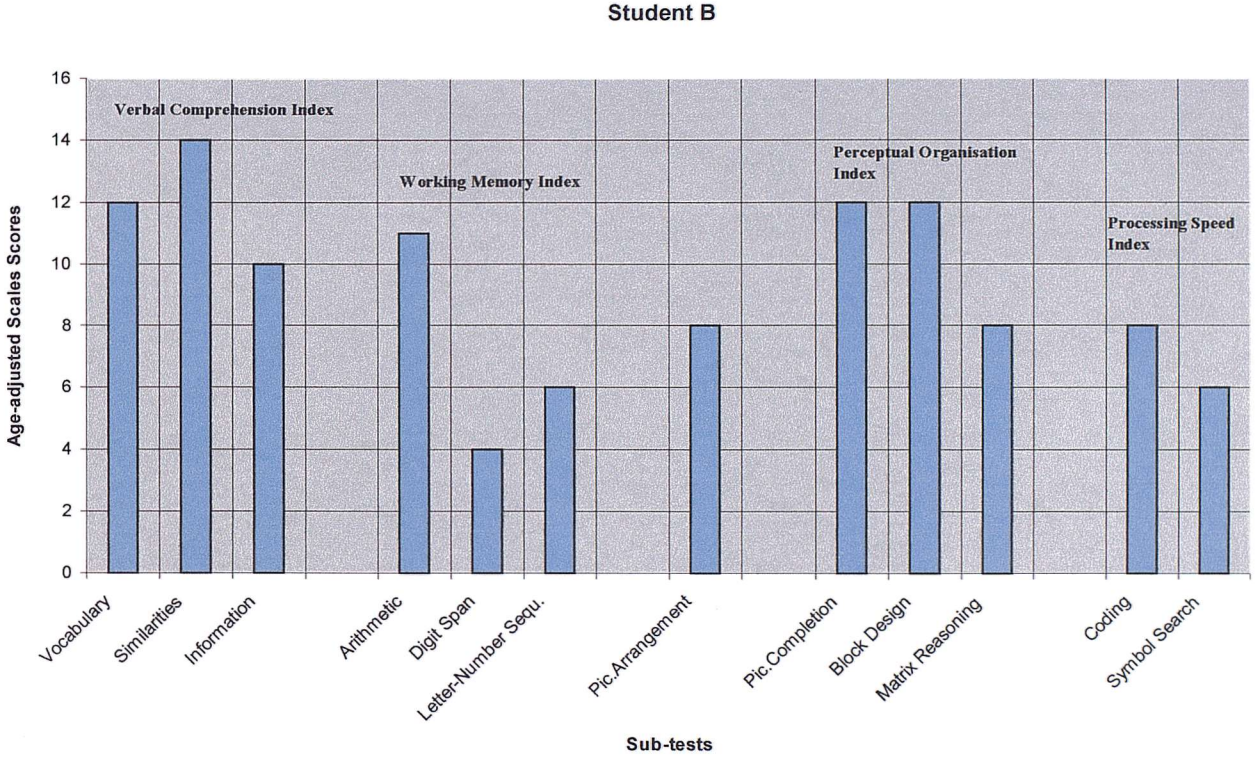


Fig. 28 Psychometric Profile: Student B

Figure 28 demonstrates Student B's uneven profile. In particular it should be noted that elements associated with speed of processing information, working memory storage and sequentially based tasks - Symbol Search, Digit Span and Letter-Number Sequencing - are below the average band (average band 7-13) in some cases. Her highest score – Verbal similarities – demonstrates a strength with simultaneous verbal reasoning.

5.3.3 Spelling:

9th Percentile,
Wide Range Achievement Test (WRAT – Revision 3)

Despite having received extra spelling support earlier in her school career, Student B still experiences significant difficulties which are a direct result of her dyslexia. Her percentile score puts her in the bottom 9% of the population. Single-word spelling and spelling in context are both below her verbal comprehension skills. She admits that often, when doing written assignments and in examinations, she will choose words which she has some confidence of spelling rather than the most appropriate words. A diagnosis of her spelling attempts demonstrates that she frequently telescopes words, by missing out letters e.g. 'explan' for 'explain' and is often unsure of sequences of letters in words, e.g. 'enthuisium' for 'enthusiasm'. Other spelling errors pay testimony to weaknesses in phonological skills, e.g. 'opurtunity' for 'opportunity'.

5.3.4 Reading:

37th Percentile
Wide Range Achievement Test (WRAT – Revision 3)
Reading Speed: 55 words per minute
Reading Comprehension Test: 14 years (2nd Percentile) – Vernon Warden Test

Her single-word reading is well below average (average represents the 50th percentile). Student B relied upon her stronger visual memory skills to help her to decode single words, using her sight recognition store. However, she experienced increasing difficulties when presented with polysyllabic words such as 'municipal' and 'seismograph' with which she was unfamiliar.
Student B's reading fluency and comprehension is greatly compromised by the low reading speed which is significantly slow for current academic purposes. Her

ability to answer the comprehension questions is reduced (she was only able to answer three out of eight with this reading rate).

The educational psychologist noted that her weak accuracy affects reading comprehension, 'particularly where she has to maintain competing meanings in her mind' (Appendix 2 (ii)).

5.3.5 Speed of production of written work: 14 words per minute, 11% spelling errors

This score was derived from Student B's free writing and a synopsis of the reading comprehension passage. Her writing displayed:

- Frequent crossings out;
- Choice of simple vocabulary to express ideas.

5.3.6 Impact upon academic studies:

Strengths	Weaknesses
Verbal reasoning skills	Auditory working memory
Verbal comprehension skills	Speed of information processing
Non-verbal reasoning	Sequential organisation
Motivation	Phonological skills
Visualisation skills	Verbal sequencing
Perceptual organisation	Working memory storage

It would appear from the results that Student B is disadvantaged by her specific learning difficulties in the current academic environment. Sequential difficulties, auditory sequential memory difficulties and speed of information processing will affect her ability to cope with lectures, extracting information from texts and in the production of written assignments, in particular in essay format. The speed at which she operates in both reading and writing tasks will make the demands of her course more time-consuming compared with similarly capable peers. She is

doubly impaired in that her verbal organisational skills and her written output skills are affected: this will have an impact upon the effort and time she will have to give to her studies to achieve equivalent success to her peers.

5.4 Student C

5.4.1 Background:

Student C is a second year archaeology student. Student C reported that she had always experienced some literacy difficulties, even from her Primary school years. She was told that she was late learning to read and that she had difficulties with handwriting and spelling. At Primary school she was given additional handwriting practice and a small amount of study skills advice from her subject teachers at Secondary school. Her teachers did not feel that her difficulties were severe enough to warrant any psychometric assessment.

She was not identified as being dyslexic until the end of her first term of her first year at University. The links between the Dyslexia Support Service and the Archaeology department are strong, and Student C was advised to be assessed for dyslexia after she handed in one of her first written assignments. A full screening assessment was carried out. It was clear from the screening procedures that the student had a possible specific learning difficulty and achieved an At Risk Quotient (ARQ) of 0.6 which places her on the borderline of difficulties and not at great risk. As a result of these findings Student C was assigned a personal dyslexia tutor to help her to develop more efficient academic skills in keeping with the demands of her chosen course.

During her interview, Student C was able to discuss her difficulties, though with little metacognitive reflection. However, she was well motivated and took on new strategies for learning on a superficial level, i.e. she used the techniques rather mechanistically with little reflective evaluation which would increase her metacognition. Her expressive language skills during interview were adequate but she displayed some problems with accurate word retrieval and at times resorted to the use of the word 'things' to express a wide range of her academic descriptions. Nevertheless, her sentence structure, though simple, was sequential.

From the interview it was apparent that Student C had acquired many of the basic literacy skills prior to entry to HE but preferred getting information through the medium of television and the internet which helped her when organising new information and concepts. She admitted that written assignments took a long time and she frequently ran out of time to meet deadlines.

All the following test scores have been derived from the latest educational psychologist's report which was carried out in the second term of her first year in HE when Student C was 19 years of age.

5.4.2 Psychometric Profile:

Her psychological report demonstrates that Student C is 'of high average intelligence' (Appendix 2 (iii)). Her verbal scales are slightly higher overall than her performance IQ scales:

Overall Verbal IQ	115
Overall Performance IQ	112

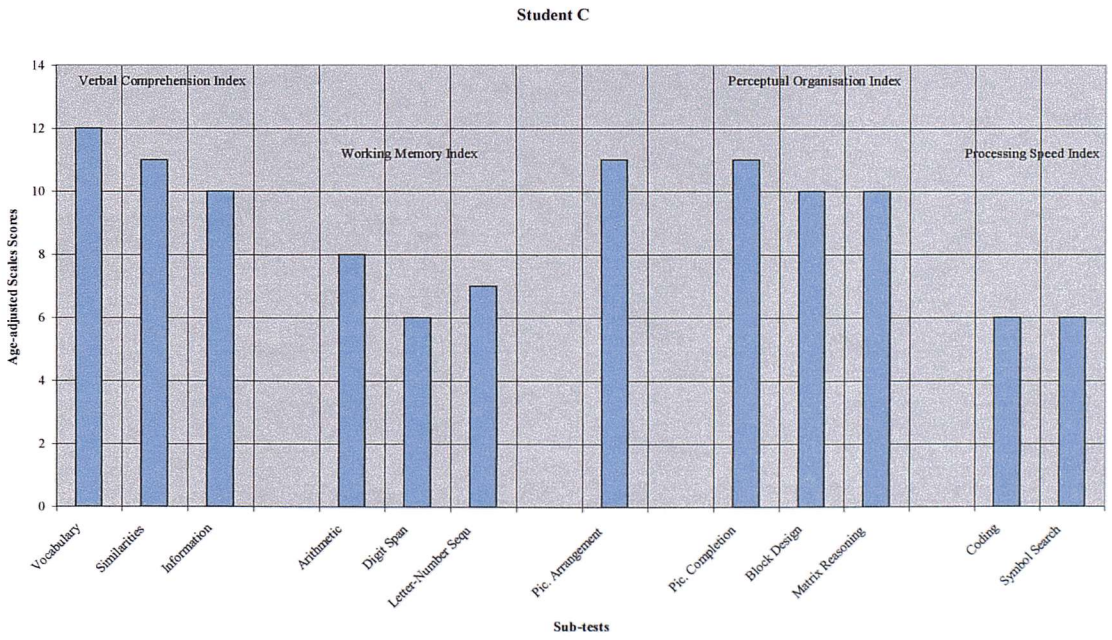


Fig. 29 Psychometric Profile: Student C

Figure 29 demonstrates Student C's uneven profile. In particular Digit Span (6), Coding (6) and Symbol Search (6), the elements associated with **working memory capacity and speed of information processing,** fall in the 'below average' range, as described by the WAIS categorisation. In addition, the scores achieved for Arithmetic (8) and Letter-Number sequencing (7) are unexpected in a student who is classified as 'of high average intelligence'. This demonstrates that there are also weaknesses in sequencing and simultaneous processing.

5.4.3 Spelling:

17 years – 47th Percentile
Test: WORD (Wechsler Objective Reading Dimensions) spelling test.

Student C was able to work at an adult level when tested for single-word spelling which demonstrates that she is able to encode, using phonological skills. Nevertheless, it should be noted that she is functioning below her chronological age. However, spelling in context was a different matter, and the speed at which she is able to simultaneously process language, utilising working memory capacity, is compromised and affects her performance. As the educational psychologist notes, she is 'vulnerable in self-generated written text' (Appendix 2 (iii)). Student C disclosed that often, when composing text for assignments and in examinations, she had to spend time finding alternative words which she could spell rather than the vocabulary she would have liked to use which more accurately expressed her thoughts.

5.4.4 Reading:

17 years – 47th Percentile
Test: WORD (Wechsler Objective Reading Dimensions) reading test.
Reading speed: 30 words per minute.

Although her single-word decoding is at least of adult level, it is below the chronological age which would not be expected from a student of 'high average

intelligence'. It is possible that many of the words in both the single-word spelling and reading test are words with which she has become familiar and has therefore developed a level of automaticity of operation.

5.4.5 Speed of Recall: 63%

Immediate speed of recall proved to be faulty. This is worthy of note in that the test which the educational psychologist used cannot be relied upon for standardised scores because the ceiling of the test is 17+ years, and the test, designed for secondary school children, was not age appropriate. The passages used to derive the score of 63% would be considered easy for an HE student. Nevertheless, diagnostic information can be drawn from this exercise, and her inaccuracies in immediate recall become more notable for these reasons. Because her reading accuracy and speed were at reasonable levels, it would be expected that her comprehension/recall levels would not be affected. This can be explained by the weaknesses in working memory capacity. Reading performance in the context of her HE studies painted a different picture. Student C noted that she became weary when she had to study large amounts of texts and that her concentration levels dropped, which had an impact upon her performance, making it difficult to absorb the content of the texts she was reading. The need to assimilate complex concepts in texts slows down her speed of processing.

5.4.6 Speed of production of written work: 25 words per minute

The student was asked to write on a curriculum topic for nine minutes. Her handwriting, though legible, displays irregularities and was not always in cursive script. Although the content was interesting, there were occasional errors in sentence construction.

Student C was tested for the possibility of scotopic sensitivity. She responded well to a pale green overlay, and it was suggested that she used this for reading texts and that she changed the background colour on her computer screen to help

reduce difficulties and to support minor weaknesses in visual perception while performing these types of tasks.

5.4.7 Impact upon academic studies:

Strengths	Weaknesses
Expressive language skills	Working memory capacity
Verbal reasoning	Freedom from distractability
Perceptual organisation	Speed of information processing
Good self esteem	Motor co-ordination
Well motivated	

It would appear from these results that working memory capacity and the speed at which Student C can process language information, particularly on output, will pose difficulties for the type of academic study which is required of her at this level. She experiences more difficulty with written performance overall and in interview stated that she would not have chosen her subject, Archaeology, if she had known how much essay writing was involved! Word retrieval was time-consuming and had considerable impact on the overall process.

The educational psychologist suggested that there was a trace of dyspraxia in her profile which would account for her visual perceptual difficulties and the history of poor motor co-ordination. One of the differences between the dyslexic and the dyspraxic reader, in general terms, is that the latter does not usually experience difficulties in learning to read. This was the case with Student C. However, the dyslexic reading difficulties would account for her speed of processing language information whilst drawing upon working memory capacity.

5.5 Student D

5.5.1 Background:

This student was in his third and final year studying Biological Sciences. He expressed a wish to pursue his academic studies and wished to study Medicine. He presented as a mature young man who was at ease and well able to cope with

social situations. He explained that he came from a highly literate background (Appendix 3 (iv)) where family discussions were the norm and an aspect in which he participated fully. He was educated in the private sector.

He was first assessed at the age of 12 years 2 months at the National Hospital's College of Speech Science in London. He received some support for his dyslexic difficulties but this was sporadic because the family moved to Africa where Student D lived for some years. The family returned to live on Guernsey, and he attended the Dyslexia Institute day centre while studying for his 'A' level examinations, receiving additional individual support from one of the dyslexia tutors.

Student D was thus identified prior to entry to HE and he attended the Dyslexia Support Service where he received intermittent support when he felt it was needed. During interview Student D presented as confident and able to express himself verbally. It was noted that he had a slight speech impediment and that some slight dyslexic-type pronunciation in speech occurred: for example he said 'septicism' for 'scepticism' (Appendix 3 (iv)). This truncation is often observed in written text and can be transferred into speech. It has been my experience that dyslexic people are unaware of these speech errors and the effect they have on the listener! It was obvious from the interview that Student D enjoyed conversation and had developed many definite ideas about all sorts of subjects.

The impact of his dyslexia would appear less evident to an untrained eye. He accepted his diagnosis and did not feel that he was in any way disadvantaged by his dyslexia. It has to be said that he is a very able young man and that this enables him to cope very effectively.

5.5.2 Psychometric Profile:

All test scores have been derived from his latest educational psychologist's report which demonstrates that Student D falls within the 'very superior' band (Appendix 2 (iv)).

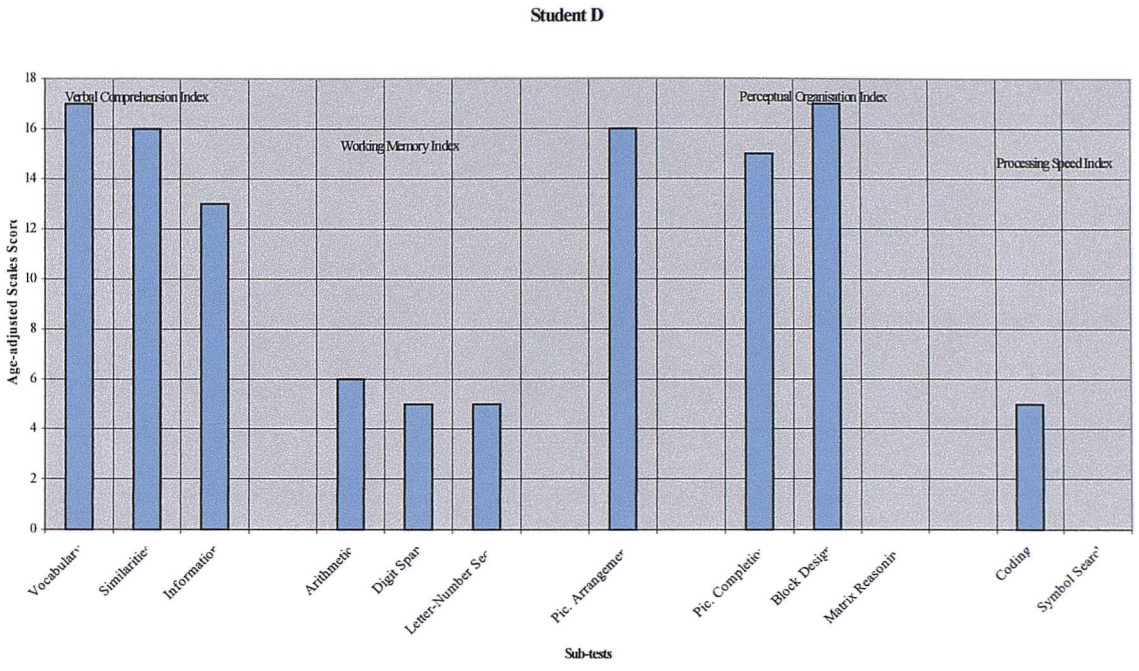


Fig.30 Psychometric Profile: Student D

Figure 30 demonstrates a 'spiky' cognitive profile. The discrepancies between his high and low scores are significant and reflect those of an able student with dyslexic difficulties. His verbal ability shows 'very superior' scores. It was noted that, despite these high verbal reasoning scores and his supportive background, he had expressive language difficulties and was slow to retrieve language, making frequent circumlocutions. These attributes have remained and are evident in his recent interview. The sub-tests relating to perceptual organisation are also within the superior band and indicate good non-verbal reasoning as well as spatial visualisation. Such high scores, therefore, make the contrast with his **working memory capacity and storage and speed of processing** more acute and account for his written performance which will be discussed in a later chapter.

5.5.3 Spelling:

15 Years 9 Months - 34th Percentile
Test: Wide Range Achievement Spelling Tests (WRAT Revision 3)

This score places Student D below the average (average is 50th percentile) and it should be taken in the context of the overall psychometric assessment which places Student D in the 'very superior' range and who, therefore, would be expected to have greater potential. Nevertheless, it has to be taken in its academic context. His spelling performance is weaker than that of his reading. He has developed orthographic competence and his underlying phonological difficulties, which were noted in the educational psychologist's report, are by-passed so that on a single-word spelling test he is able to perform just below the average. However, this performance differs from his spelling in context where word retrieval difficulties slow him down and produce a 6% error rate. He is able to access a wide vocabulary to express himself but his processing of sounds slows down his spelling ability.

5.5.4 Reading:

18+ Years - 79th Percentile
Test: Wide Range Achievement Tests Reading Tests (WRAT Revision 3)
Reading speed: 66.3 words per minute

Student D experienced a developmental delay in reading but soon caught up with his peers after being educated for a year by his mother, who took him out of the state system. He has always enjoyed reading and has read widely. Therefore, this score, in the average band, is to be expected. However, it must be taken in the context of his cognitive profile and does not reflect what would be expected for a non-dyslexic student. His single-word reading and reading in context do not present any discrepancies and both fall within the average range.

5.5.5 Speed of production of written work:
17 words per minute

The student was asked to write on a curriculum topic for ten minutes. His rate of writing is well below the average of what is expected at this level of study and confirms that his weakest area is in written production. He is able to use punctuation fairly well and has knowledge of complex sentence structures, which he is able to use to express his ideas.

5.5.6 Impact upon academic studies:

Strengths	Weaknesses
Verbal reasoning skills	Word retrieval skills
Non-verbal reasoning	Working memory capacity
Spatial visualisation	Working memory storage
Perceptual organisation	Freedom from distractability

Student D is able to use his verbal skills to best effect and copes well with the reading for research. However, these abilities are not matched when he has to tackle written work. He is at times frustrated because he knows what he wants to say and is slowed down while he tries to remember the appropriate vocabulary. He displays the typical 'tip of the tongue' syndrome which is so infuriating for these able students who not only understand their subject and have a wide vocabulary but cannot retrieve the word they want to use. He is aware that writing assignments can take him longer than his non-dyslexic peers but does not always take this into account when planning and organising his work. However, he can often achieve good grades when he focuses heavily on his written tasks.

5.6 Student E

5.6.1 Background:

Student E was in third and final year of a Mechanical Engineering degree, having obtained an engineering scholarship. He was an older student, aged 24 years at the time of this study and entered HE having successfully completed his apprenticeship and ONC/B.Tech. qualifications. His background prior to entry to HE was very different from that experienced by Students A, B, C and D, none of whom are classed as mature students.

He is a competitive young man who is highly motivated to succeed. His experiences in the engineering field have meant that he adopts a pragmatic approach to many situations and always wishes to find practical solutions to his problems. He demonstrates great determination and perseverance at all times. He is an opportunist who makes the most of his circumstances. He is an extremely hard worker and is prepared to listen carefully to advice and act upon it – provided that he respects the advisor.

He is a reflective learner and takes note of constructive criticism. He is also a strategic learner and will carefully weigh up all aspects of an assignment before embarking upon the work. During the interview he openly discussed his early childhood school experiences. He spoke with some bitterness that his difficulties had not been fully recognised, although he did acknowledge that he had received some extra help in Primary and early Secondary school for his literacy difficulties.

His self-esteem is strong, as would be expected from a student who has already achieved considerable success and secured sponsorship from national competition. Like most older students who return to education, he wishes to make the most of his time and get as much as he can from his three years of study.

Student E was not identified as dyslexic until he came to University. He was asked why he had not visited the Dyslexia Support Service earlier. He stated that

he had lived with his difficulties for so long and had developed strategies to compensate so that he was not aware that there was any need. His tutor advised him to attend because of observed discrepancies between practical and oral performance and some of his written work. The grades varied, and there was a distinction between coursework and examination grades such that his performance in the latter was often lower than the former. A full screening assessment was conducted. It was clear from these procedures that there were discrepancies in his scores which would indicate a specific learning difficulty. He achieved an At Risk Quotient (ARQ) of 1.4 using the Dyslexia Adult Screening Test (DAST) (where >1 is regarded 'at risk'; maximum ARQ is 3). Whilst this score did not put him in the severe range, there was sufficient evidence to indicate that Student E had specific difficulties. He was assigned a personal dyslexia tutor to help him to examine the strategies he was using and to consider ways of progressing.

He appeared to be very well organised and had developed strategies which had enabled him to cope with the rigours of his course. However, he was disappointed with some of his grades and wanted to know how he could increase these by learning new skills. He reported that he often spent longer than he wanted on the reading for his course because he had to read and re-read passages to ensure that he had got the gist of what was being said. He was aware that his written work sometimes lacked structure, from the comments of his tutors, but could not identify his problems so therefore had no strategies to rectify the difficulties. He is well organised and even builds in time in his work plans to check his work. He was anxious to improve his revision skills for examinations because he indicated that his grades did not reflect the depth and understanding of his knowledge of the subjects.

5.6.2 Psychometric Profile:

All test scores have been derived from his latest educational psychologist's report, which was carried out in the third term of his second year at University.

The psychological report demonstrates that Student E is 'of at least above average overall ability' (Appendix 2 (v)), based on the test scores of the Wechsler Adult Intelligence Scales (WAIS).

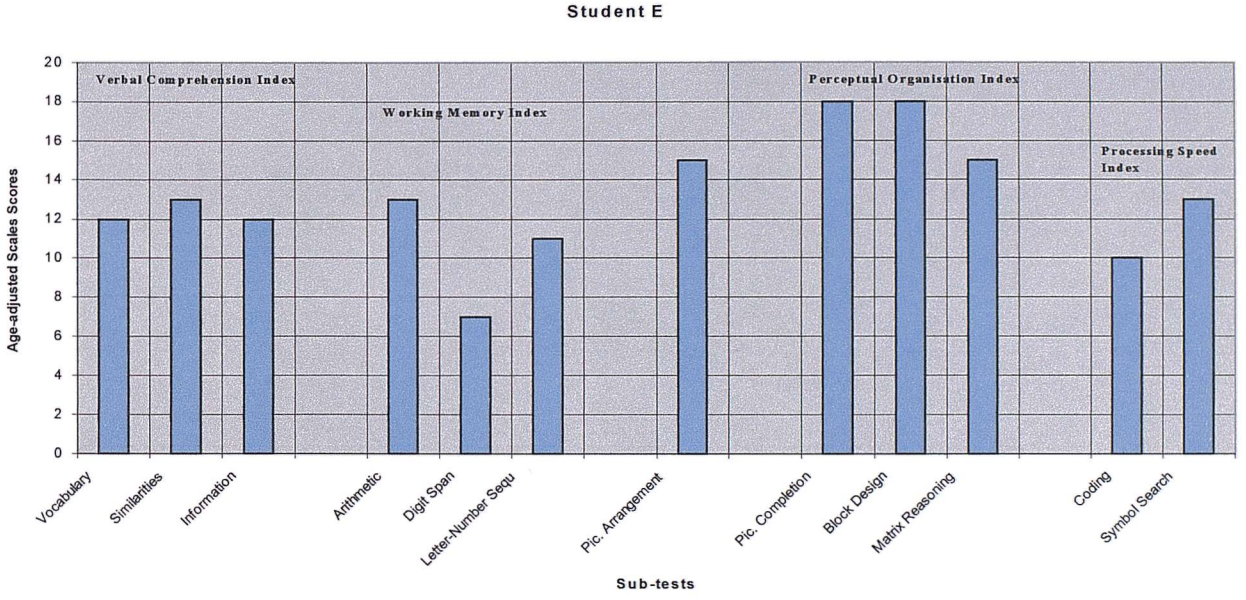


Fig. 31 Psychometric Profile: Student E

Figure 31 demonstrates Student E's uneven profile. The performance groupings (in particular the Perceptual Organisation Index scores) are higher than the Verbal Comprehension Index. Indeed, he falls within the top 1% of the population for Picture Completion, Block Design and Matrix Reasoning. It is interesting to note that he has chosen to specialise in engineering where these skills are highly desirable. In comparison, his processing speed for symbolic information is significantly weaker, and the size of the discrepancy occurs in less than 0.6% of his age group (Appendix 2 (v)). This in itself is unusual and will have implications for the way in which he approaches academic work and will result in a slowing down when he has to decode, encode and compose written responses.

The Arithmetic score is worthy of note. Typically, the score for this sub-test is markedly different within an overall profile for a dyslexic subject. However, Student E's score falls within the average range. Student E explained that with his work background he was used to manipulating figures and had had practice with this. This being the case it could be expected that his score would be higher and might, therefore, lead us to consider the possibility of underlying difficulties which he is trying to compensate for with well developed strategies. Nevertheless, his processing speeds and working memory storage are below average and demonstrate discrepancies in performance which are likely to affect the writing process. Furthermore, it has to be said that these scores do not demonstrate the discrepancies of some of the other students. Some psychologists might not consider this a dyslexic profile. The dips in Digit Span (7) and Coding (10) suggest executive control weaknesses which are likely to affect the writing process.

5.6.3 Spelling:

9th Percentile

Test: Wide Range Achievement Tests (WRAT – Revision 3) single-word spelling test

This places Student E in the below average range for spelling of single words with 91% of the population achieving a higher score. It represents below what would be expected for his chronological age. His errors demonstrate underlying phonological weaknesses. Weak auditory sequencing was evident in the type of errors which occurred: for example, he spelled

"advice" as "adice"

"ruin" as "run"

Such difficulties could also be the result of working memory capacity which quickly becomes overloaded. These spelling errors and slow processing hinder automaticity when composing.

5.6.4 Reading:

16th Percentile
Test: Wide Range Achievement Tests (WRAT – Revision 3) single-word reading test
Reading speed: 62 words per minute
Reading Comprehension Test: 15 Years 8 Months – Vernon Warden Test

Student E achieved this score by making use of his strong sight vocabulary. However, when asked to decode unfamiliar words he had difficulty and this demonstrates weaknesses in phonological skills. His visual discrimination and visual sequential memory skills are weak and result in reversals of letters. However, these reversals produce real words which demonstrates his close adherence to attempts at making sense of what he is reading. For example, he read 'benign' as 'begin' and 'split' as 'spilt'. This has implications for accuracy when accessing academic texts. He will draw upon his strong visual clues but may misinterpret what is there, thus resulting in inaccuracies which will affect his comprehension. Student E would also be slowed down by such inaccuracies because he would have to read and re-read a text during comprehension monitoring.

Student E's reading fluency and comprehension is further compromised by the low reading speed which is 'very slow for academic purposes', according to the educational psychologist's report (Appendix 2 (v)). Like many dyslexic readers of this age, he relies heavily upon context to compensate for his decoding weaknesses but at the expense of reading speed because he ends up reading and re-reading passages. Comprehension was also further compromised by weaknesses in working memory capacity, whereby he has difficulty in maintaining competing meanings in working memory at the same time as having to expend precious memory capacity on low level skill operation such as decoding unfamiliar, polysyllabic words.

5.6.5 Speed of production of written work:
13 words per minute with 11% spelling error rate

This score was derived from Student E's free writing and a synopsis of the reading comprehension passage. His written work contained an 11% error rate in spellings. This places him below the average range and much below the level of his ability. His lack of fluency with written expression is significant for his academic studies and will have an impact upon time management.

5.6.6 Impact upon academic studies

Strengths	Weaknesses
Perceptual Organisation Skills	Working memory capacity
Visualisation Skills	Speed of information processing
Motivation	Phonological skills
Verbal Reasoning	Visual discrimination skills
Non-verbal reasoning	Sequential memory skills

Student E is clearly disadvantaged by his specific learning difficulties in the written aspects of his chosen course. However, his perceptual organisation skills give him an advantage in his practical and experimental design work for his mechanical engineering degree. Working memory capacity and speed of language processing will mean that written tasks will be more time-consuming for him compared with his peers. Meeting deadlines for written work will be further exacerbated by his reading performance.

5.7 Student F

5.7.1 Background:

Student F is involved with post-graduate studies and is in her first year of an MSc. She is a mature student who returned to study once her children had reached midway through secondary schooling. She had always wanted to do a

degree in English Literature and obtained a place at University where she achieved a 2:1 classification.

She comes from a large family and is one of thirteen children. At least one other of the siblings is dyslexic. Her parents were professional people, and her mother always encouraged the children to read. Student F experienced reading difficulties at a young age but her love of literature was supported by her mother who read books to her throughout her childhood. This engendered a fascination with fiction, although she admits that she has read few books herself from cover to cover. She does some reading of fiction now but it takes many months to finish a book. She qualified as a state registered nurse on leaving school and worked for many years with geriatric patients. She found this work rewarding but gave up to have a family. One of her two daughters has been identified formally as being dyslexic. She was not formally identified as being dyslexic herself until her second year of undergraduate study. Nevertheless, she strongly suspected that there was a possibility of dyslexia from information she had heard on the radio.

When her children attended Primary school, Student F felt greatly disadvantaged as she could not help her daughters learn to read. When they brought home their readers, she dreaded this activity because she was aware that she herself struggled with the phonics and could not blend letters with ease, demonstrating residual phonological difficulties. She would have liked to help out with reading in class like the other mothers but felt unconfident to do so.

She is highly motivated and is prepared to spend much time on her studies to ensure that her written work reflects what she wants to communicate. She openly admits that she is dyslexic, thus demonstrating self-confidence and a matter-of-fact approach to her problems.
She attended the Dyslexia Support Service towards the end of her second year of undergraduate studies to gain practical support for her difficulties. She would, perhaps, have come forward earlier but for the fact that she had whole days to herself when she could quietly do her academic work without interruptions from

her family. Thus, in a sense, the time it took to finish a piece of writing did not become a problem.

5.7.2 Psychometric Profile:

Student F does not have an educational psychologist's report because she did not need to obtain one in order to get the support she needed at University. Had she been detected while at school, an educational psychologist's report would have been compulsory in order to tap into the financial support systems.
All the following test scores and the cognitive profile are the most current data available when she was tested for dyslexia at the Dyslexia Support Service where a full screening assessment was conducted. The assessments conducted by the trained staff at the DSS are made up of a variety of components. Each screening takes on average two to three hours to complete with the student.
This screen consists of the following components:

- Initial screening questionnaire, based on the Adult Dyslexia Questionnaire devised by the British Dyslexia Association and adapted by me for the HE context (see Appendix 4 (i));
- Single-word reading and spelling are examined to ascertain decoding and encoding skills and phonological functioning (Appendix 4 (ii) & (iii));
- Ravens Advanced Matrices, (Raven, 1960), examine 'educative factors' by testing (Appendix 4 (v) & (vi)):
- non-verbal reasoning;
- problem-solving abilities;
- visual and spatial perception;
- freedom from distraction – a key component of working memory functioning;
- Reading comprehension and reading speed;
- Writing speed;
- Dyslexia Adult Screening Tests (DAST), (Fawcett *et al.*, 1998), which are a group of psychometric tests exploring phonological abilities, digit span and speed of information processing (Appendix 4 (iv)).

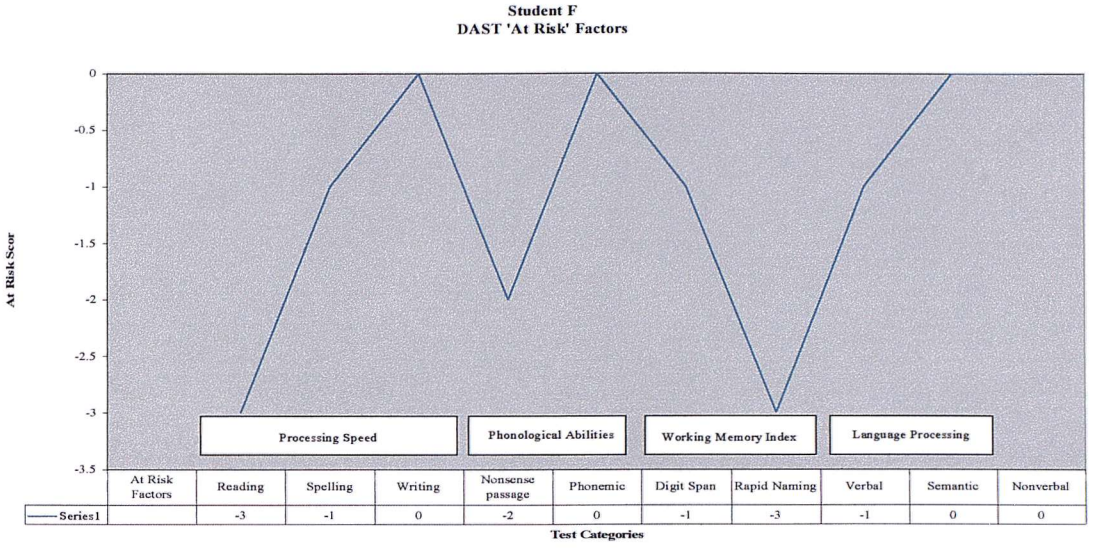


Fig. 32 Psychometric Profile: Student F

Figure 32 demonstrates Student F's uneven profile. The overall 'At Risk Quotient' (ARQ) is 1 where 1 is regarded as 'at risk' and >1 scores demonstrate further severities. Although the elements of this tool vary slightly from the WAIS there are similarities and correlations which can be drawn. **Speed of information and language processing** is weak as shown by the Rapid Naming and Reading sub-test scores which produce the most 'at risk' factors. Phonological abilities demonstrate residual difficulties which, in an adult learner, may now be by-passed using other strategies. Nevertheless, the underlying difficulties are still present and these will have an impact upon speed of processing language. **Memory capacity and storage** is also affected as shown by the backward digit span test. Although this score (-1) is not in the most severe category, it should be taken in the context of the very weak processing speeds, particularly when language is involved, which will have an effect upon capacity when simultaneous operations are required. The differences in performance between **verbal and semantic fluency** are notable. Student F had greater difficulty retrieving language when there was no context within which to place the activity. This is demonstrated by the differentials in performance in two of the subtests for Verbal and Semantic Fluency. The Verbal Fluency test requires the testee to recall as many words as possible beginning with the letter 's'. Whereas when asked to

name as many animals as possible in the Semantic Fluency test, she was able to use visualisation strategies to help her. For example, she was able to categorise animals in a zoo and recall what they looked like to support language retrieval.

5.7.3 Ravens Advanced Matrices: Overall IQ = 100
Mill Hill Vocabulary Test (Appendix 4 (vi)): Verbally average range

Student F worked slowly and methodically with the non-verbal reasoning tests. She spent time visually checking and re-checking and told me later that she is never confident that she has got the right answer and so has to make frequent checks. Her most common error fell into the category of using the wrong principle by which to derive the answer. Weak visual discrimination skills mitigate against a student scoring well in this type of test.

5.7.4 Spelling:

10th Percentile
Test: Wide Range Achievement Tests (WRAT 3) spelling test (Appendix 5 (iii))

This score places Student F in the below average range for spelling of single words with 90% of the population able to achieve a higher score. It represents very low performance for post-graduate students. It was observed that at times, although the final effort was correct, often the processing time was very slow. She relied upon the look of the word to check its authenticity. An admirable strategy if visual discrimination and visual memory are strong – which proved not to be the case with this student. Errors demonstrated this fact when she wrote 'sugestion' for suggestion; 'familliour' for 'familiar'; and 'nessessity' for 'necessity'.

In the main a miscue analysis of the errors highlighted weak visual sequential memory, linked to weak phonological ability. Lack of knowledge and expertise in using language rules was also noted: e.g. 'sincerly' for 'sincerely'; and 'electrisity' for 'electricity'.

5.7.5 Reading:

27th Percentile

Test: Wide Range Achievement Tests (WRAT 3) reading test (Appendix 4 (ii))

Reading speed: 69 words per minute, with a 1% error rate

Student F's reading became slow and hesitant when confronted with polysyllabic words in the single-word reading test. Her speed of processing was slow while she tried to sound out and blend the words into something that she recognised. She was unsure of vowel digraphs and experienced difficulty with segmentation. She informed me that she had never been taught how to split words up so that she could blend them more easily. Additionally, with these words her weak visual discrimination skills resulted in further errors, for example she read 'physiological' for 'psychological'. These behaviours were noted when she was given a passage for comprehension. However, she tried to make use of the context and showed that she constantly monitored her comprehension by returning to sentences to correct words.

5.7.6 Immediate Recall: 62.5% correct

It was interesting to note that Student F was able to remember much of the gist of the passage and could even quote verbatim a phrase which she remembered from the passage. However, she performed less well on the fine detail which demonstrates weak working memory capacity.

5.7.7 Speed of production of written work:

28.8 Words per minute, 7.6% error rate

This score was derived from Student F's free writing. This places her below the average range, particularly for academic purposes at post-graduate level, and below her level of ability. The use of vocabulary in the free writing is interesting

and demonstrates knowledge of vocabulary. However, the language is fairly simple and suggests that she uses words which she is more confident of spelling than words which she would like to use. Sentence structure was simple with no complex use of punctuation.

The handwriting was poor with evidence of some crossings-out. The letter formation on the whole is poor and immature and is not always on the line which further indicates visual perceptual weaknesses. She demonstrated difficulties when multi-tasking because she had to pay attention to low-level encoding skills and letter formation as well as difficulties with word retrieval. The tight grip on the pen denotes some anxiety during this test and results in tiredness.

5.7.8 Impact upon academic studies:

Strengths	Weaknesses
Non-verbal reasoning	Speed of information processing
Verbal reasoning	Visual discrimination skills
Personal organisation strategies	Working memory capacity
Motivation	Sequential memory skills
	Phonological skills

Student F is clearly disadvantaged by her specific learning difficulties in the written aspects of her course, where her speed of information and language processing will have a great impact upon the ability to multi-task. Weaknesses in her working memory capacity will also create additional difficulties during written composition and the writing process. Nevertheless, as a mature student she has learnt many coping strategies which will be examined and discussed in later chapters.

5.8 Student G

5.8.1 Background:

Student G was involved in post-graduate studies in the School of Education. He is a practising teacher who participated in Master's level study to obtain advanced

teaching qualifications in Specific Learning Difficulties (Dyslexia). He is a mature student who spent eighteen years in the catering industry before returning to part-time study. After gaining his first degree, he trained to be a teacher and has many years teaching experience with secondary children who are experiencing special educational needs (SEN).

There is a history of dyslexia in his family, and he stated that his mother was dyslexic and his maternal grandfather was most likely dyslexic, although he was not labelled as such nor was he formally identified. However, he explained that his grandfather, who experienced difficulties while at school, ended up working in the local docks. His grandfather had spelling difficulties and weak handwriting. He went to night-school to improve his handwriting because he felt embarrassed with his written script. Student G's three sons have been diagnosed as dyslexic and all went through the statementing process while at school. Having observed his sons' behaviour, reluctance to go to school and literacy behaviours, he became aware that their problems mirrored his own and this led to him questioning whether he was dyslexic. At the age of forty he obtained a formal assessment which confirmed his feelings.

He enjoys his work with SEN pupils and has a keen interest in information and communication technology (ICT). For some years he ran his own computer company and has been involved with software design aimed at the dyslexic user. He demonstrates creativity and lateral approaches to problem-solving. In the classroom he uses technology frequently to help the dyslexic students develop strategies for coping with their GCSE work. This keen interest in technology has resulted in the development, over the years, of many personal strategies for coping with the problems associated with his dyslexia.

Although motivated to succeed, Student G lacks confidence in his skills and displays high levels of anxiety when engaging in academic study. This is partly because he does not think he is able to meet the standards and because he is aware of the barriers posed by his specific difficulties. He is reticent when sharing his ideas with his peer group, both at University and in his professional

role in school. Although he has a wealth of personal insights into the impact of dyslexia and can also draw upon his professional experiences, he informed me that he was often unwilling to tackle colleagues about negative attitudes towards the dyslexic pupils in his school because he felt inadequate and was concerned that he could not properly express his thoughts. He stated that he was 'often lost for words and that it doesn't give a good impression'.

He needed much encouragement and support while doing his course assignments in order to reduce the stress levels induced by having to commit his ideas to paper. However, he is a reflective student who, because of his particular teaching role and his personal dyslexic difficulties, has become conscious of the strategies he uses when writing. He frequently analyses his own ways of working and adopts a metacognitive approach to learning.

He has a very individual way of working and organising himself during the writing process, which could appear chaotic to a non-dyslexic or someone not used to the ways of working of dyslexic students.

5.8.2 Psychometric Profile:

The diagnostic process with adults is complex and fraught with difficulties. Interpretation of the findings is never straightforward and often brings into question the reliability and appropriateness of many of the traditional assessment tools used to identify dyslexia (Morgan *et al.*, 2000). This is especially so in the case of Student G who not only has developed many strategies for compensating for his difficulties but who is also working in education and, more crucially, in the field of special educational needs where the thrust of practice involves the development of spelling and reading skills. This backdrop needs to be taken into account when examining his test scores so that underlying difficulties can be extracted and analysed.

All the test scores have been derived from his latest educational psychologist's report which was carried out in 1991.

The psychological report demonstrates that Student G has 'high average visual skills and superior verbal skills' (Appendix 2 (vii)). The report suggests that his overall scores, Full Scale IQ of 118, Overall Verbal Scale IQ of 120 and Overall Performance Scale IQ of 111, are depressed because of his specific difficulties and that a more realistic interpretation of his ability and performance would be obtained if the working memory and processing speed indexes were taken out of the equation. This would result in scores which fall in the 'very superior range' – Full Scale IQ of 133,
Overall Verbal IQ of 137
Overall Performance IQ of 119.

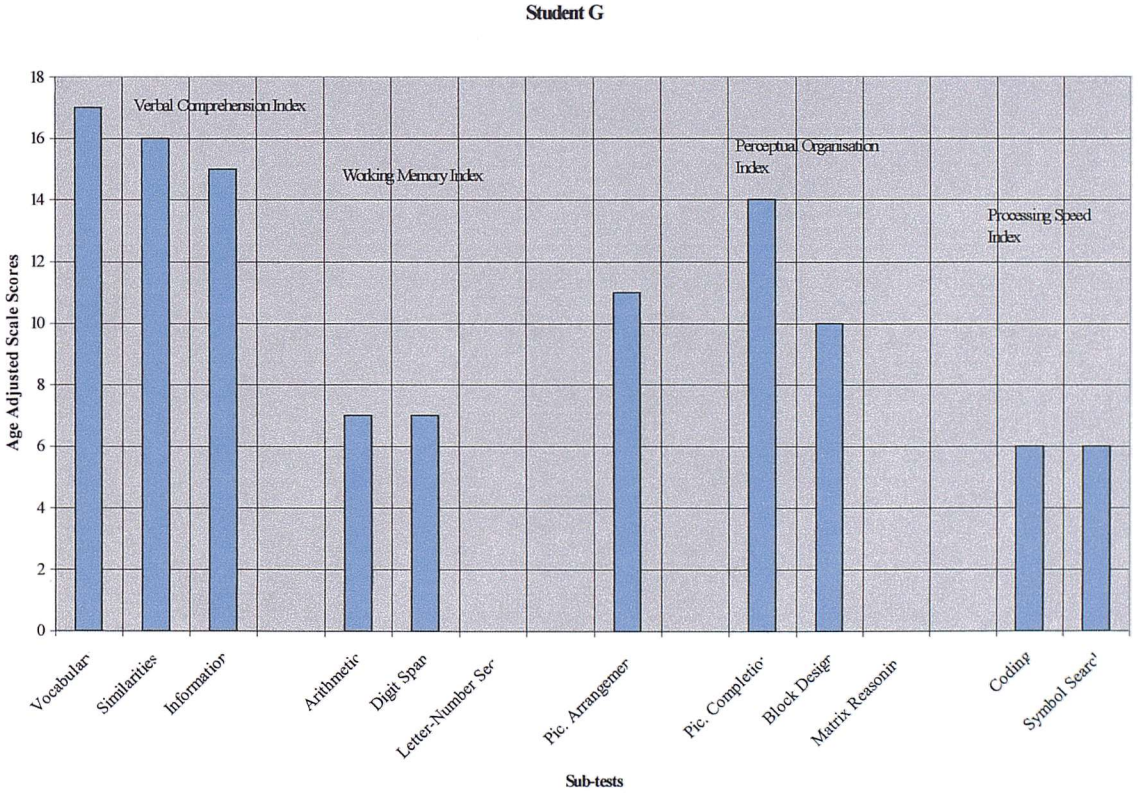


Fig. 33 Psychometric Profile: Student G

Figure 33 demonstrates Student G's uneven profile with significantly low scores on **working memory and processing speed indices**. It is worth noting that the verbal comprehension index is stronger than the perceptual organisation index. I was surprised that the verbal comprehension scores, in particular the Vocabulary and Comprehension subtests, were strong, because the student has severe difficulties expressing his ideas both orally and in written format. His interview data demonstrate real difficulties when he is trying to explain his ideas, and he is frequently at a loss to find the word which he wants to use. However, these verbal performance scores relate more specifically to knowledge of vocabulary and receptive language skills and are often augmented by educational exposure and cultural background. In the case of student G, his professional experiences would increase his performance in these areas. Thus, these specific subtests may not give a reliable picture in this student's case. Nevertheless, the Similarities subtest is a measure of verbal reasoning and demonstrates ability in this area.
The Overall Performance IQ sub-scores are of interest and show the unevenness of his profile in this area as well as his overall spiky profile. When he has to perform tasks which involve anything associated with sequencing ability, viz. Picture Arrangement (PA) and Block Design (BD), his scores are immediately depressed – yet they still fall within the average range. It is interesting to note that the subtest Picture Completion (PC) is within the high-average to superior range. Whilst all three subtests involved visual skills in one way or another, the factors mainly affecting subtest PC are perceptual visualisation; while PA and BD subtests are affected by visual attention skills and visual-motor integration skills. These would suggest that Student G has weaknesses in **visual** short term memory when he needs to sequence information. This will be further exacerbated by the low scores in the working memory and processing speed indices. Student G could be said to have the classic 'ACID' profile of a dyslexic, as explained at the beginning of this chapter.

5.8.3 Spelling:

62nd Percentile

Test: Vernon Single-word Spelling Test

This places Student G in the average range for single-word spelling. This unusually strong score may be explained by the fact that Student G is an SEN teacher and therefore is involved in the teaching of spelling to his pupils. This may have made him more conscious of spelling patterns and may have resulted in a level of automaticity of high frequency words, which the test uses. Underlying phonological ability is therefore masked by these circumstances.

5.8.4 Reading:

14 years 5 months – 10th Percentile for single-word reading
Test: British Ability Scales Word Reading Test (BAS)
18 years 0 months – silent prose reading
Test: Vernon-Warden

The BAS test involves single-word reading aloud and is compared with his silent reading which was assessed using the Vernon-Warden Test where he scored 18 years. The explanation for this discrepancy is two-fold:

a) context clues are available in the silent reading test and a student may rely heavily upon 'reading for meaning' as a strategy to compensate for weak phonological skills;
b) single-word reading places great emphasis upon phonic skills and phonological knowledge. It is also a test of sight vocabulary which should be increased because of Student G's particular situation.

Thus, it is apparent that, like many dyslexic readers, Student G compensates for his linguistic weaknesses by using context to support understanding and fluency. In interview Student G intimated that he had never read a book all the way through until after he had completed his 'A' level studies and that, even now, reading is not an activity which he would choose to do. When asked to explain this further, he stated that he finds the mental organisation of the information time-consuming and hard work. He often forgets what he has read if he reads too long a chunk of information. When asked what he considered a long chunk of

information, he said that after a page of dense text he would be unable to relate what he had just read to an internal, conceptual framework or mapping.

This suggests that the weaknesses in his working memory capacity affect immediate recall and would disadvantage him when having to conduct background reading for his assignments.
Student G's reading fluency and comprehension is further compromised by the frequent need to read and re-read sections of text. This, again, can be explained by his low working memory index scores.

5.8.5 Speed of production of written work:

20 Words per minute

This score is derived from Student G's free writing. His handwriting is 'reasonably fast' but his overall rate is slowed by his weak processing speed. It is to be expected that his handwriting speed is fluent because it is a skill which he has to use daily in his professional capacity, and he has developed greater automaticity through constant practice.
The psychologist noted that his score would be expected to be higher given his Verbal Scale IQ.

5.8.6 Impact upon academic studies:

Strengths	Weaknesses
Verbal reasoning	Verbal organisation
Verbal comprehension	Auditory sequencing
Visual discrimination	Visual sequencing
Visual conceptualisation	Working memory storage
Receptive vocabulary	Processing speed
Non-verbal reasoning	Working memory capacity

Student G has developed many coping strategies. However, his profile demonstrates that the underlying deficits in working memory capacity and processing speed could have a significant effect upon his performance in written work. His difficulties with verbal organisation will impinge upon the writing process, despite his strong verbal comprehension index scores. The psychological report recommended that he receive extra time in examinations because working memory capacity was weak and would affect performance in the timed conditions of examinations.

5.9 Summary

As has been demonstrated in this chapter, the notion of' differential aptitude' (cf. Chapter 1, p. 21) has been examined from the psychometric data (Duane, 1991). The 'unexpectedness' of the subtest data (cf. Chapter 2, p. 41 for discussion) is illustrated as a factor with all the students, demonstrated by the 'spiky' profiles. However, there are differences which have emerged, showing that the strengths and weaknesses of these dyslexic students are individual. What has emerged, however, is that to a greater or lesser degree, each of the students experiences deficits in working memory capacity and speed of processing. It has been shown that both these factors are involved in sub-processes which are vital to academic studies and performance. The psychometric data will be analysed in more detail in the following chapter.

Student Tag	**Single Word Spelling** (In Percentile Scores)	**Single Word Reading** (In Percentile Scores)	**Reading Speed** In words per minute – wpm	**Writing Speed** In words per minute – wpm with spelling error rate, where available
A	14th	47th	Test data inconclusive	15 (6% error rate)
B	9th	37th	55	14 (11% error rate)
C	47th	47th	30	25
D	34th	79th	66.3	17 (6% error rate)
E	9th	16th	62	13 (11% error rate)
F	10th	27th	69	28.8 (7.6% error rate)
G	62nd	10th	Not available	20

Table 1 Summary of Literacy Performance Scores

The impact of the test performance together with the data collected from the semi-structured interviews , the writing logs and the written products will also be triangulated in the following chapter.

An overview of each student's literacy levels demonstrates areas of weakness which will have an impact upon academic performance. This will be discussed in the following chapter in more detail.

Chapter Six: Data Analysis and Discussion

The data have been analysed in such a way that the quantitative and qualitative data can be examined both collectively and separately. In this way, various sets of data are viewed and synthesised so that comparative analyses of the diverse layers of information can best be scrutinised. With this hybrid study, it is important to bring together various elements of the research into a coherent structure so that the discussion of the results can better inform future research.

6.1 Identification of SpLD/Dyslexia

Although the extent to which the identification of dyslexia influences a person's personality and behaviour is not the main thrust of this study, it nevertheless may need to be taken into account to help to inform the interpretation of student commentary, writing behaviour and strategies employed (Humphrey *et al.*, 2002b, Humphrey *et al.*, 2002a). In my experience, students who were identified early, or while still at school or sixth form college, are most likely to have had some specialist teaching by a trained dyslexia tutor, prior to entry to university. This may have influenced the compensatory strategies adopted. This teaching input could also have some effect upon the way a student manages and organises the writing process.

The impact of identification after compulsory education is multifarious and individual . On the one hand, it has a bearing upon academic performance; while on the other hand, it can affect self-esteem and self-perception (McLoughlin *et al.*, 2002, Morgan *et al.*, 2000). As McLoughlin pointed out, some dyslexic adults, returning to study at HE level, experience a type of role reversal and revert to a childhood dependency mode. Whilst these students have often had successful careers, developed compensatory strategies and may have been responsible for supervising others, the way in which they adjust to the return to academic study may be affected by their own negative, childhood experiences at school (McLoughlin *et al.*, 2002). These factors have a compound effect on the use made of support services in terms of the frequency and type of support required.

> "There are several external factors which undoubtedly influence the individual's perception of the significance of dyslexia on his or her life. Perhaps the most important variables are the stage at which dyslexia was first diagnosed and the type of support, both emotional and academic, that was received."
>
> Morgan *et al.*, 2000, p. 49

Table 2: Composite picture of student identification and support

Student Tag	Age Identified	Prior to HE	Post School	Additional Teaching	Confidence as a writer	DSS Use
A	6 Years	√		Specialist dyslexia tutor from Primary schooling	High self-esteem No secondary emotional difficulties	Sporadic and restricted to crisis management
B	20 Years		Term 2, 1st Year of undergraduate study – 1st Year re-sit	Basic reading and spelling lessons in Primary school	Lacks self confidence in writing ability	Heavy use Frequent sessions with dyslexia tutor
C	19 Years		Term 2, 1st Year of undergraduate study		Unsure of writing ability	Heavy use Frequent sessions with dyslexia tutor
D	12 Years	√		Specialist dyslexia tutor from Secondary school	High self-esteem No secondary emotional difficulties	Sporadic and restricted to crisis management
E	24 Years		Term 3, 2nd Year of undergraduate study	Basic reading and spelling lessons in Primary school	High Self-esteem	Heavy use

F	42 Years		Term 2, 2nd Year of undergraduate study		Vulnerable but prepared to tackle writing	Sporadic support as u/g; more during p/g
G	40 Years		While in employment		Low self-esteem Vulnerable as a writer	No support

6.1.1 Identification Prior to entry to HE

Only two of the students in this study were diagnosed as dyslexic prior to entry to HE: students A and D, who were identified while at school. Student A was identified at the age of six years and received on-going specialist tutorial support throughout his schooling. Although, on re-assessment at age sixteen years, his reading skills had improved, his spelling performance was still below his chronological age. Students A and D are well-adjusted, self confident young men with none of the secondary emotional difficulties often associated with dyslexia. The interview data revealed that these students did not feel disadvantaged by their dyslexia: as one student said, he was 'never allowed to feel bad about his dyslexia' (Appendix 3,(iv)). This view reflects studies which demonstrated that early identification can help some students to adjust and to strengthen self-esteem (Riddick *et al.*, 1997, Riddick *et al.*, 1999):

> "Students who have a long established identity as a person with dyslexia may well be more confident and comfortable with their identity and reconciled to their strengths and weaknesses."
>
> Riddick *et al.*, 1997 cited in Farmer *et al.*, 2002, p. 61

Both students were content to receive specialist support, which echoes findings from other surveys (Gilroy, 1996). However, they make only occasional use of the DSS, even though additional funding is available for specialist tuition through Disabled Students' Allowance (DSA). The dyslexia support tutors have commented in a conversation with me that there is a pattern to their sporadic use of these

support systems: crisis management of academic work. This type of support builds upon previous study skills tuition and plugs gaps to help enhance more appropriate strategies to meet the academic demands. It could be argued that the reason these students do not make heavy use of DSS is because they have received on-going specialist support prior to entry to HE. It could be said that early skill teaching has equipped them with a range of techniques for dealing with academic work and writing in particular. However, the support tutors have noted that these students have new academic skills' support requirements as a result of the HE context. These new demands and pressures result in the need to plug the gaps with sporadic use of DSS.

6.1.2 Identification Post entry to HE

Analysis of identification post entry to HE is more complex. Factors such as the age of the student, educational history and family context must be taken into consideration. Students B, C, E, F and G were identified after compulsory education. Students B, C and E were identified at university following referral by subject tutors; and Student F was identified at university by self-referral.

Students B and C could be termed traditional HE students in that they have come to university straight from school; while students E, F and G have pursued career paths prior to return to study. In the case of Students F and G, they are themselves parents of dyslexic off-spring.

Formative influences would appear to have some effect upon up-take of support in HE and self-esteem. The type of support received at school, and the awareness and attitude towards dyslexia in the home environment have been described as factors in the amount of 'emotional baggage' such students carry with them into HE (Saunders, 1995, Morgan *et al.*, 2000).

Students B, C, E, F and G remarked that they were aware of their literacy difficulties, even in Primary school. Students B and C commented that their literacy difficulties were not deemed severe enough by the school system to warrant assessment (and possible identification). Students B and E received basic **literacy**

support in Primary and Secondary school. This focussed on the development of reading (decoding) and spelling (encoding) skills and appears to have been restricted to lower order skill acquisition. No higher order skills development was provided. Student C attended a private school where she intimated that she was in a highly structured environment which supported her needs at that time (Appendix 3, (iii)). This type of support does not prepare students for the demands of academic study in the HE context. In my experience such students have not been taught appropriate strategies for the writing context in which they find themselves at university. Nor have they internalised strategies so that these can be generalised to new situations, as seen with Student C later in this chapter. In other words, their metacognitive control of the learning context has not been developed, and without this they will have difficulty matching skills to academic demands (McLoughlin *et al.*, 2002).

Students B, C and E make good use of specialist tutorial support available through DSS. Students B is an unconfident learner, and her self-esteem is precarious. She is re-sitting her 1st Year studies, which may account for her anxieties. However, it has had a positive effect in that she has developed a more reflective and strategic approach to her skill acquisition. This is explored in greater detail in section 6.7.2, later in this chapter.

Student E also makes heavy use of DSS facilities for specialist tutorial support. However, the reasons for this are slightly different. Student E had successfully undergone an apprenticeship in engineering and had gained sponsorship for his undergraduate studies from a well-known national engineering group. Consequently, his self-esteem was high. He had undergone some study during his apprenticeship. He was identified in his second year of study after referral by one of his subject tutors who noticed discrepancies between his coursework and examination performance. He had long been aware of his difficulties but had developed compensatory strategies to by-pass them. He did, however, express concerns that the compulsory education system placed him with pupils who were of low ability and that his dyslexic literacy difficulties were never fully recognised at school. Once he was identified, he made use of the DSS to increase his strategies and to learn more about dyslexia and his own condition.

Student F was not identified until she was in her forties although she suspected that she was dyslexic because there was a strong family history of dyslexia. She explained that her family background had provided rich and encouraging support, and that her mother propped up her delayed reading development by providing literacy enrichment in the form of reading stories to her. Such parental support helped her to develop a positive attitude but may have masked difficulties which made early identification more difficult.

She did not feel that it was necessary to be formally identified prior to entry to HE because the demands made upon her as a carer in an old people's home and as a mother did not warrant either the expense of assessment nor the stress such a process would inevitably produce. She has also informed me that there was always the fear that dyslexia would ***not*** be identified, and she would have to re-consider many of her self constructs! This comment resonates with current, personal accounts of dyslexic experiences in HE (Palfreman-Kay, 2001, Hetherington, 2001, McLoughlin, 2001, Farmer *et al.*, 2002, Morgan *et al.*, 2000). In a study of forty-four students at the University of Southside, it was noted that seventeen students were 'apprehensive' of the assessment process and were concerned that:

> "the assessment might indicate that they were not dyslexic but simply 'thick'".
>
> Farmer *et al.*, 2002, p. 77

It is important that such student concerns and anxieties are recognised when Higher Education Institutions formulate policy for assessment and identification, ensuring that students' perceptions of this process are taken into account. Identification and assessment are often regarded by students as a necessary evil, a means to an end. In many cases this process opens the door to additional tutorial and technology support through the DSA. If handled sensitively, it can be an empowering process which enables the students to develop more positive self-esteem and provides them with the evidence that their profile encompasses *strengths* as well as *areas for development* of appropriate coping strategies (Farmer *et al.*, 2002). Diagnosis is, therefore, not just about obtaining measurements – the psychometric profile – but is also one stage on a road to self-discovery.

> "For the dyslexic adult, being diagnosed is at the heart of coming to terms with being dyslexic and can have a profound effect, making sense of years of confusing frustration and failure."
>
> Morgan *et al.*, 2000, p. 21

Student F's positive attitude to her abilities and her life experiences as a nurse and mother meant that she did not feel the need to attend academic skills support sessions. To some extent she denied the reality of the mis-match between the requirements of current academic study and the appropriateness of her strategy use by a resigned acceptance – 'I've never been any good at this sort of thing' (referring to drafting and composing during the text generation process). In conversation with her she informed me that it was a question of time management for her. She had developed many compensatory strategies for coping and did not think that she could afford to spend precious time with a dyslexia tutor. In retrospect she has explained that she was concerned that the intervention would be focussed on basic skills and was unaware of the type of support on offer by DSS tutors. Since embarking on post-graduate studies, she has received some tutorial support and now accepts that her strategies for coping could be improved to meet the demands of academic study at this level.

Student G was a part-time postgraduate student who was not identified until he reached the age of forty. Thus, he struggled through his undergraduate studies without any help or specialist support. Like many dyslexic adults who have not been identified in the school system, his reasons for finding out if he was dyslexic were triggered off by the growing awareness that his sons' condition was very similar to his own – he has three sons who went through the Statementing process in school (Morgan *et al.*, 2000). He informed me that there was a long history of dyslexia in his family, going back three generations.

Student G has received no specialist tutorial support for his dyslexia and has developed many coping and compensatory strategies for academic work. Although a successful professional, he is anxious about his academic skills and his self-esteem is very precarious.

As can be seen from table 2, there are patterns of behaviour related to the identification process. Those students who were identified early, i.e. during Primary and Secondary schooling, were more confident about their writing ability and did not feel the need to partake of regular specialist support, rather using this when they reached an impasse in their writing and did not have the appropriate strategies or techniques to complete the writing assignment effectively.

The students who were identified after compulsory education did not approach the writing task with the same self-confidence and frequently shrugged off any errors during the drafting process by stating that they had always been 'no good at writing'. The dyslexic difficulties of students B and C did not manifest themselves until well into the first year of undergraduate study when they had carried out their first written assignments and had taken their first semester examinations. These two students have made, and continue to make, heavy use of the specialist dyslexia tutorial system for developing academic skills.

Student E was different from the above students in that he has high self-esteem and is a risk-taker, prepared to try out new strategies to meet the demands of the written assignment. As soon as he realised that he had exhausted his own strategies for coping with the writing process, he was prepared to accept help and received regular academic skills tuition in his final year of study.

The two post-graduate students, F and G, were not formally identified until they were in their forties. Both students pepper their comments about their writing abilities with excuses for errors as 'just normal behaviour' for them. Their motivation and determination are high, and these factors provide the stimulus to carry out written assignments, despite a belief that they cannot do this sort of task. However, the patterns of specialist support are different. Although both students are part-time, student F works on campus and is able to tap into the support systems without difficulty while student G is rarely on campus. Student G was highly anxious when given initial feedback on his first assignment and had great difficulty listening to positive criticism aimed at helping him to develop his writing skills.

6.1.3 Summary

The way in which students seek support in HE is determined mainly by two factors: previous targeted support for dyslexic difficulties by a specialist tutor and self esteem as a writer which is closely allied to self perception of dyslexia and the age of identification. All the students whose dyslexia was identified after compulsory education display secondary emotional difficulties associated with dyslexia to a greater or lesser extent. Self-awareness and self-esteem are critical in the development of writing competence. Studies of apprehensive writers have shown that although there was no difference in the quality of text between those with a fear of writing and those who are confident about their writing ability, it is the impact this has on performance which is more important and that apprehension can impede performance (Boice, 1985, Madigan, 1996, Harris *et al.*, 1992).

6.2 Cognitive Profiles

The cognitive profile is like the human fingerprint: remarkably individual. However, in order to answer my research questions, it was necessary to establish if there were any similarities which could account for a 'cognitive dyslexic writing type' (cf. Chapter 2, 2.6.1. – discussion of dyslexic types) The cognitive profiles of the students have been analysed to ascertain if there are any common patterns within the profiles of all the students. An understanding of the cognitive profiles is needed so that comparisons with the writing performance profiles – using real-time data and interview transcriptions – can be accomplished.

All the students, except Student F, have a psychologist's report which is based on either the WISC or the WAIS, depending upon the age at assessment. Where possible, Student F's assessment data is quantified against the relevant WAIS subtests when correlation co-efficients have been established in the development of the tests.

The Wechsler suite of tests is a method of demonstrating intelligence defined as:

> 'the aggregate or global capacity of the individual to act purposefully, to think rationally or to deal effectively with his environment'
>
> Wechsler, 1939, p.3

The validity of intelligence tests in the identification of dyslexia is contentious (cf. Chapter 1, section 1.4). While concerns about the nature of these tests form part of the on-going debate between psychologists and specialist, educational assessors (Turner, 2000), they are not the main thrust of this study. My reason for using data from these tests is that they are the ones most frequently used in psychometric assessment at the present time (for discussion see Chapter 5, section 5.1).

The scores for the WISC/WAIS subtests have been clustered into:

Verbal Comprehension Index
Working Memory Index
Perceptual Organisation Index
Processing Speed Index.

Knowledge of the sub-test scores is important in order to derive, for each student, a detailed picture of the cognitive functioning which is related to the complexities of text generation during the writing process. An understanding of the objectives of each of the sub-tests and the labelling terminology of these types of tests is vital in order to interpret the scores.

6.2.1 The Role of the Verbal Comprehension Index:

This consists of three subtests:

i) **Vocabulary** is a test of word definition and the factors which affect performance on this subtest are:

Long-term memory
Verbal comprehension and expression
Language knowledge
Auditory discrimination
Cultural background

ii) **Similarities** is a test of verbal reasoning and the factors which affect performance on this subtest are:

Verbal concepts
Verbal comprehension and expression
Receptive and expressive language skills
Verbal reasoning – associative and logical

iii) **Information** measures the student's ability to recall particular general knowledge facts, and the factors which affect performance on this subtest are:

Educational background
Long-term memory
Receptive and expressive language skills
Language retrieval
Associative thinking

This test is one of the tests of the 'ACID' profile. It is implicated with SpLD mainly because the first nine questions require the testee to recite sequences such as days of the week, months of the year and the seasons.

6.2.2 The Role of the Working Memory Index:

This index is associated with Freedom of Distractibility referred to in other psychometric tests and measures memory and attention dimensions of performance. This consists of three subtests:

i) **Arithmetic** is a test which measures the ability to solve mental arithmetic problems which are presented orally, and the factors which affect performance on this subtest are:

Basic numeracy
Concentration
Working memory capacity and storage
Multi-tasking skills
Attention
Visualisation
Auditory memory
Anxiety

This test is one of the tests of the 'ACID' profile.

ii) **Digit Span** is a test which measures the ability to retain and repeat in a correct sequence both forward and backward information which is given orally. The backward repetition is the most significant element for identifying learning difficulties because it can demonstrate executive function problems and corresponds to the ACID profile. The factors which affect performance on this subtest are:

Working memory storage and capacity
Multi-tasking – organisation and re-organisation of information
Attention
Auditory sequential memory

iii) **Letter/symbol sequencing** which is a test which measures both working memory storage and capacity. Testees are asked to listen to sets of letters and single numerals alternated with each other and then repeat them grouped in ascending numbers and alphabetically ordered letters. The factors which affect performance on this subtest are:

Working memory capacity and storage
Auditory sequential memory
Knowledge of number and alphabet symbol sequences
Multi-tasking - organisation and re-organisation of information
Attention

6.2.3 The Role of the Perceptual Organisation Index:

This consists of three subtests:

i) **Picture Completion** measures the part-whole/whole-part reasoning and perceptual abilities, and the factors affecting this are:

Visual conceptualisation
Perceptual organisation
Long-term memory organisation
Visual discrimination
Concentration and attentional ability

ii) **Block Design**

This test measures the ability to look at an abstract design, analyse it into parts and reproduce it using coloured blocks. The factors affecting this are:

Visual discrimination
Visualisation of parts – whole
Perceptual organisation
Spatial orientation
Abstract conceptualisation
Visuo-motor co-ordination
Anxiety
Concentration

iii) **Matrix Reasoning** is a test which measures the ability to reason, and the factors which affect this are:

Non-verbal reasoning
Visual perception
Spatial perception
Freedom from distractibility
Problem-solving ability

6.2.4 The Role of the Processing Speed Index:

This consists of two subtests:

i) **Coding**

This is a measure of a person's ability to reproduce symbols as part of a set code, and the factors affecting this are:

Visuo-motor dexterity
Speed
Accuracy
Associative thinking
Anxiety
Spatial orientation
Visualisation
Working memory capacity and storage

ii) **Symbol search** is a test which measures the speed at which the person can determine the presence or absence of a given symbol in a line of symbols. The factors affecting this are:

Concentration and attention
Speed
Accuracy
Anxiety
Spatial orientation
Visual perception
Visualisation
Working memory capacity and storage

The Wechsler intelligence tests 'Full Scale Score' represents general intelligence often referred to as 'g' or 'g-loaded' intellectual measurements. The student data is linked to the ratings defined by the Wechsler tests and the overall definitions of intellectual ability are derived from the manual.

Table 3: Wechsler Full Scale Scores and IQ Descriptions

Full Scale IQ	WISC/WAIS Description
130 and above	Very Superior
120-129	Superior
110-119	High Average
90-109	Average
80-89	Low Average
70-79	Low Extreme
69 and below	Mentally Retarded

Subtest scores will be referred to in the subsequent analyses, and it is important to relate these to IQ equivalents and percentile ranking to demonstrate the student's ability in relation to the rest of the population.

Table 4: Relationship between WISC/WAIS Subtest Scores, IQ Scores and Percentile Rank Equivalent

Subtest Scores	IQ Scores	Percentile Rank Equivalent
	145	99.9
	140	99.6
17-19	135	99
16	130	98
15	125	95
14	120	91
13	115	84
12	110	75
11	105	63
10	100	50
9	95	35
8	90	25
7	85	16
6	80	9
5	75	5
4	70	2
1-3	65	1

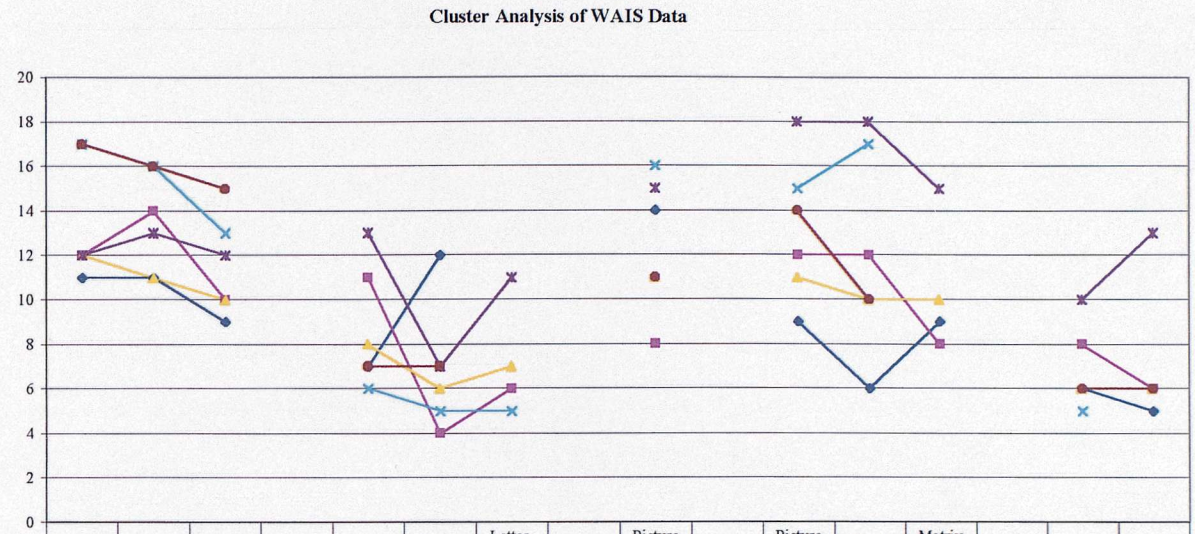
The students in this research reflect, in the IQ range, the type of population expected to attend an HE institution. As such they represent a typical spread of ability. In some cases the educational psychologists have been unwilling to provide Overall IQ Scores because these would not provide a true picture of the functioning ability of the student and may give a negative representation of the individual student, which could be detrimental to the perceptions of those 'reading' the results. One of the most common reasons for this is that the highs and lows of the profile are not adequately expressed as an Overall IQ Score, and the demonstrably low performances depress the Overall. Thus, a summary table of their IQ performance, according to the Wechsler definitions, demonstrates this spread of ability and provides a summary of the type of student in this research.

Table 5: Student Classification According to Wechsler Definitions of IQ

Student Tags	IQ Definition
A	Average
B	Average
C	High Average
D	Very Superior
E	Above Average
F	Average
G	High Average

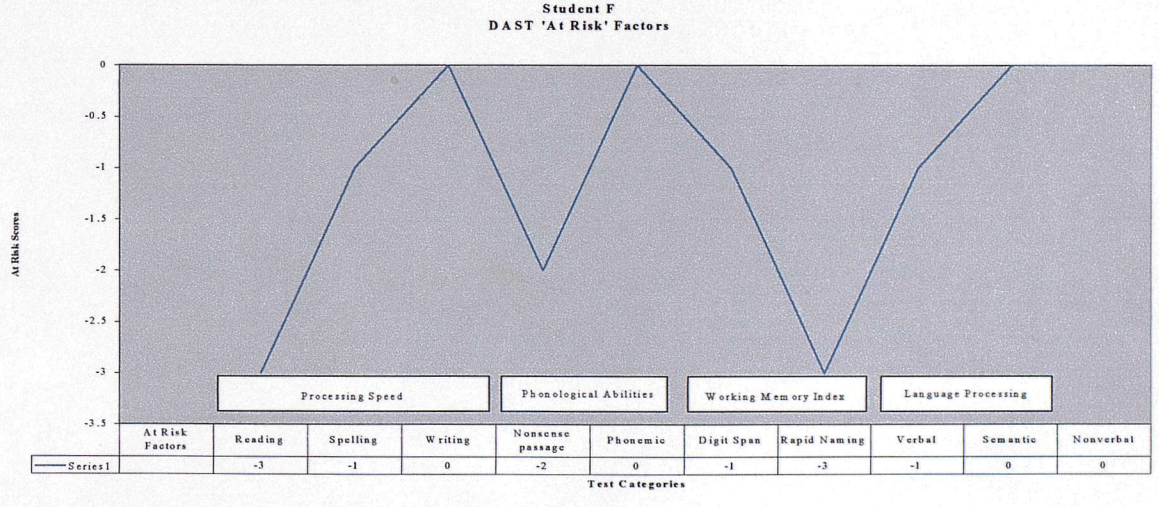
6.3 Comparisons of Psychometric Profiles:

It is hypothesised that the typical features of a dyslexic cognitive profile will have an impact upon performance during the writing process. In order to examine this in detail, it is necessary to analyse the psychometric data to attempt to derive patterns of performance. An analysis of the cognitive index data of the individual profiles can provide a 'within-student' representation. The analyses of these will provide inter- and intra- data analyses and will enable me to examine in detail whether significant patterns have emerged which could have an impact upon the writing process.



	Vocabulary	Similarities	Information		Arithmetic	Digit Span	Letter-number Sequ.		Picture Arrangement		Picture Completion	Block Design	Matrix Reasoning		Coding	Symbol Search
Student A	11	11	9		7	12			14		9	6	9		6	5
Student B	12	14	10		11	4	6		8		12	12	8		8	6
Student C	12	11	10		8	6	7		11		11	10	10		6	6
Student D	17	16	13		6	5	5		16		15	17			5	
Student E	12	13	12		13	7	11		15		18	18	15		10	13
Student G	17	16	15		7	7			11		14	10			6	6

Fig. 34 Cluster Analysis of WAIS Data



At Risk Factors	Reading	Spelling	Writing	Nonsense passage	Phonemic	Digit Span	Rapid Naming	Verbal	Semantic	Nonverbal
Series1	-3	-1	0	-2	0	-1	-3	-1	0	0

Fig. 35 Student F – DAST Data

The first chart demonstrates the overall spread of performance of the students and shows that each of the students has an uneven profile, the significance of which will be examined in more detail in the individual profile analysis later in the chapter. Student F's data were derived from different sources which do not provide a

standardised correlation with the above categories. However, the DAST screening data show that her processing speed and working memory capacity are significantly low and that her profile, like others in the study, is spiky.

Highest and Lowest Indices Scores converted to IQ and Percentile Ranks

The significance of the breadth of the differentials in each of the index clusters is worthy of note. By linking the percentile ranking to the WAIS IQ categorisation, it is possible to interpret the effects of the scores and put them in the context of the general population. Table 6 demonstrates the breadth of performance scores of the case studies.

Index Category	Highest Score		Lowest Score	
	IQ	Percentile	IQ	Percentile
Verbal Comprehension	135	99th	95	35th
Working Memory	115	84th	70	2nd
Perceptual Organisation	135	99th	80	9th
Processing Speed	115	84th	75	5th

Table 6: Highest and Lowest Index Scores converted from IQ to Percentile Ranks

6.3.1 Verbal Comprehension Index

The overall scaled scores, in Table 6, represent a difference between 99th percentile at the highest scores and the 35th percentile at the lowest score, with the highest scores in the Vocabulary category and the lowest appearing in the Information category. Dyslexic students are expected to perform better on the Vocabulary and Similarities categories, which test verbal reasoning and verbal comprehension,

compared with the Information category, which is a measure of language retrieval. The Verbal Comprehension Index shows a regression for all students with better performance on Vocabulary compared with Information. This downward trend in the scores for all students is also proportional to the individual. Comparing Vocabulary and Information scores there is a downward trend of two points for all students except student E, whose scores are flat. A comparison of Similarities and Information scores does not present such a clear-cut picture with a variation in the differential of between one and four points. However, there is an overall downward trend between the two categories.

These trends are expected to have an impact upon the writing process, and in particular the collection and translation phases, in which the students have to call upon verbal reasoning and language retrieval in reading comprehension – both of their own and other people's texts – and in text generation. Lower scores in 'Information' will, therefore, express themselves in longer time being taken in these aspects of the writing process.

6.3.2 Working Memory Index

Not all students were administered the Letter-number Sequence test which is a new addition to the WAIS. The overall scaled scores represent a difference between 84th percentile at the highest scores (Table 6) and the 2nd percentile at the lowest scores. This differential demonstrates great discrepancy in performance for the subtests in this index, particularly if taken in relation to verbal performance. The 2nd percentile is ***unexpectedly*** low (classified as 'low extreme' in the WAIS definitions of intelligence and bordering on the 'mentally retarded' category of the WAIS), taking into account the overall high IQ levels of these students. Thus, not only is the overall trend downward but this cluster of scores is depressed compared with the previous index. This will affect all aspects of the writing process. It will severely impair the ability to perform simultaneous operations.

6.3.3 Perceptual Organisation Index

The results in this index represent a range of individual scores with no trend. However, there is a wide range of scores from 99th percentile to the 9th percentile. Taken overall, this score cluster is higher than the Working Memory Index. (A higher Perceptual Index than WM Index is expected with dyslexic students.) All students, except Student A, fall within the 'average' to 'superior' range for this index. This would suggest that students rely upon global/holistic thinking processes with strengths in visualisation. It implies that strengths in this index cluster would enable students to manipulate the macro elements of structure. Whilst global perceptual abilities can have an effect upon career preferences, relating to architecture and civil engineering (West, 1991), it is not always the case with the writing process. This can be explained by the combination of global planning, language processing and cognitive resource capacity, which are essential ingredients of the writing process. However, weaknesses in the Working Memory Index often outweigh the Gestalt strengths of the dyslexic cognitive profile as will be seen later in this chapter.

6.3.4 Processing Speed Index

The overall scaled scores represent a difference between 84th percentile at the highest scores and the 5th percentile at the lowest score. Dyslexic students are not expected to perform well on these subtests. The scores are similar in range to the Working Memory Index scores. With the exception of Student E, all scores are lower than could be expected of students whose overall IQ scores fall within the average to superior ranges and when compared with the Verbal Comprehension Index scores. All the students, apart from Student E, fall well below the average, with scores ranging from 25th to 5th percentile which is unexpected for students in HE.

6.3.5 Summary:

The above analysis of the IQ performance demonstrated that all students, with the exception of Student E, have spiky profiles. Trends in performance can be seen:

working memory performance and speed of information processing is considerably lower and demonstrates depressed performance for all the students, with the exception of Student E. These are set against demonstrably higher performance in verbal comprehension. However, the perceptual organisation index shows that individual differences are more apparent in this cluster, with an overall wider range of scores.

Thus, the ***dyslexic cognitive profile*** which has emerged with the majority of this sample of students is that there are unexpected deficits in working memory storage and capacity and automaticity performance levels. These areas of deficit are set against strengths in verbal comprehension and reasoning. In the context of theoretical models of the writing process, it will now be possible to evaluate whether this type of profile makes a difference to the students when they are engaged in the writing process.

It is worth noting at this stage that Student E's profile is not typical of the traditional dyslexic profile because his scores are relatively flat. Additionally, his scores all fall within the average and above range, with the notable exception of the Digit Span subtest. It is this score which is considered to be a marker for specific learning difficulties (dyslexia).

6.4 Analysis of Literacy Performance Scores

One of the paradoxes of the literacy performance of the dyslexic adult is that the difficulties are often masked, and that they (dyslexic, adult writers) do produce work which is of a high standard. Statistical data needs to be analysed carefully to ensure that they are interpreted effectively in the HE context. It is, therefore, necessary to re-visit the table which was presented at the end of the previous chapter (p. 172).

Student Tag	**Single Word Spelling** (In Percentile Scores)	**Single Word Reading** (In Percentile Scores)	**Reading Speed** In words per minute – wpm	**Writing Speed** In words per minute – wpm with spelling error rate, where available
A	14th	47th	Test data inconclusive	15 (6% error rate)
B	9th	37th	55	14 (11% error rate)
C	47th	47th	30	25
D	34th	79th	66.3	17 (6% error rate)
E	9th	16th	62	13 (11% error rate)
F	10th	27th	69	28.8 (7.6% error rate)
G	62nd	10th	Not available	20

Table 1: Summary of Literacy Performance Scores

A note of caution is always needed when examining normative data. Such data give measurements of performance on a specific day, at a specific time. They provide a statistical snap-shot. A reading age or a percentile score tells little about the strategies employed when tackling text for research reading. All tests have limitations which need to taken into account when interpreting the data. This can be problematic for a number of reasons. To those not used to dealing with data from standardised tests, such data may send out the wrong messages. For example, academic tutors, and indeed the students themselves, may question the efficacy of

admitting dyslexic students with severe literacy weaknesses into HE. Knowledge that a tutee has a reading age of 14 years 5 months may be misinterpreted. It is important, therefore, to analyse the findings, mindful of the test activity and its possible limitations, and in terms of the implications for academic study.

What do the tests set out to do and what are their limitations?

Single word spelling and reading tests are useful to demonstrate underlying phonological strengths and weaknesses. They provide information which shows the testee's ability to encode and decode – what has been referred to as lower-order skills. Such tests are usually untimed which has implications for interpretation of language processing abilities. If analysed diagnostically, with a miscue-analysis, it is possible to explore cognitive functioning in terms of, for example, auditory and visual discrimination and perception. Assessment of these within-student factors can determine teaching support and strategy development. Low-level literacy skill ability is one of the components in the writing process which needs to be automated so that cognitive capacity can be maximised for higher-order operations (cf. Chapter 2, sections 2.12 and 2.13). Thus, low percentile ranking on single word spelling and reading will put pressure upon cognitive resources.

Equally important is the consideration of spelling during text generation. Writing speed scores, taken in conjunction with spelling error rate during this type of activity, can help us to understand how the student is functioning and in this sense give not only a within-student (micro) but within-context (macro) picture of performance. These types of activities rely upon timed conditions. Thus, if a student has a high writing speed but this is accompanied by a high spelling error rate, it is possible to surmise that this has implications for time spent proof-reading written work. It also demonstrates weak accuracy and fluency. Low writing speeds (with high or low spelling error rates) will give a clearer picture of the student's ability to process language in context.

There are patterns which have emerged. As can seen in Table 1 above, many of the students are functioning well below expected levels if IQ scores are correlated. With the exception of Students C and G, spelling lags behind reading on single word

performance. This phenomenon has been recorded in studies with dyslexic children (Miles, 1993, Thomson, 1984, Adams, 1990, Frith, 1989), and it is interesting to note that the differentials carry through to HE. Weaker encoding skills will have a greater impact upon the writing process. Percentile rankings of 16 and below place students in the 'low-average to extremely low' WAIS categories, functioning at IQ levels of 80-85. Such encoding capacity will greatly compromise ability to produce written work effectively in the context in which these students find themselves and may have a knock-on effect on working memory capacity function.

It is worth noting writing speed performance in relation to text generation. As yet there are no standardised measurements for writing speed (Sawyer *et al.*, 1996). The most frequently-used assessment for this is to get students to copy the sentence 'The quick brown fox jumps over the lazy dog' for one minute. It will be noted that this sentence contains many of the letters of the alphabet and can, therefore, provide diagnostic information about letter formation. However, this is not the most appropriate method of assessing writing speed for dyslexic students in HE. Copying a sentence and generating text measure different cognitive functions. It is more important to find out how the dyslexic student functions when generating text, and whether they are disadvantaged in any way compared with non-dyslexic students. Little research has been conducted on this aspect of writing speed. Two studies of dyslexic students in HE, matched with a non-dyslexic control group, found that for a copying task dyslexic students produced 27.65 wpm and the control group 33.06 wpm. (Hughes *et al.*, 1994, Hatcher, 2001). Research of tasks which involve writing speed and language processing has shown that undergraduates produce 20.2 wpm compared with 16.9 wpm for dyslexic undergraduates (Sterling *et al.*, 1998).

The range of writing speed for the students in this study is from 28.8 wpm to 13 wpm. Students B and E have the highest error rate, and this reflects the low percentile ranking for single word spelling. This suggests that weak lower-order spelling skill has a greater effect upon spelling accuracy in context. With so few studies available currently it is not possible to draw firm conclusions about the students' rate of production in this study. Nevertheless, the speed of production, linked with error rate, have an impact upon text generation and time spent proof-reading during the writing process.

6.5 Analysis of the Writing Log Data related to Torrance's study

Real-time writing sampling data will be examined in this section to find out if there are a) similarities or differences between the dyslexic writers and the three writing types ('procedures') of the Torrance study; and b) whether there are any dyslexic patterns of writing which need to be commented upon.

All of the students produced a writing log while they were occupied in writing their essay. The data from these logs have been entered into a computer program which provides me with a breakdown of the total time and the percentage time that is spent on each of the aspects of the writing process.

Table 7: Percentage of Time Spent on Each Aspect of the Writing Process by Each Student

Student	Total Time in Minutes	% Time for Collecting	% Time for Planning	% Time for Translating	% Time for Revising	% Time for Neat/Proof
A	239	38.99	20.13	24.53	15.09	1.26
B	411	25.18	11.68	49.27	12.04	0
C	321	35.51	4.67	47.20	12.62	0
D	156	31.73	36.54	28.85	0	2.88
E	267	13.48	21.91	37.08	16.29	11.24
F	666	13.29	7.43	46.85	32.43	0
G	216	36.11	11.11	33.33	17.36	2.08

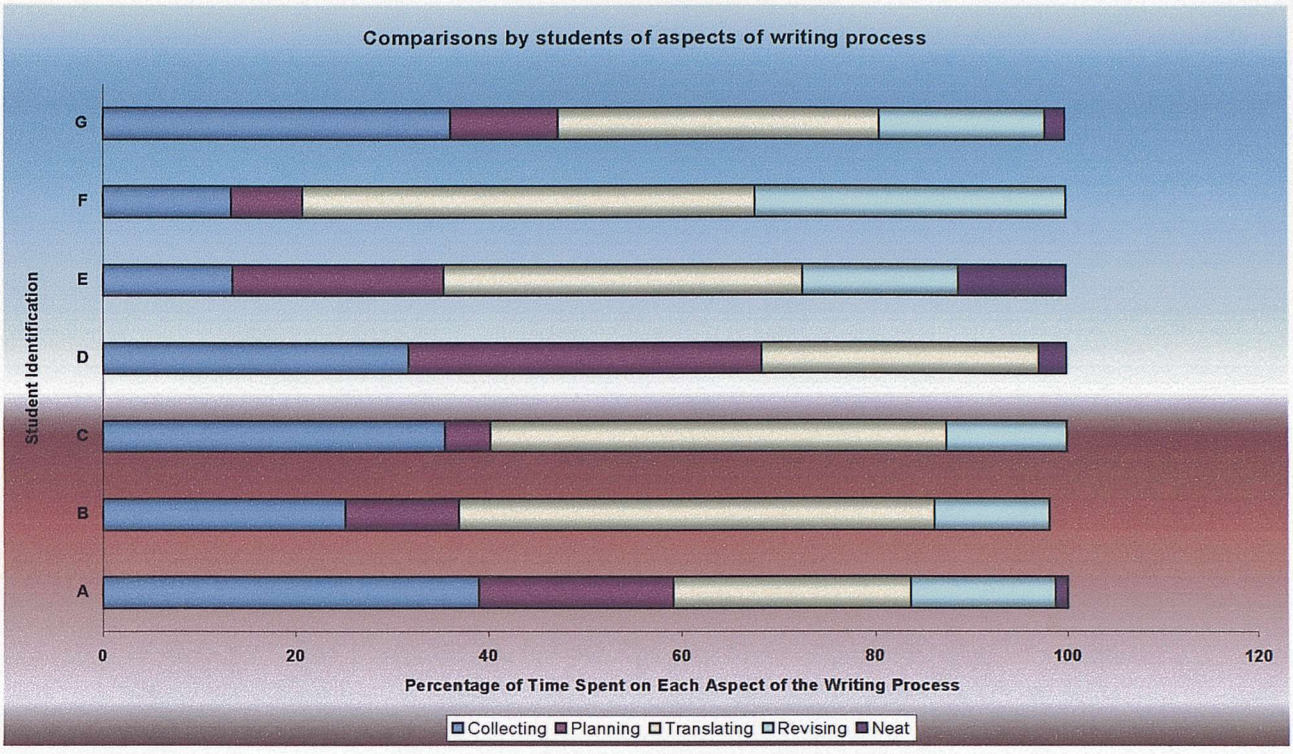


Fig. 36 Inter-student Writing Process Comparisons

Figure 36 clearly demonstrates that no single dyslexic writing profile has emerged. Nor was this to be expected given the variety and range of difficulties and deficits shown in the psychometric profiles. Indeed, what it does illustrate is the individual differences of the dyslexic students. However, on closer examination of the five components of the writing process, there are certain features worthy of note.

6.5.1 Collecting:

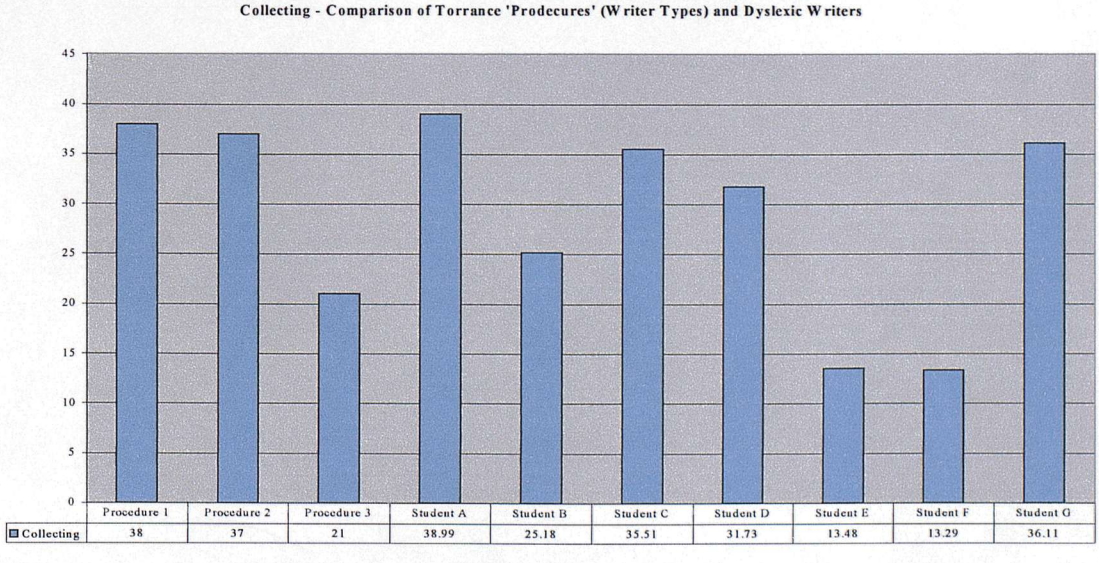


Fig. 37 Collecting – Comparison of Dyslexic and Non-dyslexic Writers

As Figure 37 exemplifies four of the seven students in this investigation spent more than 30% of their time collecting information for the assignment. This involved reading and searching textbooks, articles, web sites and various types of notes. It also entailed making notes from these sources. These activities rely upon lower and higher order functions as well as working memory, language processing and speed or automaticity in simultaneous processing. Any deficits in these areas will slow down fluency and will increase the overall time spent on this aspect of the process at the expense of other components in the process. Although there is little difference between the dyslexic writers and the three types of writers (categorised as different writing 'procedures' by Torrance) in the Torrance study for this component (see Fig. 37) , this aspect needs to be taken into consideration in relation to the other components of the writing process for the dyslexic writer in order to examine whether the dyslexic profile has had an impact upon performance.

6.5.2 Planning:

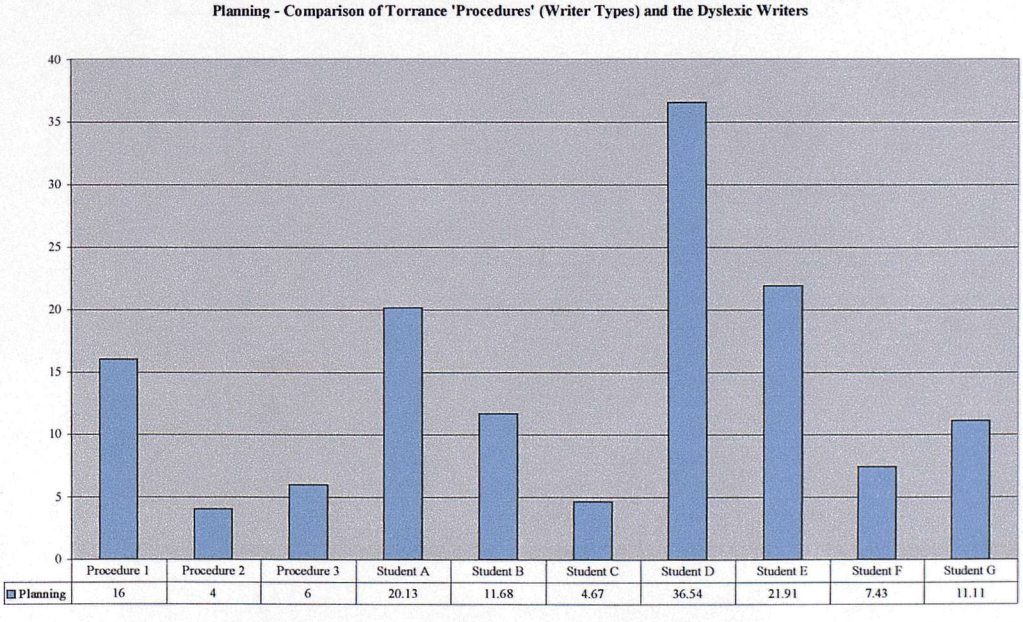


Fig. 38 Planning - Comparison of Dyslexic and Non-dyslexic Writers

The students spent between 4.67% and 36.54% on this activity within the whole process. A comparison between the data in Figures 37 and 38 demonstrates,

Students A, B, C and G spent between 13.5% and 30.84% less time on this aspect than on collecting information. Student E spent 8.43% more time planning than he did on collecting information. While Student D spent almost one third of his time on collection and another third on planning, these two activities represent a major part of his writing. (This will be explained in more detail in the individual analysis.) Student F, however, spent 5.96% less time on planning compared with collecting. However, it should be noted that these two aspects of the process only represent 20.82% of her overall time.

Planning encompassed thinking about the content and what to put into the essay. This involved making structural plans or outlines for the whole essay (on a macro level of planning) as well as thinking about the inter-structural aspects (on a micro level of planning paragraphs and sentences). This activity taps into visual perceptual organisation as well as the central executive part of the working memory. With the exception of Students A, D and E, the dyslexic students did not allocate much time to this aspect of the process. A closer examination of the individual student activities will shed light upon this and help to analyse whether these students are adopting compensatory strategies to alleviate the storage/capacity difficulties which this activity places upon working memory.

6.5.3. Translating:

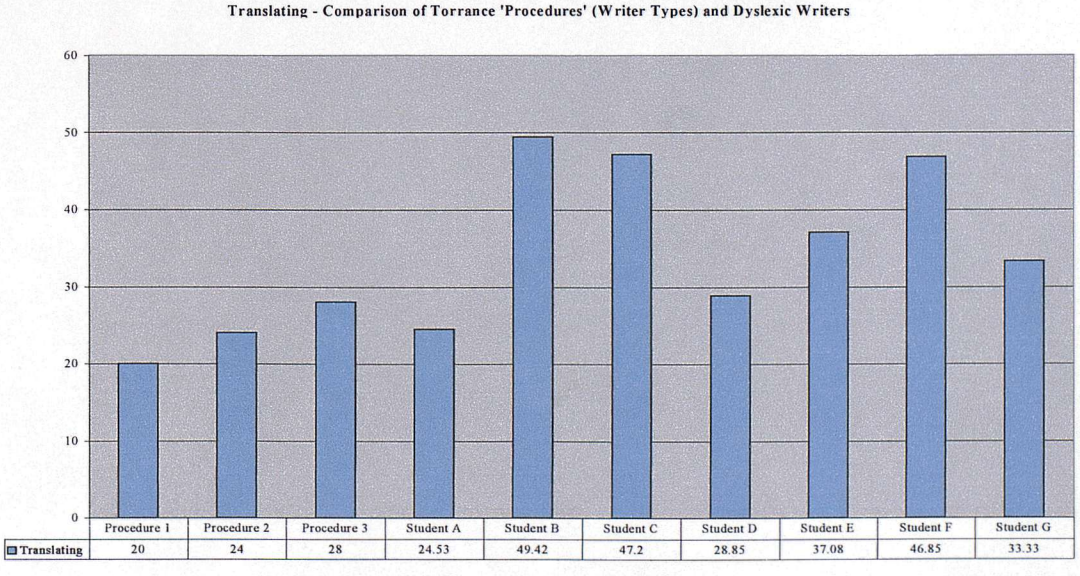


Fig. 39 Translating - Comparison of Dyslexic and Non-dyslexic Writers

Five of the dyslexic students, Students B, C, E, F and G, spent a longer time on this activity than the students in the Torrance study. Student B spent almost 50% of the total time on her assignment engaged in this part of the writing process (49.27%); While Students C and F spent 47.2% and 46.85% respectively on this activity. This represents a considerably longer time on this component than any of the writing types in the Torrance study who came out at between 20% and 28% for this activity. Even Students E and G spent proportionally more time on translating compared with the Torrance writing types at 37.08% and 33% respectively. Not only do these percentages differ from the Torrance writing types but the percentages represent a significant percentage of the total time spent on each assignment for the students in this study. It can, therefore, be said that, for these five dyslexic students, translating is the most time-consuming part of the writing process. It is not surprising that this should be so when the higher-order skills and the cognitive resources for this activity are taken into account.

6.5.4 Revising:

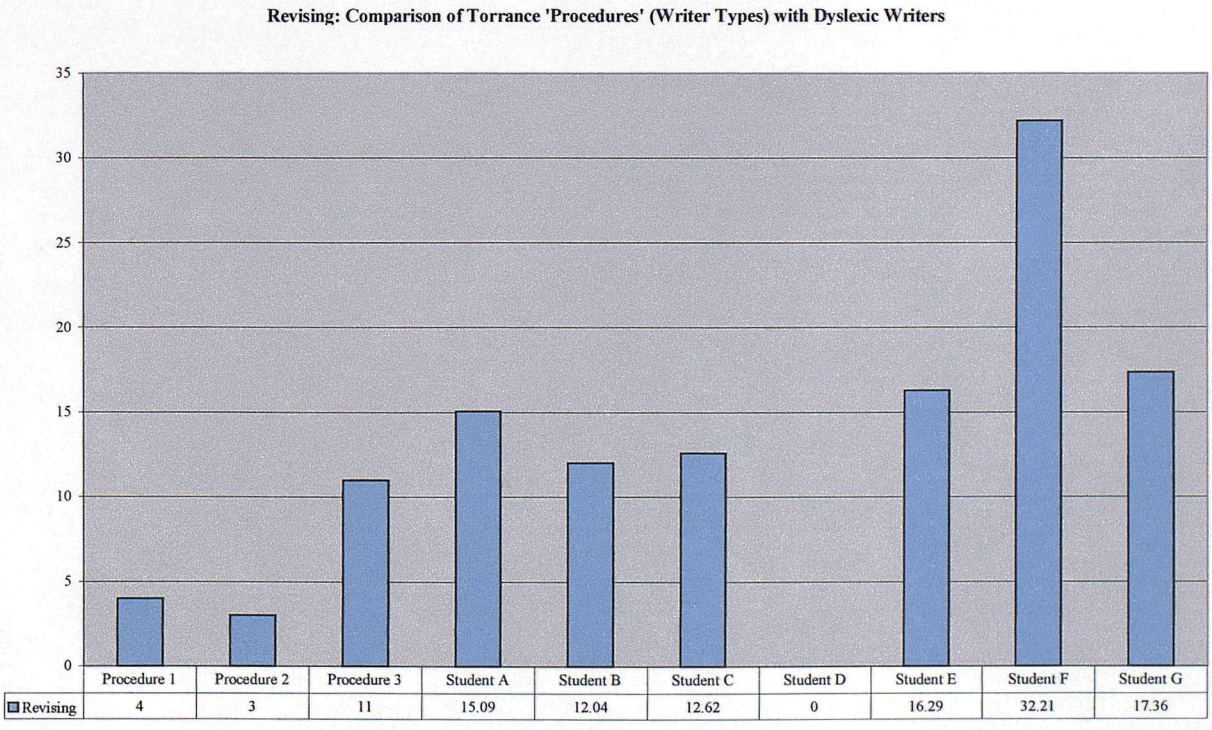


Fig. 40 Revising - Comparison of Dyslexic and Non-dyslexic Writers

Student D's nil score may seem unusual but it has to be taken within the context of his writing assignment. He was asked to produce a summative written essay which was based upon a poster presentation which he gave to his year group the previous month. This had implications for his writing behaviour which will be explored in the individual student activities.

Students A, B, C, E, F and G spent longer on this component than any of the Torrance writing types. However, many of these students are closely allied to Torrance's procedure 3 writers, and, with the exception of Student F, the additional time spent is not significant.

The reason why dyslexic writers may spend up to three to four times the amount of time on revising their work, compared with Torrance's writing types one and two, could be that revising and editing rely heavily upon sound linguistic skills and the ability to retrieve language effectively from long term memory – skills with which many of the students experience difficulty.

The great difference in time spent on this activity by Student F can be accounted for in her very individual approach to organising her written work and the collecting of information for essay writing. This will be explored in more detail in the section on individual writing behaviours.

6.5.5 Neat Copy/Proofing of Work:

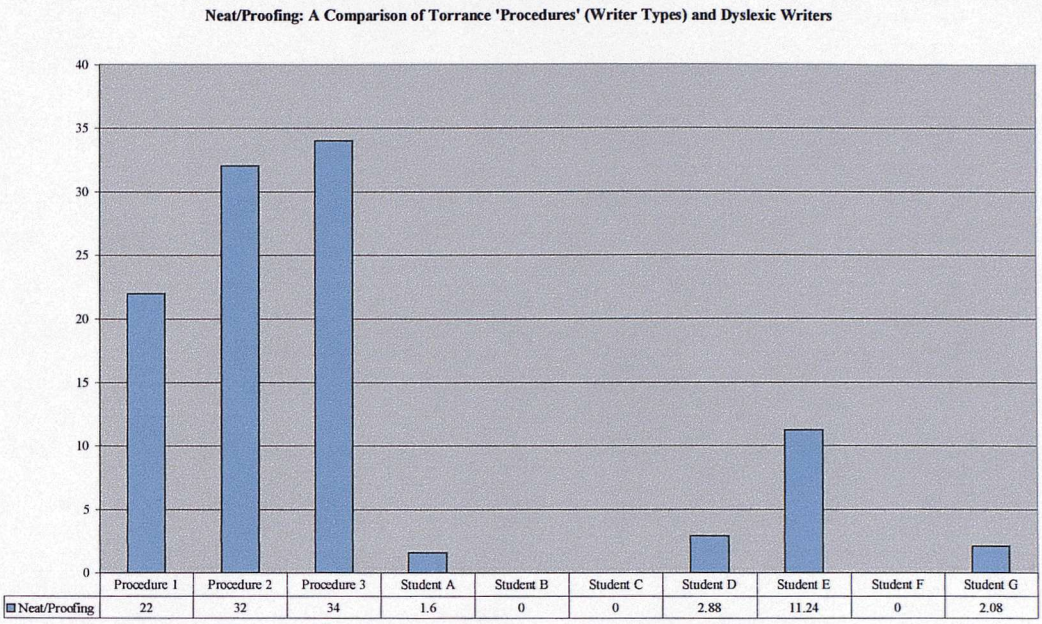


Fig. 41 Neat/Proofing - Comparison of Dyslexic and Non-dyslexic Writers

This chart shows the most significant differences in writing behaviour between the non-dyslexic students in the Torrance study and the dyslexic writers in this investigation. Three of the seven students spent no time at all on this component while a further three (Students A, D and G) spent between 1.6% and 2.88% on this activity. Although Student E spent 11.24% of his time on neat copies, this still represents approximately 50% less time than the lowest score of the non-dyslexic writers.

This can be accounted for almost entirely by the strategies the dyslexic students adopted and the use they made of technology to compensate for their dyslexic difficulties. This will be further examined in the section on writing behaviours of the individual, dyslexic students.

6.5.6 Summary:

Comparisons between the Torrance non-dyslexic writer types and the dyslexic students in this study demonstrate that no clear picture has emerged. None of the dyslexic writers conform exactly with any of the three Torrance writer types.

However, when judged by certain components of the writing process, some similarities become evident between individual dyslexic students.
There is no evidence to point to a clear-cut dyslexic writing profile. However, some of the differential percentages of specific components of the writing process need further explanation.

6.6 Is there a link between dyslexic cognitive profiles and the components of the writing process?

It is important to examine the data to ascertain if there are similarities between clusters of psychometric scores and time spent upon different aspects of the writing process to find out if the dyslexic cognitive profile has any effect upon writing. Some patterns have emerged.

The previous section has demonstrated that the dyslexic writing behaviours often do not match the findings of the Torrance study. It has been posited that weaknesses in working memory capacity and storage, language retrieval difficulties and the speed of information processing will affect the writing behaviour of the dyslexic student. The data suggest that if students present with significantly low scores in these areas ***coupled with*** observable discrepancies in their spelling and reading performance scores, the result is that they spend a considerable proportion of their time in the translating component of the writing process.

	A	B	C	D	E	F	G
Arithmetic	0.07	0.11	0.8	0.06	0.13		0.07
Digit Span	0.12	0.04	0.06	0.05	0.07	0.08	0.07
L-N Sequ.		0.06	0.07	0.05	0.11		
Coding	0.06	0.08	0.6	0.05	0.1	0.04	0.06
Symbol	0.05	0.06	0.06		0.13		0.06
Spelling	0.14	0.09	0.09	0.34	0.09	0.1	0.62
Reading	0.47	0.37	0.37	0.79	0.16	0.27	0.1
Translating	24.53	49.27	47.2	28.85	37.08	46.85	33.33

Table 8: Comparison of Working Memory Capacity, Speed of Processing, Literacy and Percentage of Time spent on Text Generation (Translating)

The table above demonstrates that there are similarities between Students B, C, F and G in these areas. Students B, C and F spent approximately 50% and Student G 33% of the total time on *translating*. Student G's quantified time, however, may not be representative of his 'real' performance time: in interview he stated that this aspect of writing takes up a high proportion of his energy but it was not reflected in the quantitative writing log because of his individual way of working whereby he spends periods of 'rehearsal' (working out what he wants to say and translating into linguistic structures) in non-traditional places which could not be recorded on his log. So, for example, he engages in this activity while in the car on his way to work or as he goes around the supermarket. Thus, this student may have devoted a similar percentage of his overall time to translating in line with the other students.

On the other hand, Student D has a similar psychometric profile for his working memory capacity and storage, together with his speed of information processing. What is different with this student is that his literacy performance (spelling and reading combined) would be considered adequate for many HE students (although they are unexpectedly low for one of his overall IQ ability). This student spent 28.85% of his time on translating, and this represents the lowest time he spent on any one aspect of the overall process. Similarly, Student A's weak processing speed (scores of 0.06 for Coding and 0.05 for Symbol search) has to be set against more robust performance scores on reading (47th percentile), spelling (14th percentile) and working memory storage (Digit Span 0.12).

These results suggest that it is the combination of low scores in specific area of the cognitive profile in conjunction with the weaknesses in spelling and reading performance which have an effect upon the translating performance of some dyslexic students.

6.7 Individual Writing Behaviours:

This section draws together data from the real-time writing logs, the semi-structured interviews and the students' drafts and final copy. Thus, not only does a detailed picture of writing behaviour emerge but also how the dyslexic student perceives the process.

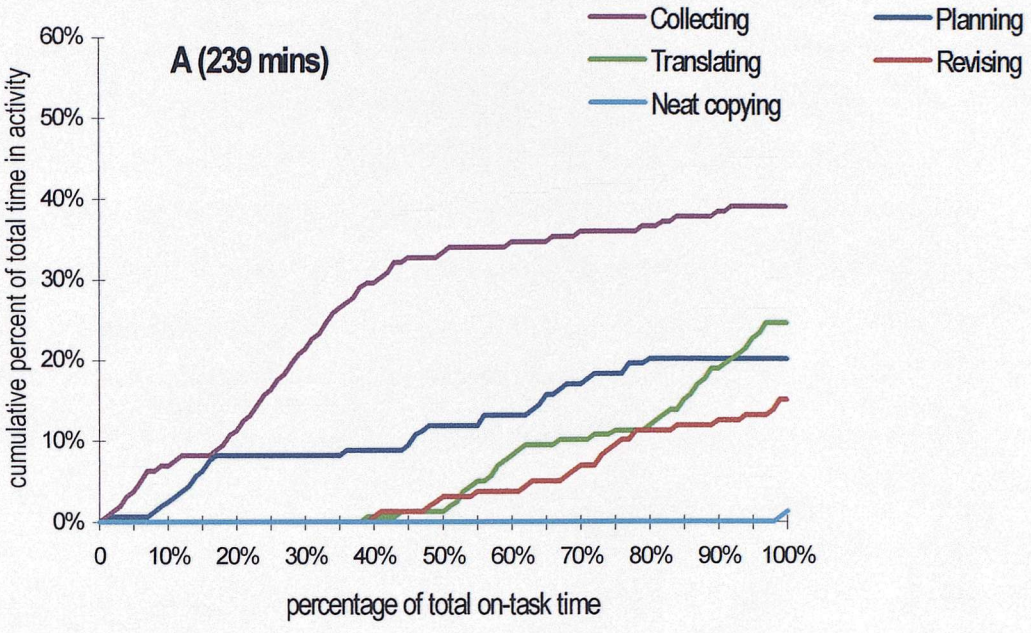
For each student there is a graph describing the cumulative percentage of total time spent in the different activities. This is plotted against the percentage of his total writing time. These data have been produced by the program which Torrance kindly allowed me to use to measure time on task and, more specifically, time on the different components of the writing process. The graphs provide a visual summary of writing behaviours. More detailed analysis and discussion is derived from the data available in Appendix 6.

6.7.1 Student A:

The writing task for Student A, a first year undergraduate Sports Studies student, was challenging. He had to examine two journal articles about Exercise Physiology and comment upon the findings.

It would appear that his writing behaviour is affected by his perception of himself as a writer and his knowledge of what has proved difficult in the past. Thus, he adopts a flexible approach to the writing process: he stated that he never goes about writing essays in the same way but that his behaviour is determined by the task.

> "It depends on the essay what I do when."
> Appendix 3 (i)



Collecting	38.99%	Planning	20.13%
Translating	24.53%	Revising	15.09%
Neat	1.26%		

What the statistical information highlights is that Student A mainly concentrated upon one aspect of the process at a time (Appendix 6,(i)). He appeared to engage in little multi-tasking which would have called upon working memory capacity and storage. The data showed the recursivity of his writing. Student A frequently revisited his structural plan, in part to revise as his text emerged and his thoughts developed but also to compensate for memory deficits, in that he needed to remind himself of his plan and the task.

He did some initial, somewhat unfocussed, reading in the library to help him to understand the term 'Exercise Physiology' and then did an initial structural plan. He then spent a considerable time in the 'collecting' phase when he read the two articles and made some notes. The 'translating' and 'revising' phases were then closely interlinked. Once he started on the 'translating' phase he formulated a sentence, read through this to see if it made sense and then returned to the articles to double check that what he had said was accurate according to what the authors had written. He

also revisited the original articles to ensure that he had used the technical terminology correctly. This, in turn, led to some further revisions both in his own text and in his structural plan. It clearly demonstrated the behaviour of a student who was unsure of language and who needed to reassure himself constantly that the language of his own text was accurate and understandable to others. It was a somewhat laborious method of working but one which may have been necessary if linguistic ability, phonological ability and language retrieval were weak. The constant need to refer back and forth between his own text and that of the two journal articles indicated not only uncertainty of language usage but also that his executive resources were quickly overloaded.

He appeared to spend time off task and, when questioned later, he stated that he was surprised by the number of apparent 'day-dreaming periods' which emerged in the log. However, on further probing he explained that he was trying to understand what he had written and to make sure that it said what he thought it said. This demonstrated that he was aware of his language processing difficulties and that he was unsure of his writing ability.

The interview data showed that the language processing deficit, taken in the context of this task, shaped his writing behaviour because it affected a) his ability to comprehend text, the speed at which this is performed and his need to constantly read and re-read information; and b) his ability to generate text effectively. Despite the fact that the reading for this task was limited to two journal articles, and, therefore, should have put less strain upon organisation and the central executive, he spent the greatest percentage of his time collecting information and making notes from these texts. Both of these activities rely heavily upon language processing abilities on input and output, also tapping into both slave systems of the working memory, viz. the phonological loop and the visuo-spatial sketchpad.

> "Understanding the articles we were given was hard because there was a lot of well (long pause while student searches for language to express himself) words. I mean really technical words to remember."
>
> Appendix 3 (i)

He was aware of deficits in this area for he noted that 'the reading seemed to take ages'. He stated that the reading was 'difficult because of the long technical words but I just kept reading and re-reading the papers.' Language processing difficulties also had an impact upon the ability to summarise information.

These difficulties were *compounded by* the deficits in working memory and became apparent when he had to generate text. He was unable to do much rehearsal before getting his thoughts down and did not have the sense of a whole paragraph.

> " I don't have a sentence in my head before I write it down. I put little bits down...."
>
> Appendix 3 (i)

Thus, he was not able to switch between macro and micro constructions because of limitations in memory capacity. Added to this was the frustration of not being able to retrieve the word which he wanted:

> "But sometimes I get annoyed with myself because I know what I want to say but the words won't come. I mean I can't seem to remember the word I want and it is frustrating trying to remember the word."
>
> Appendix 3 (i)

'Revising' for this student took on a specific activity and not the traditional making changes to the original text. He stated that he found this difficult – 'I don't think I spend a lot of time editing. Quite a few sentences will stay the same' – and this may have been because of his language storage systems which made language retrieval frustrating and time-consuming. Consequently he did not attempt a number of drafts. Nor did he appear to spend much time on proof-reading/neat copying (1.26%). He tended to rely upon the spelling and grammar checkers on his computer to help him to identify errors, which he rectified as he went along, rather than as a discrete phase at the end of his essay.

Student A was aware of genre writing from his experiences of support at school. However, this knowledge of macro structure placed Student A under pressure because it resulted in a mismatch between knowledge of what was expected and

weaknesses in his internal resources. This may account for the amount of time spent constantly revisiting/revising of his plan.

> " I did quite a bit of juggling and the hardest thing about this essay was the whole structure."
>
> Appendix 3 (i)

He knew he was expected to synthesise information from the two articles but was critical of his own ability to do this:

> " I find it quite hard because it is more like looking behind it."
>
> Appendix 3 (i)

Compensatory strategies:

Student A had developed few strategies which was surprising, given that he was identified at a young age and received individual tuition for many years prior to entry to HE. He was not a sophisticated user of technology and used his computer in a simple fashion, rather like an electronic typewriter. His notes were done in long-hand and then information transferred into text. He realised the need to make notes to support weak memory capacity – 'I have to make notes because I would forget what one person has said.' He did not use bullet pointing as a technique for note-making. However, he did photocopy sections of text which he thought would be of use to save time in note-making. Photocopying was a technique which he was taught when doing his 'A' levels and was used to supplement weak summary skills and poor grapho-motor skills. He did not use the internet to kick-start his comprehension of the subject but rather preferred the traditional approach of going to the library.

Nevertheless, some of his unconscious behaviours during the writing process suggested that he compensated for his weaknesses. For example, he realised that he needed to work on his text 'in little bits' in order to compensate for weak working memory. He was aware that the background reading was time-consuming for him but he appeared to have developed no strategies for coping with this.

> " I don't seem to have enough time to read them (course texts). I have them out of the library but often take them back late."
>
> Appendix 3 (i)

He had a superficial knowledge of essay construction and structure but his whole approach was still rather 'piecemeal'(Appendix 3, (i)). There was a gulf between his knowledge of what was expected and the strategies he needed to adopt in order to ensure greater efficiency in writing. This may be a reflection of the fact that he was a first year student who was still operating at the novice stage of writing.

Despite these cognitive deficits, the final essay would not have given any indication that the text was that of a student with language processing difficulties, and it is this which is most perplexing for tutors who are marking his work.

> " I believe that the sports physiology experiment is the superior of the two. It has used a sound methodology and provided quantifiable results that are statistically significant and can now be applied to training and enhancing sporting performances among athletes. In contrast the human physiology investigation only showed whether GLUT-1 could be produced in adult muscle fibres."
>
> Sample of finished text – Appendix 7 (i)

As can be seen from the above sample of text produced by Student A, in his essay his sentence structures are complex and the paragraph has some degree of cohesion. However, going beneath the surface with the real-time and interview data, a more accurate picture emerged of this student's writing behaviour which was clearly linked to his cognitive deficits. The student had taken a proportionally longer time to complete his essay and produce language which was acceptable. It is this aspect of the writing process which is hidden from the academic tutor.

6.7.2 Student B:

The writing task for Student B was more typical of the type of essay which first year students in HE are expected to engage in. Her essay title was ' Should I give my child the MMR vaccine?' Students were asked to refrain from tackling the essay

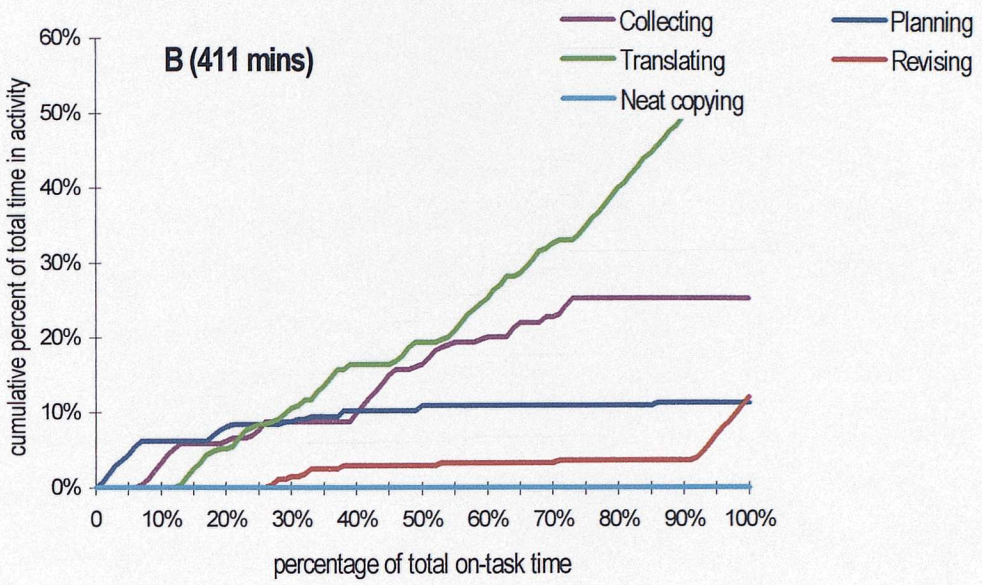
from a biological viewpoint but rather from the ethical, societal and patient perspectives.

Student B had the advantage of knowing what was expected by her tutors because she was re-sitting her first year after failing to obtain the minimum grades in the core modules of her medical course. She is a reflective learner and is aware that in the past her essays did not flow very well. As a result of her recent identification as a dyslexic, she was making great use of the tutorial support which is provided by the Disabled Students Allowance (DSA). This student presented as having severe dyslexic difficulties which affected both oral and written language production. She had significant sequencing difficulties which affected her ability to process her thoughts at speed and which also had an impact upon the sequential elements of sentence and paragraph construction. She had frequently been disappointed with the low marks she obtained, considering the time and effort she put into all of her work. She was also concerned that the final product did not mirror her knowledge and understanding.

Having failed her first year, Student B was understandably anxious that she did well and as a result was more conscious of the need to develop strategies to improve her writing skills.

> " I did my first essay and I did really badly because I didn't know how they wanted it to be written or I didn't know the language and things like that."
>
> Appendix 3 (ii)

Thus, she was a very strategic writer, and this would be demonstrated by her high level of use of technology. There was frequent evidence of recent study skills tuition in the way Student B approached writing.



Collecting	25.18%	Planning	11.68%		
Translating	49.27%	Revising	12.04%	Neat	0%

Student B started by analysing the title of her essay to ensure that she was aware of what was required of the task. This was essential and would ensure that she remained on task more effectively throughout the whole process, from collection of relevant information to text generation. She then carried out a small amount of initial reading to help to obtain a global picture before she began to plan. Her plan was very individual in that she used the plan as a personal organiser for the way she went about all aspects of the writing process and as such it was a crucial component. She spent the first 12% of the total time in collecting and planning. During the text generation stage, she frequently moved between her own text and checking her sources. She had to spend a disproportionate amount of time on translating because of the severe language processing difficulties and memory capacity deficits she experienced. Most of the time she worked on one aspect of writing at a time but for short bursts of time in the early stages she was able to work simultaneously on a maximum of three operations but more often on two – a combination of planning, collecting and translating. Translating and revising often took place one after the other.

What was significant with this student was that she had developed a particular method of planning to enable her to compensate for organisational difficulties at all levels so that she could balance the overall structure of the essay in terms of cohesion and the relationship of paragraphs within this structure (macro organisations) down to creating sentence structures (micro organisation). She uses a piece of software called Inspiration which is a mind-mapping program. However, she had adapted its use to support her weak sequential and organisational skills. This visual memory-jogger was a structural plan which was numbered in sequence of paragraphs or sections. Each section had one or two bullet points which provided the global picture for each of these smaller areas and would serve as a sentence prompter. In this way she moved from macro to micro organisation on a one sheet organiser.

Flow Chart Personal Organiser for Essay Construction

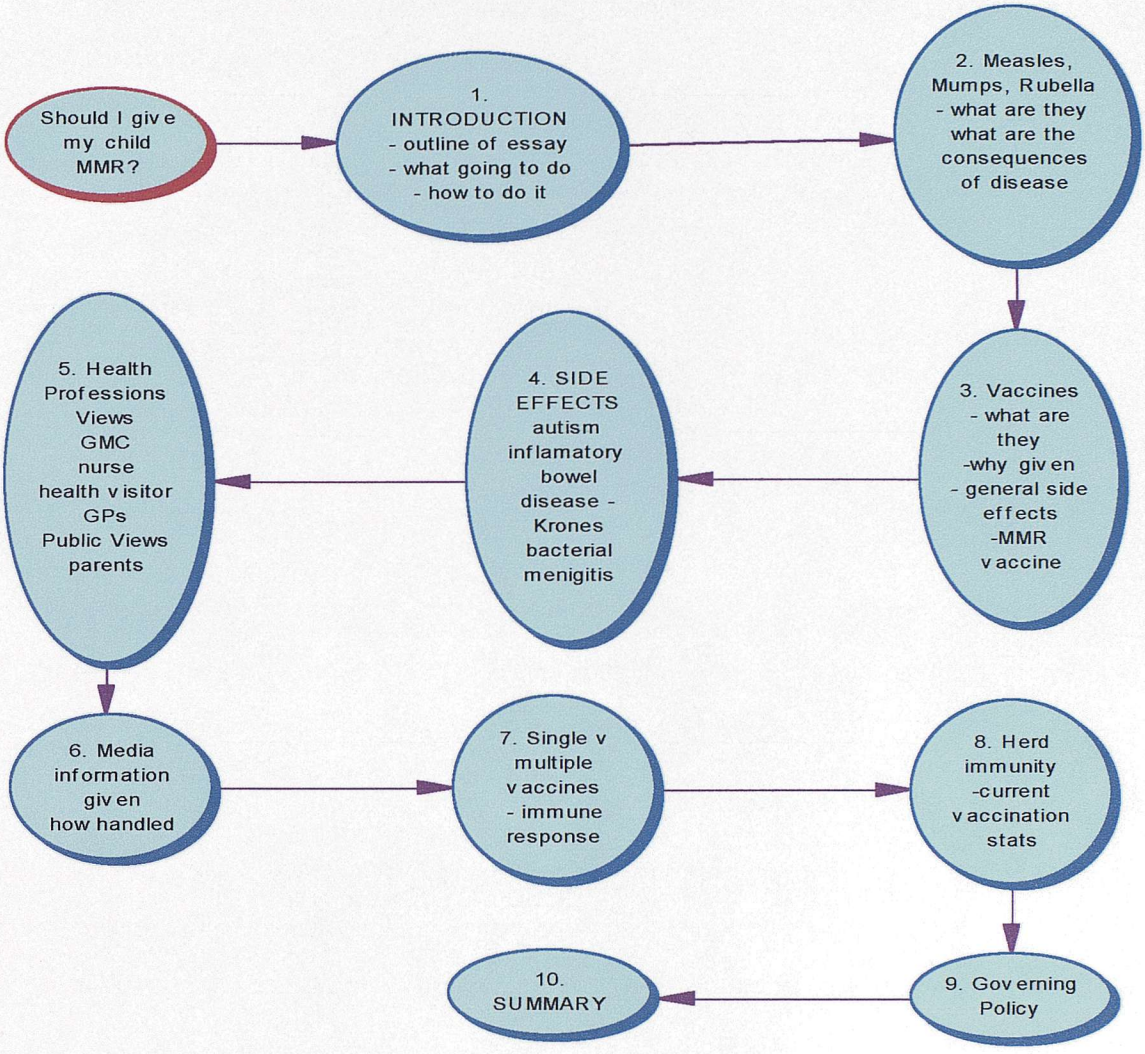


Fig. 42 Sample of Student Planning Strategy

She was then able to use this planner in a number of creative ways to compensate for her difficulties. She preferred to see bullet points because she felt that it made the reading and learning easier – 'it's psychological'. She stated that she also used this flow chart to organise her notes and put information she had collected in piles according to the numbers on her flow chart. This way she was able to cope with categorising the information physically because her memory capacity was such that she could not hold it all in her mind. She told me that in the past she made lots of notes on books etc. but then it took her twice as long to find the information when she was generating text for her essays.

Language processing difficulties were time-consuming for Student B. These problems were apparent in her speech which was extremely fragmented and disjointed (Appendix 3 (ii)).

> "I find it - 'cause I get really confused trying to work out .... like.... the written one I did for my tutorial I get all confused, so I like just using it, so that I do sort of like a flow (*chart)* so I know where I'm going."
>
> Translation of the above:
> I get really confused trying to work out and organise what I want to say. I had to do a written assignment for a tutorial and I got all confused. So I started using Inspiration (electronic mind mapping tool). I did a flow chart of my outline ideas to help me to sequence things so that I know where I am going.

Like many dyslexic people with linguistic deficits she was prone to making up her own words because she is unsure of word derivations.

> " they'll think I notate it." - example of made up word for 'make notes'.
>
> Appendix 3 (ii)

Dyslexic people often remember part of the rule and often, like young children in early language development, over-generalise the rules. Thus, she had a vague memory of the noun 'notation' and generalised the rule but took the wrong path to the verb and thus ended up with a new word – 'notate'.

She readily admitted that, when she was reading medical texts, she could 'get completely confused' to the point where she could not work out what the writer was conveying. However, her reading had improved since she was advised to use coloured acetates to remediate some of her visual perceptual difficulties. Nevertheless, these did not provide any support for her sequential language processing difficulties, which resulted in misconstruing of the texts:

> " Sometimes if I read a medical book I can confuse and what is true I'll have the opposite in my mind which I do find the most frustrating."
>
> Appendix 3 (ii)

She found that she had to set aside plenty of time when she was in the translating phase because she was aware that she needed to 'spend longer than an hour here or ten minutes ....'

The combination of weak language processing skills and memory capacity posed problems in terms of plagiarism. Firstly, she would be unable to decide which parts of her notes were her own language or that of others which she had copied word for word from the text books. Secondly, if she did realise that it was the language of others, she did not have access to a language storage system which would enable her to reformulate them into her own words. She was, therefore, constantly worried that her work would contain unintentional plagiarisms. Although she had been told that her writing lacks sound constructions she could not identify these and therefore could not edit her work effectively. To her the writing made sense.

Compensatory Strategies:

Student B made heavy use of technology to support her dyslexic difficulties. She always used a computer and no longer put her own text into long-hand because 'I would struggle to read my own handwriting'. She used:

(i) Voice-recognition software (VR)
(ii) Mind-mapping software
(iii) Coloured acetates
(iv) Talking spelling checker and thesaurus

i. VR was used by this student to help with sentence construction. She wrote a sentence and then had it read back to her by the computer. She found that if she heard what she had written she was more likely to spot any construction difficulties. However, it did not help her to identify made-up words. She had to rely upon the spelling checker for this. It was interesting that she could 'hear' the grammatical constructions but not the single words. This could be likened to the phonological difficulties of the dyslexic child who is able to cope with the global sound patterns but falls down at phoneme level or the micro level of word construction.

ii. As indicated earlier in this section, Student B used mapping/visualisation software for general organisational purposes and to support working memory capacity deficits.
iii. The coloured acetates compensated for inaccuracies in reading and helped to support her language processing difficulties.
iv. If visual discrimination skills are weak, then having a *talking* spelling checker would compensate for these difficulties.
Her highly strategic approach to writing has paid off so far. She is grappling with the many elements involved in writing at this level and has obtained a grade C for her work. She is disappointed with this mark because she spent six hours 51 minutes on the essay, and this did not include an initial library search and brain-storming activity. She informed me that most of her peers spent two hours maximum in writing. However, she has started to adopt more effective techniques which her specialist dyslexia tutor is exploring with her.

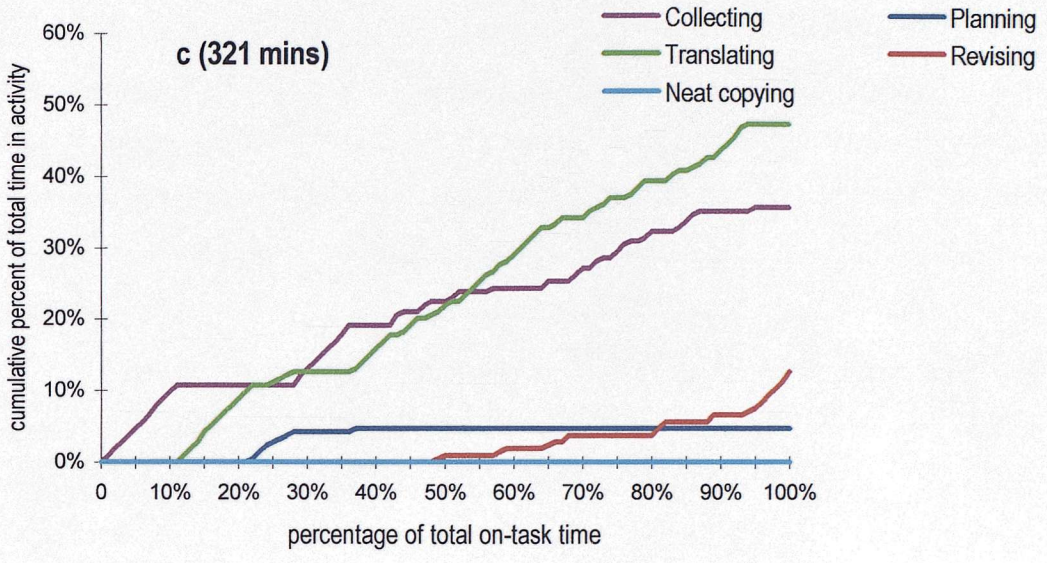
6.7.3 Student C:

Student C's task was chosen out of a number of essay titles because of her personal interest in the subject. The essay was entitled ' How can museums respond to the needs of audiences from diverse ethnic and cultural backgrounds?'

Student C carefully chose her 'A' level subjects on the basis of how much essay writing was involved. Consequently, she did not have the writing background which is expected of Arts undergraduates. She had always disliked reading, yet her reading performance, compared with some of the other dyslexic students in the study, is reasonable. Her reading accuracy is adequate but her processing of text is more vulnerable and this could be the reason why she shuns this activity:

> " I just don't read books. I'm still a member of the Beano Club! That's about the level of my reading."
>
> Appendix 3 (iii)

Student C



Collecting	35.51%
Planning	4.67%
Translating	47.20%
Revising	12.62%
Neat/proof	0%

She was a non-strategic worker and tended to adopt a 'stream of consciousness' approach to writing, which for her was an organic process – 'just let it flow'. She was a sequential writer and rarely tackled two aspects of the process at the same time (Appendix 6 (iii)). However, she would occasionally combine thinking about the content (planning) with drafting her work (translating). She did not think about planning much because she is 'not very good at the whole plan writing thing'. Consequently, she spent the early part of the process in the library on the WebCat, looking for reference books which she could take on loan. This was a slow process for her because her search skills were poor. This was understandable because advanced search skills rely heavily upon sound linguistic skills. One of the reasons why she spent so much time on the collection phase (35.51%) was because a) she

had difficulty deciding which books were relevant to her essay; and b) she spent time deciding upon the pages which she needed to photocopy from the texts. Both of these rely upon language processing and storage resources. Having spent considerable time on identifying appropriate reading resources, she did not feel that she had sufficient time (or the inclination) to make notes from the texts. She, therefore, preferred to cut out this aspect of data collection. Her perception of note-taking/making influenced these decisions. She believed that notes were to help the student concentrate (in lectures) and had not understood the difference between note-taking and note-making activities. She also freely admitted that she was spoon-fed at school, and her teachers gave her notes so that she had never had practice in developing the skill. Another reason why this phase took up so much of her time was that she was not processing the language effectively and had not developed any strategies to compensate for her weak working memory capacity – ' I'll sit there for an hour and I couldn't even tell you what the title was.'

Perhaps the reason she spent so long on the translating phase (47.20%) was as much to do with her way of working as it was to do with her dyslexic difficulties. Whereas some students (for example, Student F) spent a similar amount of time on this aspect, they have developed many compensatory strategies to optimise their time. Thus, it could be said that such students have a greater degree of difficulty than Student C. Her way of working appeared chaotic and disorganised. Once she started to draft her work, she was surrounded by the chosen reference books and her photocopied pages. She delved into these as she wrote, and they supported and triggered language for her. She was aware that what she wrote was not always effective:

> " the trouble is that a lot of the time it (own text) makes sense to me but it doesn't to anybody else."
>
> Appendix 3 (iii)

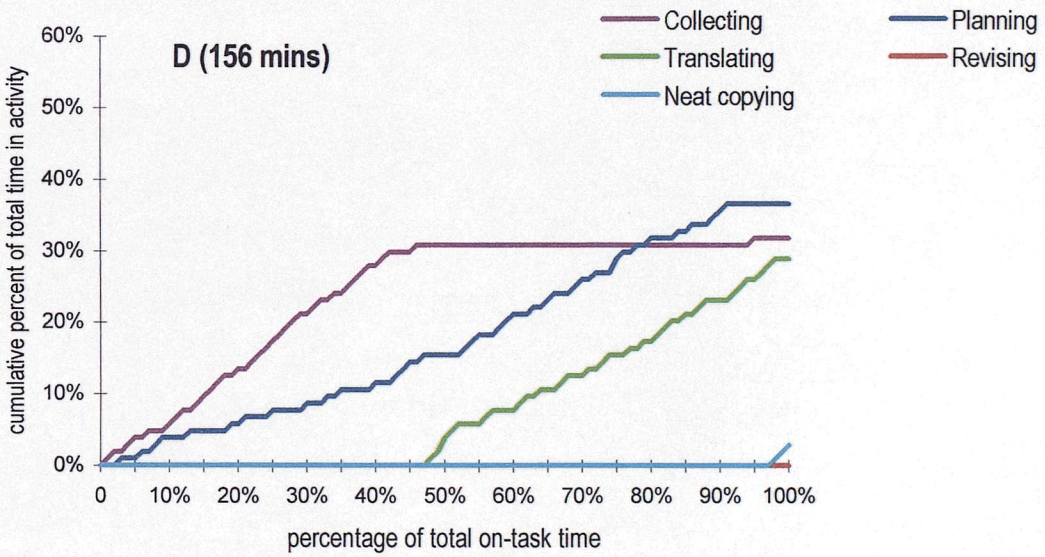
She admitted that she did not carry out much revision or editing of her work. She would leave a day in between finishing her essay and checking it, so that she could come to it fresh. She did not make many changes and relied upon the grammar checker on the computer to help her to revise her work. It would appear that her

organic approach to writing is in part at least the result of lack of knowledge of techniques which could support her dyslexic cognitive deficits.

6.7.4 Student D:

Student D's task was to write up his poster presentation, entitled 'The Convention of Biodiversity: The Bio-safety Protocol'.

Student D spent the least time on his written task (156 minutes) compared with other students in this study, and this can be explained by the fact that he had to write up his poster presentation which he had already done for his year group. In this sense, this is not a typical picture of how he tackles the writing process because he had previously collected much of the information he needed for his essay in preparation for the poster production.



Collecting	31.73%	Planning	36.54%		
Translating	27.85%	Revising	0%	Neat/Proof	2.88%

Student D worked sequentially and had some activities alternating, for example, reading references and making notes; reading references and making decisions about the relevance of the information for his set task (Appendix 6, section (iv)). As the graph shows, planning activities were pivotal to collecting and translating. He spent

the first 46% of his time in collecting and planning activities before going on to translating. This may have been accounted for by the particular task he was engaged in and because he needed to revisit his poster presentation, collect what was needed and plan how he was going to use this information for his current task.

Although his log recorded periods when he appeared to be off task, he explained that he needed to allow his brain time to process information before going on with something else. Hence, he was aware of his speed of processing and took steps to compensate for this difficulty:

> " I find the attention span sort of is, I've heard it said that it's very much like a wave, it sort of rises and it falls later on. I imagine an awful lot of these breaks are due to um, um I often ponder whether the actual strain of thinking uses up an awful lot of resources and it's a way of internal buffering and in actual fact you are processing stuff in the background but you are not technically conscious of it."
>
> Appendix 3 (iv)

This student has excellent verbal skills and is in the superior IQ range yet he found searching the Internet time-consuming because of his language retrieval skills. He was aware of his short-comings and worked around these effectively, which may have accounted for the grade A which he received for his essay.

His working memory capacity was very low when taken in relation to his verbal scores. To compensate for this and to ensure that he did not overload his capacity, he planned his work, both globally and at sentence level, as he went along. He preferred to make his notes on screen because the facilities of the word processor support those with working memory capacity deficits. Thus, he sorted his notes into the overall planned structure and worked out linking sentences that he could use when he came to the translating phase. His photocopied text notes were also highlighted and colour-coded so that information was categorised, and the decision-making/problem-solving processes were staged to prevent overload. His strong verbal skills ensured that he was able to summarise the information he had decided needed to be included. This was done straight onto screen immediately after he had read a section so that he did not forget what he had read. In this way he was able to

'convert it into phrases' ready for text generation and did not spend time editing his work because he went about the process differently. Much of his language formulation was done at the note-making stage (collecting) in conjunction with moving around his thoughts and ideas on screen in note form (planning). This would account for his writing profile:

> (describing his note-making techniques) " I go through it (his notes) and change bits and sometimes I even write a complete page of text, pretty much, in the margin linking everything together and then I'll print that up, fiddle with that on screen for a while and then often print it out again and go through."
>
> Appendix 3 (iv)

Another method of supporting his weak memory capacity was to have a small overall plan on hand while doing his reading and text generation. In this way he prevented himself wandering off task and ensured greater efficiency throughout:

> "I've generally got a scrappy bit of A4 which I've written the title on and sort of really rough plan and the highlighting of the sort of action and subject words of the essay. That's just an aid to memory so I don't end up when I'm actually taking notes, taking superfluous notes."
>
> Appendix 3 (iv)

He also had developed ways of dividing his essays into 'manageable chunks' so that things didn't come out as 'word soup'!

He did not feel that he had difficulties with language but had to take care because he knew that he was prone to retrieving words which looked the same but had a totally different meaning. For example,

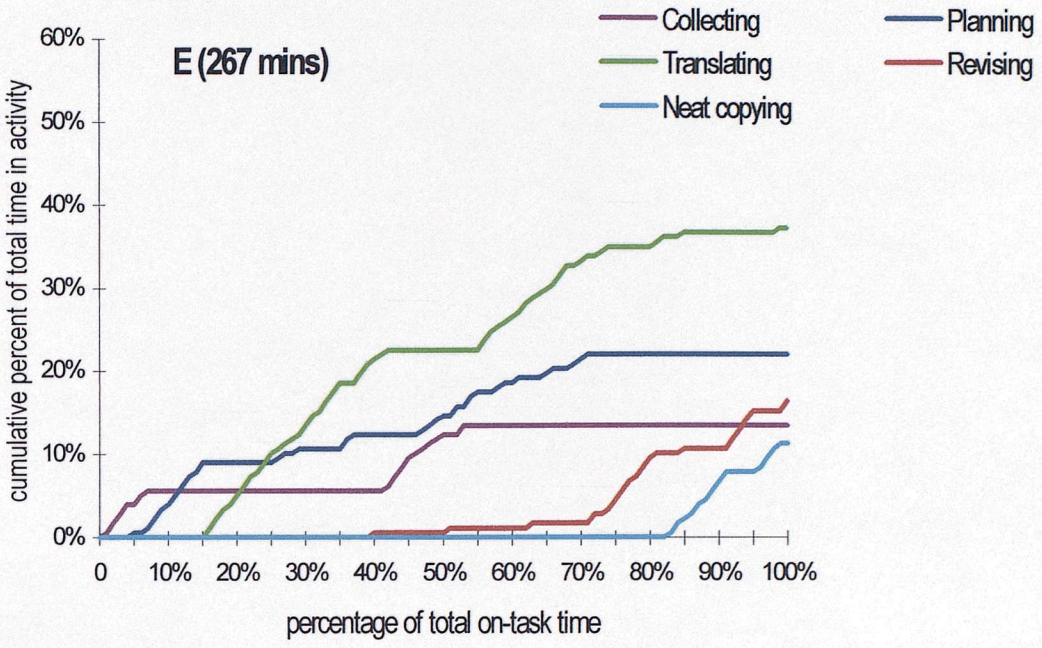
> " In writing an essay I do find that I have a tendency of putting bizarre, Freudian wordings. In my thesis at one point I had lowered 'humility' rather than 'humidity' which caused amusement which can be a bit of a problem".
>
> Appendix 3 (iv)

This method of building his essay through a thorough notes system meant that he spent little time editing and proof-reading his work because these activities had been evolving as he went along.

6.7.5 Student E:

The writing task for Student E was a final assignment for a Management in Engineering module and was entitled 'What is the relationship between accounting, finance and engineering? Do you think that engineers should be taught accounting as part of their university education?' The student chose this title because he felt that he could draw upon his personal engineering experience which would enhance the academic reflection and evaluation.

Student E's writing behaviour was, to some extent, shaped by his perception of himself as a writer. He was aware of his own short-comings and was keen to learn new techniques to help him reach his goal of a high 2:1 or 1st degree. He always wanted to be in control and therefore adopted a highly strategic approach to all his written assignments. I have worked with him for some time, providing specialist tutorial support and have been impressed by his desire to improve and develop his academic skills. Consequently, he listens carefully to advice, tries all the techniques he is taught and reflects upon the success or failure of the techniques he has used strategically.



Collecting	13.48%	Planning	21.91%
Translating	37.08%	Revising	16.29%
Neat/Proof	11.24%		

He was fascinated to see the graph of the writing log. He spent 4 hours, 27 minutes on an assignment on which his tutors told the group 'some might spend half an hour, with a maximum of two hours'. He had been taught task analysis methods and always started any written assignment by examining the question so that he understood what was wanted of the assignment. He then proceeded in an organised way by surveying what information he had which was relevant and then went through his lecture notes pulling out information which might be used when he came to the translation phase. This activity enabled him to take stock of what he had so that he could make decisions about what he needed to collect. As the graph demonstrates he went into a brief planning stage. This initial planning consisted of a brainstorm so that he could get a global picture, which he needed to drive his activities. Having established a macro structure for his essay, he took each of the components and did a separate brainstorm, breaking them down into simple bullet points. At this stage there was no sequence to the information yet he was conscious

of the need to ensure that all the pieces of the jigsaw fitted together in a rational way. He regarded his brainstorm as his 'working document' which he referred to at all times and which was frequently re-shaped as new information was found. This type of brainstorm also helped him to break down his assignment into manageable parts, which he worked upon separately before bringing them all together in the translation and revision phases. In a sense, he was compensating for memory capacity and storage deficits by ensuring that he did not overload his systems. Thus, each small section was treated as an ecosystem which stood alone during the initial stages of formulation. This would explain why there was greater convergence on the graph of each activity because he did his collection, planning and translating for one section before repeating this process with the next. This method of working, therefore, explained the break-down of his time allocation during the writing process.

His anxiety about writing was apparent and fear of the blank page syndrome, a period when the writer cannot get started, pushed him into an initial burst of writing:

> "It's daunting because you'll sit there looking at a white screen and how do you physically start?"
>
> Appendix 3 (v)

It was, therefore, important psychologically for Student E to get the text generation process started early so that he could trigger the other aspects of the whole process. Because he worked on one section at a time and almost in isolation from the other sections, he had bursts of text generation activity, interspersed with going back to his sources for information (mainly from the internet) and making adjustments to his plan.

Thus, he demonstrated the recursivity of the whole process. When he was collecting information from different sources, he was conscious of the need to grab language to help him to formulate his own sentences. He, therefore, copied information from the internet into his files (which were carefully labelled for each section) or photocopied sections from articles and books.

> "I can use that sentence, reconstruct it and then use that for my paragraph."
>
> Appendix 3 (v)

This style of working may result in more time spent on the translating and revising phases because he had to refine and polish other people's language to make it his own (to ensure that he is not accused of plagiarism). However, this placed pressure upon processing and working memory capacity. He was aware that the sentences or paragraph did not flow but he could not always rectify the errors because he could not retrieve a better word.

> " at times it's not flowing (his writing) it's not.... It's patchy; it's not worded correctly, things are the wrong way round, you know."
>
> Appendix 3 (v)

Although the brainstorm plan was pivotal to his work, he found the construction of sentences – the expansion of his bullet point – the most time consuming and difficult.

> "It's a lengthy operation going from the bullet point to the final paragraph."
>
> Appendix 3 (v)

His lack of confidence in his reading comprehension often dictated his behaviour. He had been taught the significance and importance of using key words to support hesitant phonological skills and to increase his ability to access text efficiently. Thus, he got a quick overview of information from different sources and made a decision, based on his plan, as to whether it might be useful. He then simply gathered up the information and categorised it according to the sections of his essay, for use at a later stage.

> "Anything that could be useful I got and then stapled them together and left it on the side."
>
> Appendix 3 (v)

Compensatory Strategies:

Student E was aware of his difficulties with simultaneous operations, and his method of chunking – found in his collection of information as well as his text generation – was a useful compensatory strategy to get around this without draining his cognitive resources. Student E is a sophisticated user of technology. His search skills are advanced and, for example, he uses the Adobe Acrobat 'find' facility to search for key words to compensate for his perceived hesitant reading skills. He preferred to access e-journals to save time on note-making. Like other dyslexic students, he photocopied chunks of text as part of his note-taking/making procedures because he found formulating language for his own notes time-consuming and laborious. E-journals allowed him to cut and paste information into his electronic files and draft text, and this cut down on his time.

His electronic brainstorms provided the sub-headings and bullet points to get him started with text generation which took pressure off him and helped him to construct language more efficiently than he would otherwise – 'It gives me a starting position.' He had recently started using TextHelp software to support his weak proof-reading skills. He explained that he could not spot his own errors but if he had sections read out to him by the software he could more easily identify what needed to be changed. His draft copies also showed that he was able to use the spelling and grammar checkers to proof-read his work and to help him with editing.

He realised that he could become bogged down with language and information and therefore he needed to be highly organised to ensure that this did not happen. A simple, but effective, strategy was the use of two tables in his study. One housed his computer and accompanying hardware; while the other had all of his notes printed out and set aside in different piles so that the information was gathered together, ready for the translating phase. Each pile had an enlarged print-out of the relevant section of the brainstorm as a reminder of his global aims for each section. In a sense this is a kinaesthetic approach to organisational difficulties.
Student E was the only student who spent any significant time on the neat/proof reading aspect of writing. He made a number of drafts of his work and recorded his print-out time for each of these in his log. He also relied upon the spelling and

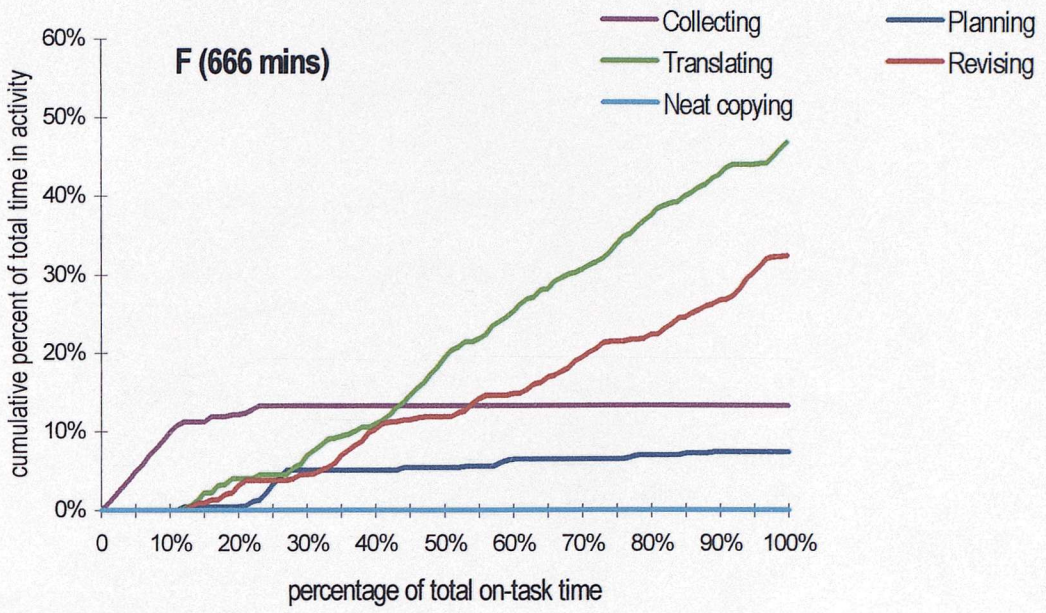
grammar checkers as his main method of checking, which was different from the other dyslexic students in the study and is a reflection of the way in which he organises the whole process.

6.7.6 Student F:

Student F's written assignment was 'An evaluation of the teaching methods for SpLD learners in HE.' She was restricted to 2,500 words which she found difficult, because it puts pressure upon summary and language skills

> "I think less words is harder. I have to go through the process of putting it all in and then taking it out!"
>
> Appendix 3 (vi)

As a reflective, mature student, she was aware of her weaknesses and in some cases had developed ways of compensating. She freely admitted that a great weakness in her system was that she was disorganised with the note-making methods, and this often had a knock-on effect with translating and revising. Her strategies and writing behaviour meant that she spent a disproportionate amount of time writing essays. She spent 666 minutes and admitted that the writing log was a *conservative* record of the time spent on the essay. She indicated that she spent much time 'thinking about the essay' in the car on the way to work and while she was carrying out her domestic chores.



Collecting	13.29%	Planning	7.43%
Translating	46.85%	Revising	32.43%
Neat	0%		

She started off the process by gathering relevant texts from the course reading list and doing an initial search on the library database. She liked to do some background reading first to get a flavour of the subject before she began to make decisions about what needed to be included and what was irrelevant for the task. Thus, there was often a long gestation period while she was mulling over information and ideas. She is a global thinker and had to have the big picture in mind to help her to be a more efficient writer. Without this or a 'thread' she finds she wastes much time in the translating phase, which then results in the need for more editing and revising. She did ten drafts before finishing her final copy.

She used text generation as a vehicle for developing her understanding of the subject, partly because of her hesitant and inaccurate reading comprehension skills and speed of information processing. Additionally, her disorganised note-making means that she almost used text generation as a combination of collecting and

translating. Thus, she started generating text quite early, with text books to hand. She had, however, devised a system to ensure that she knew what she had to check up on and what needed further organisation.

> Sample of work from drafts (Appendix 7 (vi)):
> Green = my notes
> Black = text lifted from other sources
> Red = things to check before putting in the essay
> Blue = my essay text.
> It is generally accepted that dyslexic children have a number of measurable differences from non-dyslexic. This implies that the dyslexic will require a different system of teaching, which should take into account these differences.....
> It is reasoned that after all they present like younger pre-readers so the incorrect assumption is that very often that more of the same will solve the problem. This could not be further from the truth (ref).
>
> Later this is translated into:
> Dyslexia in general is considered, naively, a condition that only affects children (ref) and then only in reading, writing and spelling. However, dyslexia is a constitutional condition that cannot be 'grown out of' and persists into adulthood.
> Add quote about dyslexic adult.

She used this system of colour coding to cut down on cognitive overload and to support her weak organisational skills.

She explained that getting her ideas onto the page was '**really** difficult'. This was compounded by the fact that once the text was there, it was then 'not easy to edit'. The net result of weak summary skills and poor sequencing was that she spent a great deal of time on translating and revising because her paragraph structure was 'a jumble'. Her inability to retrieve language effectively had an impact upon the time spent on these activities.

> " get stuck on things and they go round and round and round."
>
> Appendix 3 (vi)

She did try to rehearse sentences in her mind, but the stumbling block was getting them down on paper because of her persistent lower-order writing difficulties:

> "I have wonderful sentences in my head but to write means that I have to think about the shape of letters and the spelling."

Her lack of confidence in her ability to process information effectively, both on input and output, affected her writing behaviour. She did a great amount of reading – 'probably too much' and because she had no efficient method of recording this information she 'gets muddled'. This meant that a) she spent longer trying to remember where she located the information; and b) gathered much information which was not necessarily pertinent to the thrust of her essay. The latter could be disastrous for those with weak memory capacity and language processing difficulties because the large volume of information had to be sorted and summarised.

Compensatory Strategies:

Student F used technology to support her dyslexic difficulties. She realised that she needed to be able to get her ideas onto screen quickly before she forgot them. For this she used Dragon Dictate, which is voice recognition software. In this way she was able to dictate her ideas straight onto screen from working memory. Once the information was on screen she then went about the translating and editing processes. Kurzweil software is an adaptable, read-back type of software and complements voice recognition software. She used this software to help her with her paragraph structure and the macro structure for the assignment. It was a flexible piece of software in that she could choose not only the type of voice she preferred to hear – male, female, English, American or Australian – but she could adjust the speed at which the text was read back.

Read-back speed adjustment is particularly important for dyslexic readers with faulty processing speed. If the text contains new technical terminology or is a subject which the student is coming to grips with, it is better to slow down the speed of read-back to accommodate more effective comprehension. However, if a student is using

the facility to proof-read text, it is better to speed up the voice to allow for chunks of information to be assimilated and heard.

Student F preferred to scan texts into her computer and have them read back to her in order to support her inaccurate decoding and weak phonological skills.

She used mindmaps to help her to get the global picture of the information contained in books, chapters or journal articles. She often did these by hand while the text was being read to her by the computer. This helped her to see 'how everything fits together'. Her lack of confidence in her writing ability was such that she always asked friends and family to check her work before she handed it in. She had noticed that even with spelling checkers and technological aids, mistakes in spelling, punctuation and sentence construction were pointed out to her by her tutors. She felt that her way of organising language in written form was individual and often circuitous, making her text, at times, difficult for the reader.

6.7.7 Student G:

Student G's written assignment was 'An evaluation of the teaching methods for SpLD learners in secondary schools.' He was restricted to 2,500 words, which he found difficult because it puts pressure upon summary and language skills.

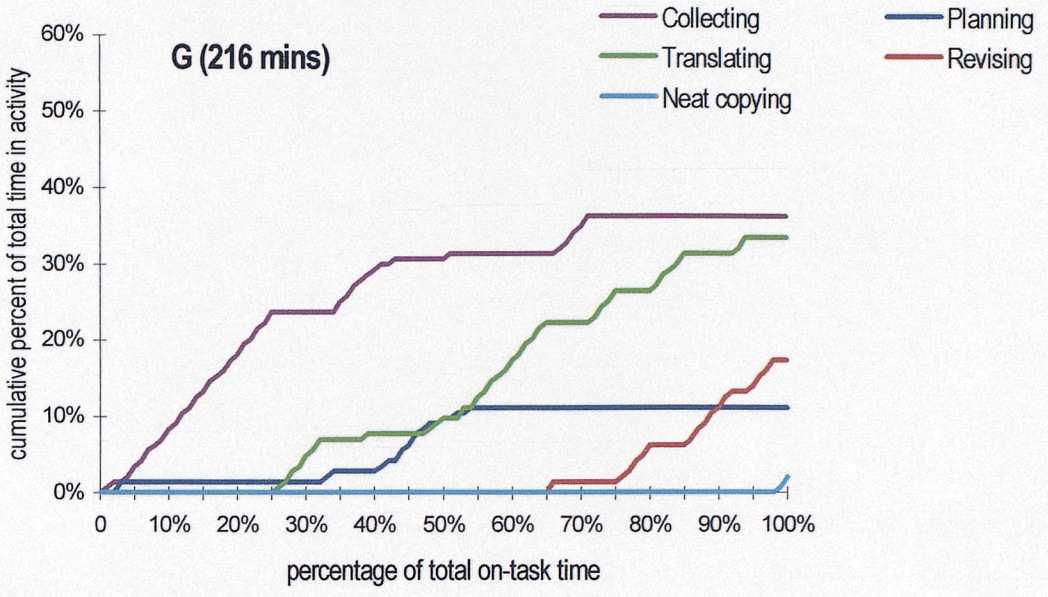
This student forced himself to do written work but was extremely anxious when given feedback of his draft work. He was very different from many of the others in the study in that his spontaneous hand-written work can be carried out at speed and is relatively legible. However, it is his thought processes which are the most bizarre and reflect a totally different way of perceiving the world and of receiving and communicating ideas. He is highly creative but does not conceptualise in a linguistic form but rather in a 3-D visualisation. Thus, in order to complete any written task he has to translate his ideas from 3-D to language and, similarly, when reading he has to reverse this process. The result is that at times his sentence structures are fragmented, and he telescoped many ideas into a single, rambling sentence, making it difficult for the listener and reader to decipher the train of thought. The example below demonstrates his chaotic sequencing of thought:

> "I read one book up to finishing my 'A' levels cover to cover and going to college Wind in the Willows and this was because it had been read to the class and I had imagined the whole story in 3-D and was able to revisit it on demand."
>
> Appendix 3 (vii)

This individualistic way of working had implications for how he went about the writing process. He was aware that his way of thinking is fast and when he tries to translate his thoughts into language his brain often went ahead of the language, and this resulted in missing sections which were in his head but not on paper.

> " At the end of the day, what is in my head doesn't have the connections of language to hang it together. Because ***I*** don't need it."
>
> Appendix 3 (vii)

He explained his way of taking in information meant that he had no filtering system and that he could hold a great deal of information in visual format in his mind. However, the disadvantage of this way of processing was that the lack of a filtering system made a difference when organisation and summary were required of the task, as in most written assignments. Thus, a dormant filtering system results in cognitive overload occurring quickly.



Collecting	36.11%	Planning	11.11%
Translating	33.33%	Revising	17.36%
Neat	2.08%		

Student G did not multi-task but rather put his energy into one activity followed by another (Appendix 6, section (vii)). The first 25% of the overall time was spent in collecting information, reading background texts, making notes and engaging briefly in a rough plan. From this he went straight into text generation, occasionally altering or adding to his overall structural plan. With his need to translate from 3-D to language it was not surprising that collecting (which involves reading and note-making) and translating (which involves formulating language as an expression of thought) together took up a staggering 69.44% of his total writing time.

Memory capacity deficits and language retrieval difficulties meant that Student G was not able to rehearse sentences in his head during the translating phase. Thus, he had to write everything in short, fragmented chunks which he could remember in translation, and he felt that it appeared to 'come out like a long sausage.' He spent time subsequently shaping the sentences so that they flowed together. Often he ended up with far too many words, and the work had to be edited or revised. This became problematic because of memory difficulties. He was never sure what was in

his head and what he had committed to paper with the result that some of his work did not hang together.

Compensatory strategies:

Student G used surprisingly few technological aids to support his difficulties, despite running his own software design company for some years. He was very aware of the appropriate technology for his dyslexic learners in secondary school but did not always employ the strategies himself.

He did use a word processor and this enabled him to cut and paste information. He realised the need to save his work frequently but his poor organisation was a stumbling block. Multiple versions of his work became an organisational issue because he was unable to remember which was the last revision. This was due to faulty systems for saving his draft files. The variable speed controls of a tape recorder and the read-back facility of Kurzweil helped Student G to regulate the amount of information which was being processed.

6.7.8 Summary:

The writing behaviours of these students demonstrate that, although there are many individual differences, the need to support faulty cognitive resources is paramount, and that each student has developed his/her own approach to the writing process. However, patterns emerge in the compensatory strategies which have been adopted. Technology is used most effectively to help the students cope with memory capacity deficits and organisational difficulties. Difficulties with language processing and word retrieval appear to be more resistant to support in this way.

6.8 The paradox of the dyslexic writer in HE - Writing Behaviour and the Written Product

Literature is divided about whether writers fall into neat categories of novice and expert or to put it differently, those who are functioning at a simplistic or sophisticated level of operation ((Flower *et al.*, 1981, Scardamalia *et al*, 1987). Yet, dyslexic writers are a paradox. The difficulties which they experience because of their cognitive deficits might lead us to regard them as novice writers. On the one hand, they still experience lower-order difficulties attributed to novice writers, such the surface problems which take up so much central executive resource capacity at the expense of capacity for higher-order functioning. On the other hand, the environment of the writing task for them is such that they are expected to perform at a knowledge-transforming level, manipulating content knowledge, rhetorical knowledge and discourse knowledge simultaneously. Yet, the quality of the text produced, when examining the final, 'neat' copy, compares well with that of their non-dyslexic peers. This can be seen by the grades awarded (see Appendix 8).

What is immediately apparent from a closer look at the dyslexic students' texts is that complex sentence construction, syntax and synthesis of ideas are achieved - all qualities which are anticipated as being those of the expert or knowledge-transformer. The following examples of dyslexic writing may help to prove this point:

> "Dyslexia is often still naively considered as a condition that only affects children (Thompson and Watkins, 1998), and then only with particular reference to reading and spelling. However, dyslexia is a constitutional condition that cannot be 'grown out of', persisting throughout adulthood."
>
> Student F, Appendix 7 (vi)

The use of 'still' and 'naïve' are excellent indicators of the synthesis of current research and reflect the student's ability to communicate her background reading and understanding of research. The construction of the second sentence puts across

the thrust of her views and juxtaposes the relationship between childhood and adulthood and the dyslexic condition, linking the two with the marker 'however'.

> " It is far from certain that this marvellous science will prove a blessing or a curse to humanity. On the one hand agri-business seeks to use it to maximise profit at the expense of man and the environment with terminator technology and glyphosphate resistant crops. On the other, the possibility ....."
>
> Student D, Appendix 7 (iv)

This example of the initial sentences of one of the paragraphs shows that the student is able to demonstrate clear paragraph structure with an introductory summary sentence which is further elaborated. The language of the discursive genre is used to put across his argument, e.g. 'on the one hand' and 'on the other'. He uses technical vocabulary with ease: e.g. 'agri-business' and glyphosphate resistant crops'. The syntax within the sentence construction is complex yet supports clear communication of his ideas.

These examples help to demonstrate clearly that, *despite their cognitive deficits*, the dyslexic writers in the HE context are able to produce text of good quality but at a personal and emotional cost.

I would, therefore, refute the claim that there must be a reduction in text complexity if working memory capacity deficits are apparent.

> " Developmental difficulties in the complexity of texts produced map onto difficulties in the number of ideas that can be co-ordinated within the limits of the writer's short-term storage capacity."
>
> McCutchen *et al.*, 1982

If this is accepted then dyslexic writers in HE have a double disadvantage which they have to overcome. Not only will they produce simpler texts which are inappropriate in the writing environment in which they find themselves, but also cognitive resources are compromised by the specific writing environment. In order to produce the type of text above, what is key is the time factor involved and the

use of strategy in resolving the tensions. The need to ensure that errors are smoothed out may result in multiple drafts such as those found with Student F. Similarly, the strategy of working upon small sections at a time will reduce the overload of cognitive resources but has a knock-on effect with an increase in time on task. Although studies of the correlations between time on task and quality of text are, as yet, inconclusive (Kellogg, 1988), Nelson, 1988, Spivey *et al.*, 1987), it should be borne in mind that these studies have been conducted with non-dyslexic undergraduate populations in the main.

Thus, analysis of the product alone gives an incomplete picture of writing behaviour. Conversely, if the interview data is taken in isolation, the difficulties and frustrations identified by the dyslexic students during the writing process would suggest that the product would be flawed. Triangulation of the data is, therefore, essential.

6.9 Commentary on Research Design

I felt that collecting quantitative data was one of the essential components for this study (see chapter 3) but I was also concerned that the real-time sampling data would be distorted because of the subjects in this study. My worries were in part ethical and in part methodological. I was apprehensive that the distraction of the audio bleep would compromise cognitive resources and would interrupt thought and language flow. Torrance did not believe that the bleep would greatly distort the results but he was not working with dyslexic students. The bleep used to randomly record data **was** intrusive: all seven students commented upon this. It is beyond the scope of this study to measure how much this distracted attention, and whether it had an impact upon their work efficiency. As discussed in chapter 3, computer stroke analysis and/or video records were not viable alternatives if I wished to encapsulate a true representation of the writing behaviour in a *natural* setting. The altruistic attitude of the participants is to be commended in that, although they all found the bleep intrusive, they wanted to be participants in a study which might have some bearing upon future intervention methods to enable dyslexic students to cope with the rigours of this type of activity.

Any future work in this field would need to find a resolution. One way forward would be to conduct a longitudinal study with dyslexic undergraduates and to get them used to the bleep whenever they were carrying out written tasks. In this way it (the bleep) would not present attentional distortions.

The next chapter will draw conclusions from the study and examine the implications for pedagogy and research.