Part I

THEORY

There are numerous research studies incorporating different research perspectives within the field of dyslexia and literacy. We have selected here for this part of the book chapters from those researchers who hold prominent theoretical positions or have an influential understanding of the theoretical and research implications inherent within dyslexia and literacy. One of the most influential of these is the causal modelling framework (Morton & Frith, 1995) which is described by Frith in Chapter 3. This model is influential because it explains both dyslexia and literacy from causal and behavioural perspectives. The three elements of this model, biological, cognitive and behavioural, can assist and justify explanations and interventions offered by researchers and practitioners. By helping to explain the underlying concepts in this manner this model can incorporate different and often conflicting theories of developmental disorders which can account for literacy failure. Indeed, in Chapter 11 of Part II of this book, Reason speaks of the causal modelling framework as one which underpinned much of the report from the British Psychological Society Working Party investigation into dyslexia and assessment. Using this framework, Reason indicated that the report "presented ten different theoretical accounts of dyslexia as alternative or complementary hypotheses to explain learning difficulties of a dyslexic nature". These theoretical hypotheses include phonological delay, temporal processing, skill automatisation, working memory, visual processing, syndrome hypothesis, intelligence and cognitive profiles, subtypes, learning opportunities and social context and emotional factors. These represent influential factors associated with dyslexia and literacy, and the reader will find some form of reference to all of these within this book. By using this framework some of the controversies evident in this field can at least be explained, if not reconciled. The causal modelling framework also incorporates the, often overlooked, environmental dimensions: provision of teaching, cultural attitudes and socio-economic factors.

Frith herself suggests that "words and labels have a life of their own. They readily become loaded with ideology while the concepts they refer to may be perfectly non-contentious". It is interesting to consider the example provided by Frith of two established theories, one postulating the phonological deficit, the other the magnocellular deficit, both as explanations of dyslexia. According to Frith these

are not in conflict. A framework which offers explanations at different levels, the magnocellular at the biological level and the phonological at the cognitive, can make theories compatible. These particular positions are discussed in detail in Chapters 4 and 5 of Part I of this book. In Chapter 4 Hatcher and Snowling provide explanations of some of the key points in relation to the "cause and effect" aspects of dyslexia. This is particularly relevant to the area of phonological development. Hatcher and Snowling ask how we can be sure that the phonological deficits in dyslexia are a cause rather than a consequence of literacy problems. The authors provide research evidence to suggest some qualitative differences between the dyslexic group and the control group in their early language skills, such as speech errors and the use of syntax at two and a half years and object naming and phonological awareness at five years.

Everatt discusses the magnocellular theory in Chapter 5 within a more general approach and investigates a range of visual processes which can affect reading. However, he suggests that magnocellular theories are appealing because they attempt to explain the underlying causes from a visual/biological perspective. This is important because, as Everatt points out, of the "very diversity of visual deficits" which attempt to explain reading failure. Many of these perspectives are covered in this chapter.

The importance of research is that it can not only explain conditions and syndromes, but can provide pointers for practice. Robertson and Bakker in Chapter 6 show how the balance model of reading, which is essentially derived from the brain/biological perspective, has been translated into a manageable programme for practitioners. Using Morton and Frith's framework as an example, the balance model can be included at all three levels: biological, cognitive and behavioural.

Morton and Frith incorporate the environmental perspectives, including culture and teaching, into their model. It is crucial, therefore, to examine the lessons from other countries and the factors which have affected progress or otherwise in these countries. This aspect is tackled by Shiel in Chapter 8. He comments on The International Adult Literacy Study conducted in 24 countries between 1994 and 1998. Despite the controversies engendered by these types of comparative studies (the results were met with a negative reaction in some countries), data of this type can help with comparing the focus of literacy teaching and also raise questions about the meaning of "functional literacy". For example, Shiel reports on the study in which adults with low levels of literacy considered their lack of skills "did not present them with major difficulties, indicating instead that their lack of skills were sufficient to meet their everyday needs". At the same time he emphasises the need to examine data carefully and critically, especially international studies of the kind reported in this chapter. For example, in one study (IEA/PIRLS) reading is defined as a constructive and interactive process, but this can emphasise different aspects in the culture and also in the assessment framework. Some studies have pointed to the range of factors that need to be addressed, for example the association between reading gender and reading achievement and between socio-economic status and performance in reading. This can provide pointers for the development of literacy policies and practices.

Planning is also the theme of the opening chapter of this book, where Fawcett looks at the key issues for research in dyslexia and literacy. Fawcett talks about a co-operative spirit between all those involved in research and practice in this field, noted in the round table discussions at the fifth BDA Conference in April 2001, and outlines the challenge in transforming this co-operative spirit into policy and practice. As well as discussing the potential causes of confusion in the area and the progress that has been made in research and practice, Fawcett also provides targets for future research. One such target relates to interlinking of theories in order to achieve clarity and a greater understanding of some of the key areas mentioned by Fawcett, such as co-morbidity, multilingualism, early identification and intervention, investigation of new technology, and exploiting the strengths of dyslexic children and adults.

The field of dyslexia is broad and diverse. The editors of this book hope that Part I, in conjuction with Part II, will explain some of that diversity, clarify some of the confusion, and help to provide a more cohesive and enlightened understanding of the field of dyslexia and literacy.

Chapter 1

DYSLEXIA AND LITERACY: KEY ISSUES FOR RESEARCH

Angela J. Fawcett

INTRODUCTION

At the start of the new millennium, considerable progress has been made in identifying the causes of dyslexia and providing intervention to break into the cycle of failure. My brief in writing this chapter is to consider how best we might consolidate this progress by working together to influence policy and practice for dyslexia over the next decade. This is not an easy task, nor one to be undertaken lightly. However, I have been able to draw on two sources here in support of my position, to ensure that the approach I advocate is fruitful. Firstly, the call from Rod Nicolson at the Fifth BDA Conference to consider targets for dyslexia research for the next decade in terms of unity of purpose. Nicolson (2001) noted that "the stage is set for undertaking ambitious, multi-disciplinary, multi-perspective projects aimed at redefining the field of dyslexia and learning difficulties as the field of learning abilities". Secondly, and perhaps more significantly, the spirit of collegiality and consensus which emerged from the round-table discussions of causal theories, diagnosis and intervention, which concluded the conference. It was my task to act as discussant, drawing together comments from the causal theories round-table panel and the floor, summarising the issues arising to the satisfaction of all involved, and feeding back this information to the plenary session. This was a challenging task. Feedback from the three round-table sessions concluded that significant progress had been made in working together towards a common goal. Transforming this co-operative spirit into a reality, which can affect policy and practice, forms the new challenge for dyslexia research.

My plan for the chapter is threefold: first, to consider potential causes of confusion in dyslexia research and practice; secondly, to outline the progress that has been

Dyslexia and Literacy: Theory and Practice. Edited by Gavin Reid and Janice Wearmouth.

made in theory, diagnosis, support and policy over the past decade; and finally, to develop a series of targets for the next decade. Throughout the chapter, I will give my personal view of how to make progress in dyslexia research, with the key here that clarity and unity of purpose lead to success. In my role as an academic I advocate an open approach, with all the dyslexia community pulling together and respecting each others' viewpoints. This is reinforced by my role as parent of a dyslexic child, which leads me to think that no one theory will account for all the manifestations of dyslexia. It is our role here to work together towards greater understanding of the range of manifestations and theories which represent the truth about dyslexia.

The function of this chapter is be an introduction to the rest of this book. I shall therefore introduce a series of themes, which will be returned to and discussed in greater depth in other chapters in this volume.

THE DYSLEXIA ECOSYSTEM (NICOLSON 2001)

This striking analogy emerged at the Fifth International BDA Conference, to critical acclaim from the audience. In his keynote address, Rod Nicolson described the pool of different perspectives involved in dyslexia research as an "ecosystem", a group with overlapping but often conflicting needs attempting to inhabit the same space. Inevitably, failure to recognise and respect the differences between these needs has led to something of an impasse. With an increased understanding of the role that each one plays, we now have the potential to unite the dyslexia ecosystem into a dyslexia world. The associated surge in power for dyslexia research could fuel our joint targets for the next decade.

DIFFERENT ROLES

One of the major tensions in dyslexia research has been the range of potentially conflicting viewpoints which we are trying to accommodate. These might include those of researchers and practitioners; parents and teachers; teachers and educational psychologists; schools and local education authorities; local education authorities and governments—all have different agendas, and much of the time these force them into opposition. Moreoever, in order to secure funding, it is common for researchers to emphasise the differences between their approaches rather than the commonalities among them. This is by no means the most fruitful approach, indeed uniting under a common banner has led to a surge in research funding in the US over the past two decades. We would like to advocate unity of purpose in adopting a broader perspective to the manifestations of dyslexia. In our view, such an approach has the potential for a "win-win" situation, whereby substantial funding is available to all to quantify the impact of the different theories and their application into practice. We might envisage the scenario where routine use of early screening tests detected problems pre-school, leading to proactive individual support, preventing the development of the reading deficits which characterise

dyslexia. A similar approach might be adopted with adult dyslexia, with fuller screening and expert subsequent assessment, specifically for job-related goals. The net result would be greater awareness of the requirements for "dyslexia-friendly" practice, both in education and at work. These innovations would satisfy everyone involved in the dyslexia ecosystem—dyslexic people, support specialists, schools, educational psychologists, funding bodies and the government. Above all, we need to show that the costs of such a scheme would be far outweighed by the savings, linked to a successful, effective and cost-effective policy for dyslexia throughout the lifespan. Interestingly enough, the government have recently established that pre-school intervention can reduce the costs of support by a factor of 1:8 (Department of Health/Home Office, 2001). These are the factors on which we need to work if we are to influence both policy and practice.

DIFFERENT THEORIES

In scientific research one of the most important distinctions is between cause and description. Typically, a reasonably complete description of the facts is needed, which allows researchers to derive hypotheses which can account for these facts. The hypothesis is then evaluated against new data, and scientific progress is made towards the true explanation. Naturally enough, problems can arise if hypotheses are built on incomplete data, because any characterisation of the difficulties is only partial.

In our talks, we often use the "medical model" of abnormal development, which distinguishes between cause, symptom and treatment. An appropriate analogy here might be with allergies. The same allergy can lead to different symptoms in different people, and the mechanisms are poorly understood. It is therefore necessary to use further, more sensitive tests, administered by a trained specialist, to determine the true underlying cause, and thus the appropriate treatment. Of course, there are very wide differences in the motivation of different protagonists within the dyslexic ecosystem. Practitioners are primarily concerned with treatment, educational psychologists with symptoms, and theorists with the discovery of the underlying cause(s). It is clear that, despite these different perspectives, a full understanding demands the investigation and integration of these three aspects. For example, in order to develop an applied test for early diagnosis of dyslexia, it is necessary to build on theoretical insights into the predictors of dyslexia which lie outside reading. Otherwise, we have no option but to return to the system where we wait for children to fail to learn to read, with all the associated trauma and negative impacts on self-esteem, which can damage children for life.

A further important discrimination is between the three "levels" of theory: the biological, the cognitive and the behavioural levels (Frith, 1997, and see Chapter 3 by Frith). Symptoms such as poor reading or rhyming deficits represent the behavioural level. Theories are explanations at the cognitive level; these might include deficits in working memory, phonological awareness, automatisation, and slow processing speed. Finally, the underlying brain mechanism lies at the biological level, with abnormalities in cortical language areas, magnocellular pathways, and the cerebellum. It should be recognised that these levels are different, that

none is intrinsically "better" than another, and indeed that any complete explanation must include all three, with the cognitive level providing a necessary link between brain and behaviour.

Finally, let us consider development in terms of Thelen's "ontogenetic landscape" approach (Thelen & Smith, 1994), drawing on themes from developmental cognitive neuroscience. Here we need longitudinal studies of individual children, rather than the cohort approach which has been common in psychology, in order to see how underlying differences in the brain and cognition interact with the environment over time to produce the symptoms of dyslexia.

In summary, in order to develop a mature theory of dyslexia, we need to take on board all these different perspectives, and integrate them within a rich multidisciplinary framework, with specialists in all areas working together towards a common understanding.

DYSLEXIA OR READING DISABILITY?

One of the most contentious issues from an educational perspective is the concept of the dyslexic child as in some way "special" and deserving different treatment from the equally disadvantaged reading-disabled child. Many educationalists rightly stress the need for equal treatment for non-dyslexic children with special needs (Siegel, 1989). It is by no means clear whether dyslexia is a syndrome, like obesity (Ellis, 1993), or a collection of sub-types (Boder, 1973; Castles & Holmes, 1996) or based on a common "core" deficit (such as phonology). In Miles' (1994) terminology, a debate has arisen between the "splitters" and the "lumpers".

In the 1980s, US dyslexia researchers changed the focus to "reading disability" rather than "learning disability", thus concentrating resources on a painstaking analysis of the reading process rather than of the learning processes which underlie reading. Inevitably, this has led to divisions between researchers trying to find the causes of dyslexia and those trying to find the causes of the reading problems. In line with the analysis above, it should now be clear that both approaches are needed for a mature theory of dyslexia.

THE SITUATION IN 1990

In 1990, when we published our early work on automatisation (Nicolson & Fawcett, 1990), the dominant theoretical framework was the phonological deficit, derived from seminal research in the UK by Bradley and Bryant (1983) and by Snowling (1986, and see Chapter 4 in this volume), and in the US by researchers such as Stanovich (e.g. 1988). Indeed, in the US this consensus among dyslexia researchers was instrumental in generating substantial long-term funding via the NICHD Learning Disabilities Program. Phonological awareness deficits, based on abnormalities in the language-processing areas of the brain, were posited as the key to the deficits in grapheme–phoneme translation which characterised dyslexia. The

natural solution lay in intensive training in phonological awareness, and research focused almost exclusively on identifying the cause of the phonological difficulties.

By contrast, as the parent of a dyslexic child, I was aware that the deficits in dyslexia included, but extended far beyond, these phonological deficits. Indeed, I had noticed that there were subtle differences in the fluency with which children with dyslexia performed on all tasks, including those in which their performance was to all intents and purposes normal. Crucially, many of these skills were not related to literacy, with motor skills in particular featuring strongly in the work of Augur (1985) and Haslum (1989). Working with Rod Nicolson, whose theoretical background was in theories of learning, it was natural for us to consider all these varied manifestations of dyslexia. We therefore formulated and tested the automatisation deficit hypothesis (DAD)—that dyslexic children have problems in becoming automatic in any skill, whether or not it is related to reading. The most stringent test of the theory was in a domain as far away from language as possible, and so we chose balance. Somewhat to our surprise, and precisely as predicted by the DAD hypothesis, we found that the dyslexic children whom we tested did show problems in balance, especially if they were prevented from concentrating on balancing by having to perform another task at the same time. Interestingly enough, phonological skills are built up in precisely the same way (without explicit instruction) over several years, and therefore this explanation could also be applied to phonological deficits. We argued that the automatisation deficit could provide a broader framework for dyslexia research, integrating the phonological deficits within mainstream theories of learning.

We were somewhat dismayed by the negative attitude of some dyslexia researchers towards our hypothesis. Naively, we had assumed that they would share our excitement at this new perspective, which we hoped would be fruitful for dyslexia research. Eventually, we realised that many researchers had mistakenly assumed that we were advocating training in balance to overcome these automatisation problems in dyslexia. This interpretation had not even entered our minds! By contrast, many practitioners and parents of dyslexic children resonated strongly with our automatisation hypothesis—often with the reaction "That's our Johnny" (Miles, 1983).

However, in 1992 we talked to many influential dyslexia researchers and practitioners for our international survey (Nicolson et al., 1993) on screening for dyslexia in adults. The project involved a literature survey of adult literacy and diagnosis of dyslexia, interviews with UK experts on theoretical and applied aspects of dyslexia, and finally an international questionnaire study with a wide range of dyslexia practitioners and researchers. Most pleasingly, the survey established a clear consensus in the dyslexia community that was particularly impressive given that the respondents were specialists whose opinions spanned the spectrum of approaches to dyslexia and adult literacy. Respondents agreed that testing procedures that do not need a trained clinician could be carried out cost-effectively in adult literacy centres, units for young offenders or job centres. However, they also agreed that a second-stage testing procedure must be available, and that the screening should be integrated within a support framework. This survey strongly

influenced our subsequent three-stage Screening–Assessment–Support proposal outlined below.

However, if we screen and support children proactively, this "stitch in time" approach could prevent reading failure, and lead to a situation where the child would no longer be diagnosable as dyslexic. It is important to recognise that dyslexia still exists at the biological and cognitive levels even when these literacy-based symptoms have been remediated. Consequently, we need to move away from just examining the symptoms to examine the brain and cognition in dyslexia. This requires the development of a range of new tools and techniques.

PROGRESS 1990–2000

I shall consider progress in terms of policy, theory, diagnosis, and support.

Policy

This is the area in which the most consistent progress has been made, moving from a position where dyslexia was not recognised to one where the 1994 Code of Practice for Children with Special Educational Needs made it the responsibility of schools to identify and support children with dyslexia and other learning disabilities. A series of stages and procedures was introduced to ensure that children received appropriate and effective support, and interestingly, these were very much in line with our own recommendations (see Figure 1.1 below).

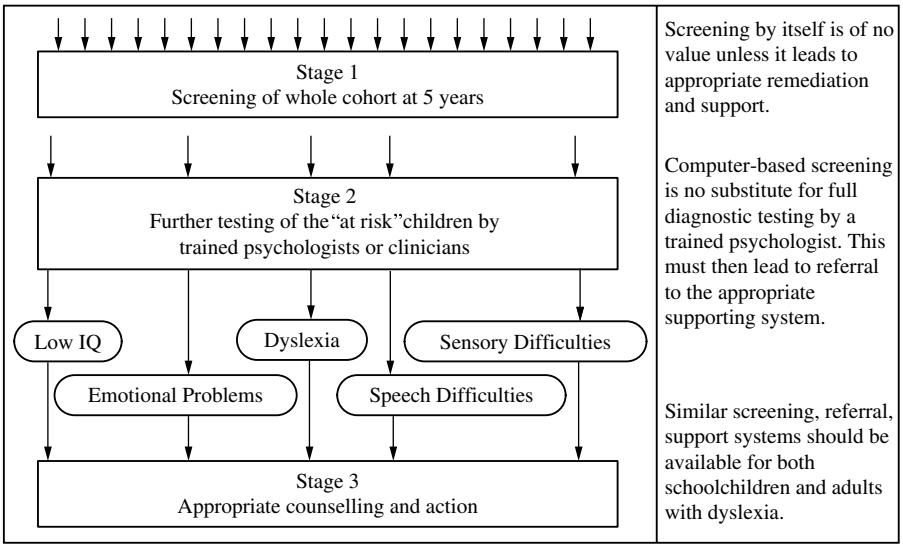

Figure 1.1 Objective: Introduction of systematic screening, diagnosis and support. This diagram is taken from our early-screening project, but our objective is to provide similar facilities at all ages—pre-school, junior school, secondary school and adult dyslexia (adapted from Fawcett & Nicolson, 1999)

The Code considered dyslexia specifically under the heading of "Specific learning difficulty (for example, dyslexia)" when considering criteria for making a Statutory Assessment (§3.60–3.63). A key requirement is that

> *"...there is clear, recorded evidence of clumsiness, significant difficulties of sequencing or visual perception; deficiencies in working memory; or significant delays in language functioning"* (§3:61iii).

At the time of writing this chapter, a new Code of Practice has been produced and will be available in early 2002.

In short, the school situation for the dyslexic child in the UK is currently one of the best in the world, well in advance of the US, where policy is fragmented between different states. Moreover, the situation for adults is improving, with the 1998 Disability Act now applied in education as well as employment, and the Moser Report (Moser, 2000) on adult literacy launching a well-funded programme of government support.

Theory

New techniques in neuroscience, brain imaging and genetics have led to outstanding progress in theoretical dyslexia research. Following Frith (1997) I shall classify theories at the biological level, the cognitive level and the behavioural level.

Biological Level

In our search for an underlying cause which was capable of handling the pattern of difficulties in dyslexia, namely, problems in balance, speed and phonological skill (Nicolson & Fawcett, 1994) we developed the cerebellar deficit hypothesis. It had always been known that the cerebellum was involved in speed, in learning and in becoming automatic in motor skill. However, new evidence coming from the US, completely independent of dyslexia research, suggested that the cerebellum might be involved in language dexterity, via rich interconnections with the language areas of the brain, in particular Broca's area. This made cerebellar deficit a prime candidate for the underlying cause of dyslexia. We tested this hypothesis indirectly, with a range of clinical tests of muscle tone and stability (Fawcett et al., 1996), and found strong evidence for previously unsuspected abnormalities in cerebellar function. Then we tested our hypothesis directly, in a PET scan study of motor learning (Nicolson et al., 1999a), known to activate the cerebellum. Exactly as we predicted, the adults with dyslexia showed reduced activation in the cerebellum, with only 10–20% of the expected level of activation compared with adult controls. This provides convincing direct support for the cerebellar deficit hypothesis, leading to a complete causal chain for dyslexia (see Figure 1.2).

In summary, the magnocellular deficit (Stein, 1997) and cerebellar deficit (for a review see Nicolson et al., 2001; Fawcett, 2000), both theories at the biological level suggest more widespread problems in addition to the phonological deficit. Further research is now needed on these theories; in particular, we need to establish the "prevalence" of the different sub-types implied by these accounts (see Chapter 2

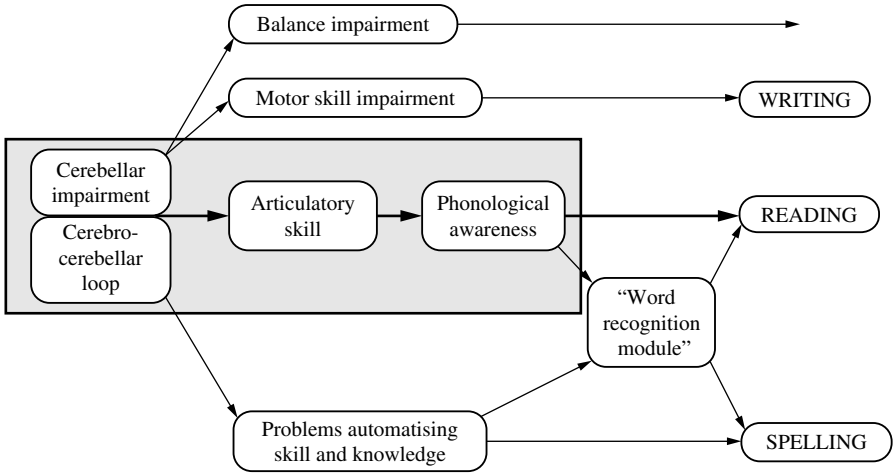

Figure 1.2 An ontogenetic causal chain for dyslexia from birth to age 8 (adapted from Nicolson & Fawcett, 1999)

by Hynd and Knight for an overview of neurological and biological factors, and Chapter 5 by Everatt on visual factors in dyslexia).

Cognitive Level

As well as the automatisation deficits and the phonological deficits account, the "double deficit" hypothesis (Wolf & Bowers, 1999) suggests that dyslexic children suffer from a processing speed deficit, in addition to their phonological deficits. A further perspective on learning from our laboratory suggests that there may also be abnormalities in fundamental learning processes such as classical conditioning, habituation, response "tuning" and error elimination. Our analysis of how dyslexic children learn (Nicolson & Fawcett, 2000) suggests performance can become automatic, but strikingly, our "square root rule" suggests that this takes longer by a factor of the square root of the time normally taken to acquire a skill. So, a skill that normally takes four sessions to master, would take a dyslexic child eight sessions, whereas if a skill normally took 400 sessions, it would take the dyslexic child 8000 sessions! This suggests that it is important to monitor learning in small, easily assimilated steps for dyslexics, providing theoretical support for existing good practice, and distinguishing dyslexia support from that necessary for other poor readers. Naturally, further research is needed to address these issues.

Behavioural Level

Dyslexic children show impairments in a wide range of skills, including sensory deficit (flicker, motion sensitivity, rapid auditory discrimination), motor (bead threading, balance) and cognitive (phonological, working memory, speed). Dyslexic children may also show strengths in non-verbal reasoning, vocabulary and problem-solving. However, it is not clear whether these patterns relate to different sub-types, and again, further research is needed to establish how distinct dyslexia is from other learning disabilities.

SCREENING AND DIAGNOSIS

Screening

Naturally, I focus here on our own screening tests—the Dyslexia Early Screening (4.5 to 6.5 years), the Dyslexia Screening Test (6.5 to 16.5), the Dyslexia Adult Screening Test (16.5 to 65) and the Pre-school Screening Test (3.5 to 4.5). Note also, however, Singleton's COPS computer-based screening tests for school-age children and adults, together with a wide range of phonological tests (see Chapter 7 by Singleton).

Each of these tests was explicitly designed to form the first stage in the systematic Screening–Assessment–Support procedure outlined in Figure 1.1. Our aim here was to satisfy the various needs of groups within the dyslexia ecosystem, particularly teachers who would be "empowered" to undertake the tests themselves, and produce understandable profiles related to their teaching objectives. Our aim was to produce tests that appealed to schools because they were quick, cheap, effective, and fitted into the Code of Practice; tests that appealed to the dyslexia community because they provided all the "positive indicators" for dyslexia; and tests that appealed to the children, in that they were fun, varied, and non-threatening. Our primary aim was to develop an early screening test for dyslexia that could be administered in a child's first year at school (from 4.5 years upwards) and that was a valid predictor of subsequent reading difficulty. In other words, we wanted to intervene before children fail!

Our key insight here was that really all the members of the dyslexia ecosystem are on the same side—they would all like a quick, simple, cost-effective test to check whether a child needs help. We believe that we have succeeded in this apparently impossible task.

Figure 1.3 illustrates the operation of the test with a 6-year-old child whom we tested. The child was very slow to name the 24 common objects on a card; 87 seconds falls within the bottom 10% for the norms for the age, which is why it has a double-minus label. The "sound order" test was 15 out of 15, which merits a 0 (average, between 25th and 75th percentiles), which suggests that the auditory magnocellular system is fine. Recognition of digits (7 out of 7) again is normal (0). The "−" band represents performance in the 11–25th percentile band, an "at risk" score, but not as serious as the double minus. The combination of "at risk" scores on the individual sub-tests (6 at double minus, 2 at minus) leads to a total "at risk" score of 14 (6@2 + 2@1), and an "at risk quotient" (ARQ) of 1.4 (dividing by 10, the number of tests used). An ARQ of 0.9 or more is "clear risk of dyslexia", and so the 1.4 ARQ indicates that the child needs extra support via the Code of Practice.

Interestingly enough, if we had measured only phonological skills, we would have noticed that the deficits here were precisely those predicted by the phonological deficit hypothesis. If we had not tested bead threading, balance (postural stability) and rapid naming, we would not have realised that this was in fact what we would consider a typical dyslexic profile, with problems in phonology, speed and motor skills. The teaching implications of problems in the right-hand five tests are

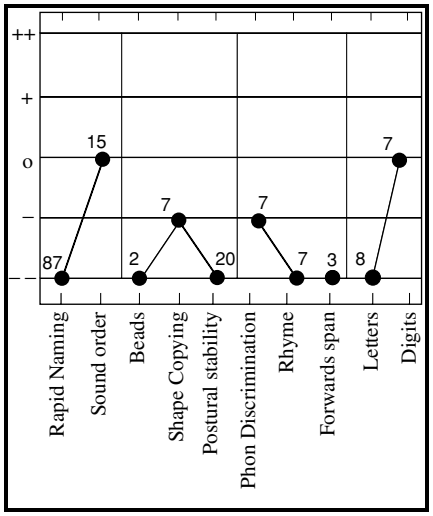

Figure 1.3 Illustrative DEST profile and at-risk quotient (ARQ) for child aged 6 years 2 months. Outcome: 6@– –, 2@–; hence ARQ = 1.4

clear—one teaches the appropriate skills. By contrast, most of the left-hand tests are purely diagnostic, rather than diagnostic/remedial. They suggest that the child is dyslexic, and therefore that standard teaching may have to be modified, as we discuss below.

Diagnosis

Until recently, diagnosis was available only for formal/legal purposes (formal diagnosis), rather than for personal development/treatment purposes (support diagnosis). At one time, as our adult screening survey showed, most diagnosticians tried to combine both functions, by starting with a structured interview, then moving to formal diagnostic tests, then ending with specific problems. More recently, the work of the Access centres in the UK has systematically addressed the issue of technical support, but it is still fair to say that there is no set approach to support diagnosis, and therefore I will focus on formal diagnosis.

In the traditional discrepancy definition of dyslexia, both reading and IQ were tested. The cut-off method takes a criterion such as "IQ of at least 90, and reading age at least 18 months behind chronological age" and the regression method takes "reading age that is at least 1.5 standard deviations below that expected on the basis of the child's IQ". The key difference is that the regression method takes account of the child's IQ (so a child with an IQ of 130 and reading standard score of 100 (exactly normal) may turn out to be dyslexic). By contrast, a child of IQ 92 with a reading standard score 90 would be classified as dyslexic using the cut-off method but not the regression method.

However, it has recently been argued that there is no point in trying to differentiate poor readers without discrepancy from dyslexic children. This is largely because in the USA poor readers without discrepancy (i.e. those with low IQ) show phonological problems just like poor readers with discrepancy (dyslexic poor readers); in other words, they are both poor readers. The recommendations of the Working Group of the BPS Educational Section also take up this point. However, Nicolson (1996) presents an alternative viewpoint. Again, this brings us back to confusion between the three issues: cause, symptom and treatment. Although the symptoms are similar, we lose focus if we lump the groups together when there may be different underlying causes. Similarly, there may also be differences in the optimal method of support, which may be lost if the groups are concatenated.

Support

Dyslexic children and adults have struggled with their literacy difficulties for many years, and often this is the last thing they wish to focus on. In fact, there are many areas of life in which they need support, particularly as adolescents and adults, and the key here is motivation. Thus, it is useful to differentiate between literacy and life support.

Life Support

Strikingly, literacy deficits in adolescence and adulthood are often accompanied by poor presentation of work, and deteriorating performance under time pressure. Moreover, problems in dynamic working memory make it difficult for adults with dyslexia to hold information in mind whilst they manipulate it, thus leading to a further range of difficulties. We have used the analogy of driving in a foreign country—it is possible, but it takes greater resources, and for dyslexic adults it may be as if they continually live in a foreign country! Some of the strongest general problems lie in organisational skills and in the ability to check work. These are natural consequences of the reduced mental "resources" caused by limitations in working memory, by slow speed of processing, and by difficulties in skill automatisation (Nicolson & Fawcett, 1990). McLoughlin et al. (1994) argue strongly that an even higher-level difficulty—a failure to understand one's own strengths and weaknesses, and in particular to predict the effects that dyslexia will have on one's performance—could be the most basic problem, which should be tackled as soon as possible. When this error-prone work is accompanied by the over-focused tunnel vision which can characterise dyslexia, it is hardly surprising that some dyslexic adults can appear to be surly. The creativity which leads them to work from first principles (West, 1991) may become a further irritant. Couple this with difficulties in picking up implicit knowledge of the work culture, and a dyslexic adult can easily become an outsider. A diagnosis of dyslexia can provide an explanation for a wide range of difficulties which even dyslexic adults themselves may not have appreciated are associated with dyslexia. A key requirement for life support is therefore to establish the major goals for each individual, and draw up an individual support plan tuned to these specific goals.

A similar analysis holds for dyslexic children, It is not enough to provide literacy support, because many children are scarred by their difficulties, with devastating consequences—emotional trauma, loss of self-esteem, and family difficulties. Few children emerge unscathed, and many resort to clowning or disruption to mask their difficulties. Here it is important to differentiate between two forms of coping: problem-solving coping and emotional coping. An ideal approach will include a combination of analysis and listening tailored to the needs of the individual child. One area which has been largely overlooked in the literature is the impact which support of this type can have on overall performance, and we advocate using effect-size analyses for comparison with alternative interventions as outlined below.

Literacy Support

The methods traditionally recommended for dyslexia intervention are typically based on overlearning, and it can become difficult for children to maintain their motivation, given their relatively slow progression. Moreover, despite recent advances in the UK in terms of the Literacy Hour, which is meant to ensure that children progress through the stages in reading in a sequence based on established good practice, it is not clear that the teaching methods used are best tuned to the teaching of dyslexic children.

What is needed is a method of evaluating different interventions, using effect sizes, a technique for comparing relative improvement across studies. In order to evaluate interventions, we need evidence from controlled studies of the comparative effectiveness of different methods for teaching reading, especially for dyslexic children. I illustrate this with some short-term intervention studies we have recently undertaken (see Nicolson et al., 1999b; Fawcett et al., 2001 for full details). Our main aim was to inform policy decisions on providing cost-effective support for dyslexic children, and we investigated two issues: first, how much improvement could be achieved with a low-cost intervention; and second, whether such an approach was suitable for dyslexic children. From the viewpoint of policy, the important question is: how can we best use resources so as to achieve the maximum benefit per unit cost? Surprisingly, research had not assessed cost-effectiveness, nor noted that the longer the intervention, the more effect it is likely to have.

In our studies, we took children in infant and junior schools, identified those at risk of reading problems, gave them reading-related support in groups of three for two 30-minute sessions per week for 10 weeks, and monitored how much they improved on standard tests of reading and spelling over that period. Naturally, we also used matched control groups in matched schools who did not have an intervention, so that we could establish the relative improvement. In all studies the intervention group made significantly more progress than the control group, as measured by mean literacy standard scores. However, from the viewpoint of educational policy the key indicator is cost-effectiveness rather than just effectiveness. For cost-effectiveness one must divide the benefits (effect sizes) by the costs (teacher hours per child). The fact that our interventions took place in small groups for relatively short times (10 hours per group) means that both of our interventions

were very much more cost-effective than interventions which focus on the early stages, such as Reading Recovery.

Finally, we considered the results relating to dyslexia. In fact, in all studies there were children who did not improve much. Of these, almost all had "at risk" scores on the DEST (infant) or DST (junior) tests. We concluded that the results confirm the importance and cost-effectiveness of early intervention in a child's initial school years—the "stitch in time" approach. While cost-effective improvements in reading can be achieved at junior school, a significant proportion of junior-school children will fail to achieve lasting benefits from a relatively short intervention of this type. These children are likely to be dyslexic.

THE FUTURE

In pointing the way towards future developments in dyslexia research, I have benefited from insights derived from the round tables on causal theory, intervention and policy, and the subsequent plenary session at the Fifth International Conference of the BDA. I present here a synopsis of the findings, before drawing up some targets for dyslexia research.

Let us first consider causal theories. It may well be that, if a consensus can be reached on the need to investigate major causal theories more systematically, we can present a united front which will influence policy and practice. Certainly, identifying the causes of dyslexia can improve the timing of any intervention that might be delivered.

Emerging Consensus on Causal Theories

An emerging consensus was found that it was important to consider the biological level in addition to the cognitive/behavioural level. Further investigation is needed of all the major hypotheses, from underlying cerebellar deficits and/or magnocellular deficits to the overarching symptoms of phonological deficit, and to the double-deficit hypothesis. Systematic high-quality research is needed, based on comparative analyses of the incidence and severity of these deficits in different populations. Marker tasks for theories of dyslexia should be produced, to aid early identification. In order to establish how the theories interlink, a non-adversarial approach was advocated, based on listening to other theoretical viewpoints while maintaining stimulating dialectical processes.

Comorbidity

The need to examine commonalities and differences between dyslexia pure and plus ADHD, Specific Language Impairment (SLI) and dyspraxia was emphasised. Profiling of the developmental disorders would facilitate the translation of advances in theory into practice, in individually designed interventions.

Language

All aspects of language, including orthography, morphology and vocabulary, should be addressed in addition to phonology. Transparency and regularity in different languages should be addressed.

Genetics

Further research is needed on the interplay between genes and the environment, in relation to early and late plasticity in development. Particular reference should be made to the interaction between genetic endowment and deprivation.

Multilingualism

Further research is needed on the impact of the linguistic environment on the expression of dyslexia.

The Ontogenetic Causal Chain

A key requirement here is understanding the expression of dyslexia between birth and diagnosis. This involves two main areas; infancy and early intervention.

Infancy
Investigating learning in infancy is needed in terms of language and motor skills, in order to unravel the ontogenetic causal chain from infancy to school age. Family studies of dyslexia, and the impact of low birth weight should be examined. Marker tasks for sub-types of dyslexia should be produced.

Early Intervention
The need for early intervention was emphasised. An open-minded approach was advocated to the effects of complementary therapies, recognising the pain that dyslexic people suffer. This was coupled with the need for stringently controlled evaluations of intervention techniques.

The Brain

The potential of new tools such as fMRI, PET, EP, MEG and TMS in providing direct evidence of differences in brain organisation was emphasised, in order to provide converging evidence towards theoretical causal chains in dyslexia.

Strengths

Further attempts to investigate the strengths of dyslexia and work to these are recommended.

In the final section that follows I highlight where further research is needed to enrich our understanding of dyslexia, building on these insights derived from the conference round tables, in conjunction with those from Nicolson (2001). There are striking overlaps here, which in my view are indicative of a move towards a consensus within the dyslexia ecosystem. In this section, I focus on how to instantiate the insights derived from the round-table discussions.

Theory

Large-scale Quantitative Studies on Skills Across the Board
Aim: to identify the most extreme deficits, using a profile of deficits (including effect sizes), to complement the small-scale studies already completed, and establish how representative these data are for the general dyslexia population.

Quantitative Data on Prevalence and Comorbidity
Aim: to establish whether dyslexic children show one, two or more of the key indicators of phonological deficit, sensory deficit, speed deficit, and cerebellar deficit, based on a large-scale study using standardised tests that cover the range of the above skills to assess the relative incidence and overlap (comorbidity) of the possible different sub-types.

Quantitative Data on Dyslexia and Other Learning Disabilities
Aim: to investigate the unexpectedly high comorbidity between dyslexia and ADHD, SLI, dyspraxia, and generalised learning difficulty, including intriguing evidence of cerebellar abnormality in all of the specific disorders including ADHD (Berquin et al., 1998; Mostofsky et al., 1998).

Integrated Accounts at the Biological, Cognitive and Behavioural Levels
Aim: to establish how the various symptoms develop as a function of genes, brain and experience.

Screening and Diagnosis
There are now good screening tests available that can be used by a teacher or adult specialist to identify a profile of strengths and weaknesses and form the basis of an initial individual development plan. These can even be undertaken before a child starts school.

Need to Maintain Discrepancy Definitions
Key issues need to be resolved, before it would be appropriate to consider abandoning the discrepancy criteria, in particular because we have not yet clearly established whether there are different causes for dyslexia and more generalised learning disabilities.

Need for Positive Indices of Dyslexia
We need an index of dyslexia which is independent of reading, to cover the situations where a child has learned to read, and may no longer be classified as dyslexic,

despite their clear dyslexic profile in terms of speed of processing, learning and magnocellular deficit. This might include an analysis of learning ability.

Need for Clarity Regarding Diagnosis Relative to Other Learning Disabilities

We need a battery of fundamental tests which examine all aspects of performance, so that the diagnosis a child receives is not so dependent on the type of specialist to whom they are referred.

Need for Diagnosis in Multilingual Children

A key issue is identifying dyslexia in children whose first language is not English. The battery of fundamental tests above might clarify this issue.

Need for Diagnosis in Non-English-speaking Countries

We need cross-linguistic research, to identify commonalities between dyslexia in different languages, in order to advance the search for fundamental positive indicators of dyslexia.

Support

Turning to support, there has been considerable progress in teaching, but there remains a need for knowledge on a number of issues.

Dyslexia-friendly Teaching

We need carefully controlled evaluation studies aimed at identifying the cost-effectiveness of different support methods for different groups of children with reading problems. This will allow us to check whether the standardised pace of the Literacy Hour is appropriate for dyslexic children. We need to develop fluency and knowledge as well as phonological skills. Finally, we need to establish whether the same techniques are appropriate for dyslexic and non-dyslexic poor readers, as well as normal readers.

New Technology

Our research suggests that the computer provides a good method to maintain motivation, while developing automaticity in skills, and we now need to see the computer, the teacher and the learner as a team.

Exploiting Strengths

We need to remember that good learning builds on strengths rather than weaknesses.

Policy

The record of UK governments in this area is outstanding. There are further changes in hand at all stages: pre-school policy will concentrate on the development of learning in the pre-school years, in terms of a series of targets for nursery provision similar to the National Curriculum; a policy of inclusion for children with special needs will be implemented (see Peer & Reid, 2001 for further information); and finally issues of adult literacy will be addressed following the Moser report. Large

amounts of funding have been dedicated to implement these policies across the age range. We need to ensure that these advances in provision can build towards a dyslexia-friendly policy, based on a comprehensive and united research programme aimed at a complete and inclusive analysis of dyslexia theory, diagnosis and support.

CONCLUSIONS

In conclusion, the breadth of perspectives addressed in a book such as this, makes it very clear that considerable progress has been made in dyslexia research. However, dyslexia research has now reached a crossroads. In my view, we can best move forward by linking our research to the needs of policy and the government, providing the opportunity for a cohesive approach, based on partnership and moving towards a new strategy for dyslexia.

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