Delivering Skills for Life

The national strategy for improving adult literacy and numeracy skills

A Framework for Understanding Dyslexia

Information on theories and approaches to dyslexia and dyscalculia

department for
education and skills
creating opportunity, releasing potential, achieving excellence

read·write·plus

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This document was produced as part of a project to research approaches to teaching and learning with dyslexic learners in adult literacy, numeracy and ESOL provision undertaken in 2003–04. The project was jointly led by the Learning and Skills Development Agency and NIACE on behalf of the Department for Education and Skills.

A web version and additional materials can be found at:
www.dfes.gov.uk/readwriteplus/understandingdyslexia

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Images on the cover and throughout this publication were taken from video footage of sessions between teachers and learners.

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Skills for Life: the national strategy for improving adult literacy and numeracy skills

Many millions of adults in England need help to improve their literacy, language and numeracy skills. *Skills for Life*, launched by the Prime Minister in 2001, sets out the Government's strategy for meeting these needs.

Since the launch of *Skills for Life* we have gained an even greater insight into the effects of low levels of literacy and numeracy skills on individuals, their families, the economy and society. For example, adults with poor literacy and numeracy skills could earn up to £50,000 less over a lifetime and are more likely to have health problems, live in a disadvantaged area, or be unemployed. They and their children risk being cut off from the advantages of a world increasingly linked through information technology. Additionally, poor literacy, language and numeracy skills have been estimated to cost this country in excess of £10 billion a year.

Skills for Life is not an education-only strategy, nor is it just a Government response to literacy, language and numeracy skills needs. It covers all post-16 learners on learning programmes at levels from Pre-entry up to, and including, Level 2. These courses range from discrete and embedded classroom and community provision, to voluntary and work-based learning. *Skills for Life* addresses assessment through Key Skills, GCSE Maths and English and adult literacy and numeracy skills certification. It is therefore crucial that the strategy supports and reflects the successful implementation of other post-16 strategies. These include *Success for All*, the strategy for reforming post-16 further education, and the Skills Strategy, which aims to ensure that the skills we develop are valuable to young people and valued by employers. Our goal to improve the skills of young people is also central to the *Opportunity and Excellence 14–19* strategy.

Every organisation and individual has a contribution to make. Partnership and the ownership of *Skills for Life* by all our key, supporting and development

partners are the most important elements for successful delivery.

Government departments, the Learning and Skills Council (LSC), JobCentre Plus, the Prison and Probation Services, external partners in the post-16 learning sector, businesses, the CBI, the TUC and many others are all working together to improve the literacy, language and numeracy skills of adults through:

- **boosting demand** for learning via a high-profile promotional campaign and by engaging all partners across Government and employers in identifying and addressing the literacy and numeracy needs of their clients and employees
- **ensuring capacity** of provision by securing sufficient funding and by co-ordinating planning and delivery to meet learners' needs
- **improving the standards** of teaching and learning in literacy, numeracy and English for Speakers of Other Languages (ESOL) provision
- **raising learner achievement** through the new national learning, teaching and assessment infrastructure and reducing barriers to learning.

What is the Framework and who is it for?

This Framework provides general information on the nature of dyslexia, a review of theories about dyslexia, an overview of approaches and programmes used by specialists who support dyslexic learners and a resources section including detailed information on dyslexia theories, a list of further reading and a glossary.

It is designed for teachers working in post-16 education or training. It is aimed particularly at those who teach literacy, language and numeracy, either within discrete provision or embedded within another academic or vocational programme, but who are not specialists in the field of dyslexia. We hope it will provide useful information both for existing teachers and for teachers in training.

All teachers need an awareness of the indicators of dyslexia and dyscalculia and need to know how to respond when they recognise them. About 4% of the population are thought to be affected to a significant extent by dyslexia. As many as a further 6% of the population may be affected to a lesser extent – but some suggest that the percentage may be higher. Most literacy, language and numeracy teachers will have some dyslexic learners in their groups and the Disability Discrimination Act requires all teachers to be prepared to respond to their needs.

The Framework contains four sections:

- Introduction
- Theories of dyslexia
- Approaches and programmes used by specialists
- Resources

The Framework does not duplicate the guidance given in the Department for Education and Skills publication *Access for All: Guidance in making the adult literacy and numeracy core curricula accessible*. However, teachers are recommended to refer to *Access for All* as perhaps the best source of practical teaching suggestions to help dyslexic learners that is currently available.

The Framework itself is also available in a web-based version at

www.dfes.gov.uk/readwriteplus/understandingdyslexia

This Framework was produced as part of a project to research approaches to teaching and learning with dyslexic learners in adult literacy, numeracy and ESOL provision undertaken in 2003–04. Part of that project involved action research with organisations where approaches covered in the Framework are in use. On the website, together with the Framework, are additional materials from those action research projects. These include learners and teachers talking about each approach and images of the approaches in action.

Introduction

This section is written for literacy, numeracy and ESOL teachers who are not dyslexia specialists. It is designed to be of use for teachers in discrete *Skills for Life* provision and for those who support the development of literacy, language and numeracy in learners on other programmes. It provides general information on dyslexia and dyscalculia to help teachers understand and respond to the needs of their learners.

What is dyslexia?

The word 'dyslexia' comes from the Greek 'dys-', meaning difficulty with, and '-lexia', meaning words or language.

There are many reasons why people find it difficult to learn to read, write, or spell. For many such people, those difficulties can be explained by the normal range of opportunity and experience.

For others, however, those difficulties do not seem so easily explainable. Such learners may be what is termed 'dyslexic'. We understand dyslexia to be a specific difficulty, typically characterised by an unusual balance of skills. Dyslexia affects information processing (receiving, holding, retrieving and structuring information) and the speed of processing information. It therefore has an impact on skills such as reading, writing, using symbols and carrying out calculations. However, there are many differing definitions; dyslexia is an umbrella term. It is important to recognise that:

- dyslexia is not related to intelligence and can occur in severe, moderate, or mild forms
- people with dyslexia have their own individual profiles of strengths and weaknesses; no two people are exactly the same and the impact of dyslexia on each individual is different

- dyslexia does not only affect literacy skills such as spelling, but most of what we know about it relates to its relationship to language and literacy
- dyslexia may overlap with related conditions such as dyspraxia, attention deficit disorder (with or without hyperactivity) and dysphasia
- most people appear to be born with dyslexia, although others acquire it through accident or illness
- many people with dyslexia have a family member with the same condition
- some researchers think that dyslexia affects more men than women; others think that roughly the same numbers of males as females are affected.

The 'deficit' versus 'difference' models of dyslexia

The traditional view of dyslexia as a 'problem' is being challenged. The fact that dyslexia causes difficulties in processing information is generally accepted. Some now suggest that the neurological differences found in people with dyslexia may confer advantages for some individuals. This may explain the apparent paradox that some individuals who have problems with elementary skills such as reading and writing can be highly gifted in other areas. Dyslexia is increasingly being recognised as a difference in cognition and learning rather than a deficit.

Although most of the literature on dyslexia focuses on the difficulties it causes, dyslexic learners may possess, or have developed, more positive talents such as:

- creativity
- thinking laterally and making unexpected connections
- being able to see the 'big picture'
- good visual spatial skills and being able to think easily in 3D
- problem-solving skills
- good verbal skills
- good social skills.

They may learn well when they can:

- make personal, meaningful connections to secure things in their long-term memory

- remember patterns rather than sequences
- remember landmarks rather than directions
- think holistically ‘all at once’ rather than step-by-step
- learn to read and write by being very interested in the subject
- learn by experience, not from being told.

How does dyslexia affect learning?

Dyslexic learners’ weaknesses lie in areas such as phonological or visual processing of sounds and/or letters and numbers, sequential aspects of language and number, time and direction and short-term memory. This means that many learners with dyslexia have the following characteristics that may impact on their learning, though not all dyslexic learners will have all these characteristics:

- Difficulties in organising work and other aspects of their lives.
- A poor sense of the passage of time, mixing up dates and times and missing appointments.
- Directional confusions, getting lost easily and having problems using maps or finding the way to a new place.
- Difficulty in achieving automaticity when they have to do more than one thing at a time, as in taking notes.
- Difficulty in carrying out instructions, copying from the board and remembering what has just been read or said, taking messages, remembering phone numbers and dialling numbers accurately.
- Poor motor control, resulting in difficulties in controlling a pen (leading to untidy handwriting with

many crossings out and making it difficult to get ideas down on paper).

- Difficulties in recognising, or confusion between, letters or familiar words when reading or remembering the visual image of words, signs, or symbols.
- Mispronunciations caused by difficulties in discriminating between sounds.
- Difficulties in reading text caused by visual distortions such as blurring or moving letters.
- Problems with sequencing such as with instructions and mathematical procedures or sequences of numbers or letters and difficulties using dictionaries, encyclopaedias and directories.

'I find that sometimes, if I'm not really concentrating on what I'm saying, when I'm speaking, I manage to get the order in what I'm saying jumbled up. I sound like Yoda!'

Learner with dyslexia

'You have got the ideas exactly like a painter, you know exactly what colours you want to use…but if you come to put it on paper, it is very different, it is a nightmare.'

'I forget things a lot. Short-term forgetfulness normally. Silly things like forgetting my bus pass, travel card…getting on a train and getting off the other end and I've got no pass with me, so I have to go back.'

Learners with dyslexia

What do we know about dyslexic adult learners and their approach to learning?

Most of what we know about dyslexia relates to the effect it has on the learning of language and literacy skills – but it can also create difficulties with maths.

Adults with dyslexia are individuals and come to learning with their own histories, ambitions and abilities. They will be at different levels and have different learning needs. They will have some problems in common with other adult learners, but many that

‘Words move around the page. They’re always moving, especially numbers. Numbers are terrible.’

‘…numeracy is something I’ve always tried to avoid because it’s an issue for me…I don’t remember the rules for how to do sums.’

Learners with dyslexia

‘I just could not realise why these really bright lads, they were so clever at avoiding reading and writing. I thought they’re bright, but they can’t read and write, so it’s obviously not because they are stupid, because they are very good in their primary subject.’

Teacher who went on to become a dyslexia specialist

appear specific to their dyslexia. Within their dyslexia they will have an individual profile of strengths and weaknesses, and strategies they have developed to deal with these.

Unlike young children, adults have already developed physiologically as well as psychologically and this includes the neurological ‘pathways’ for processing visual and auditory information. They will have had to develop compensatory strategies for their weaknesses in perceiving or processing written language, for their memory difficulties and other problems. Some of these will be helpful, but others may need to be unlearned in order for adults to make progress.

Compensatory strategies may include relying heavily on long-term memory. Long-term memory is based on meaning, so adult dyslexics often have a very personalised approach to remembering. This may involve pattern or colour; or it may involve mnemonics that relate to their personal associations.

Other compensatory strategies might be the use of holistic or ‘global’ learning approaches. Such learners often learn best if they can see the whole before trying to understand the parts; they may be thought of as ‘grasshoppers’ rather than ‘inchworms’. The inchworm takes a step-by-step approach to solving problems; the grasshopper makes

intuitive leaps, jumping over steps, or approaching a problem in a different way. Grasshoppers may have difficulty showing how they got the answer and may need help to be able to describe their thinking processes.

Acknowledging the effects on adult learners of their previous experience of learning is important. It may have had a negative impact on them. Dyslexic adults may not have had their difficulties identified at school and may have been labelled 'thick', 'lazy' or 'careless'. They will have experienced repeated failure to learn by traditional methods and are likely to have experienced intense frustration in trying to do what their peers seem to be able to do. They are often confused about their abilities and have no way of understanding the reasons for their failure at school. Many will have accepted the negative labels given to them and believe themselves to be unable to learn.

In addition, lack of literacy and/or numeracy skills may have limited their level of educational attainment. This may have restricted opportunities in areas where the learners have strengths. It may have also held back learning at a higher level.

'It's something that you sort of know yourself. You'd hold it in and not tell anybody. Because you was ashamed and you wasn't, like, fitting in.'

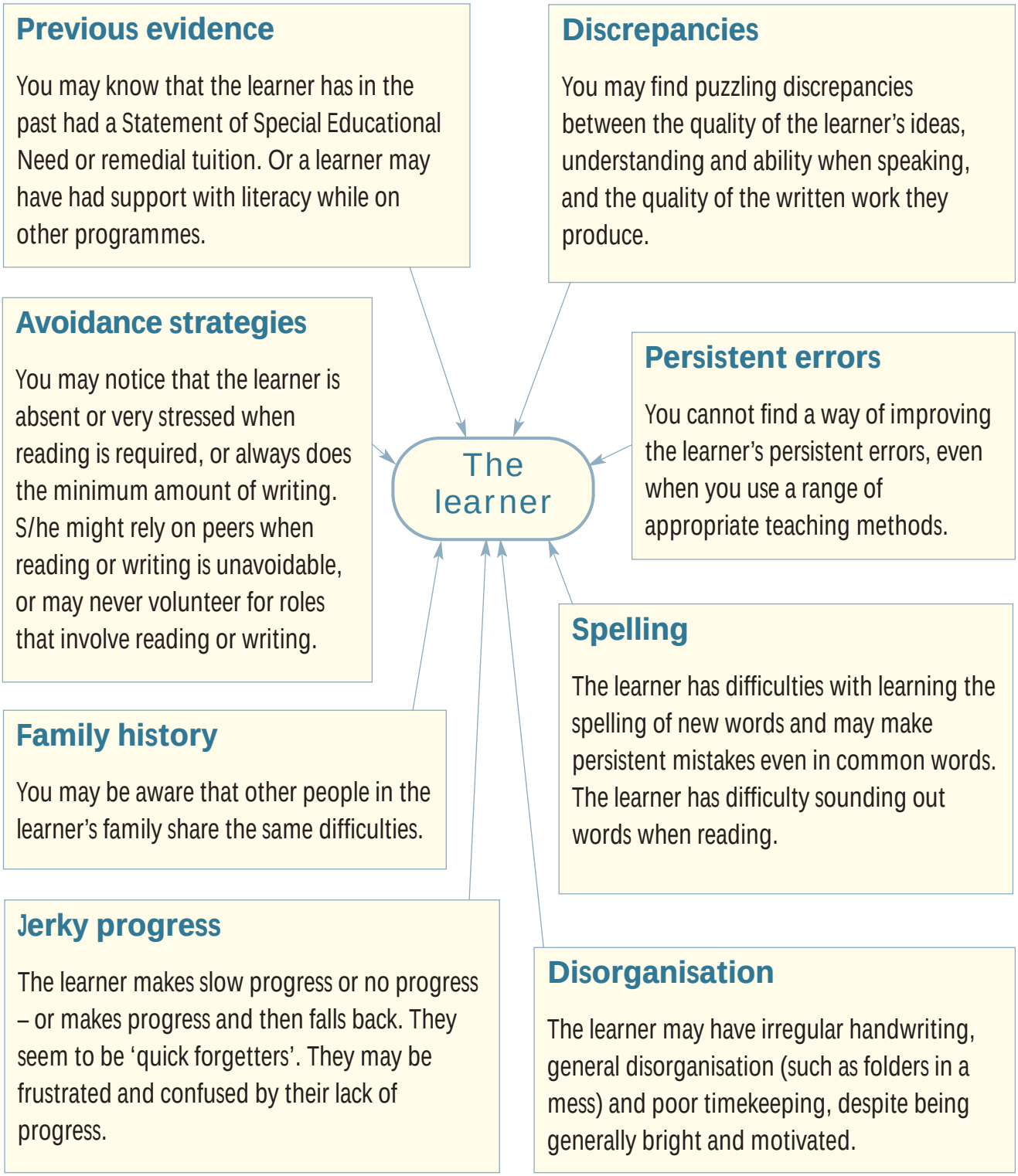
'Before, it was like I never grew, like inside, like up here in your head. But now it just feels as if it's filling out. I can't explain it, I feel like a plant that's grown.'

'I think they called it backward then.'

Learners with dyslexia

Learners who have recently been diagnosed as dyslexic may feel anger at previous negative experiences and will need support to deal with such emotions. Once learners have understood their difficulties – and that these are not related to intelligence – their self-esteem may grow.

How might you recognise a learner with dyslexia in your group?



What should you do if you think a learner might have dyslexia?

The Disability Discrimination Act has applied to education since September 2002 and covers dyslexia. The Act requires providers of education to:

- offer opportunities to learners to disclose that they have a disability
- ensure that all those who need to know are informed once a learner has disclosed a disability
- make 'reasonable adjustments' to allow that learner equal access to all 'student services' – which includes facilities such as the library, learning centre and teaching in the classroom.

This means that learners are entitled to have an assessment for dyslexia if they wish, so you need to find out to whom to refer the learner – either to a specialist within your organisation, or to an external organisation. It is important that learners are offered the option of a formal assessment. Some may decline, but might be prepared to have a preliminary chat with a specialist, or might prefer to leave the option open.

Under the Act, reasonable adjustments in the case of dyslexia might include:

- using a wider range of teaching methods appropriate to dyslexic learners
- reworking of handouts and background reading requirements to make them more accessible
- printing on paper of the colour preferred by the learner, or offering coloured overlays
- having assistive technology or readers and scribes available
- organising extra time and other facilities for exams and assessments.

Dyslexic learners may also benefit from specialist support, at least for a short time, especially if they are not making good progress or, more

importantly, are frustrated with their progress. It is also helpful to get advice on teaching methods from a dyslexia specialist.

When should you refer a learner to a specialist?

In this document, the term 'specialist' refers to those whose main role is to support dyslexic learners and who have been trained specifically for that role. Some specialists follow specific programmes. Others have developed their own ways of working with adult learners, drawing eclectically from a number of different approaches. It is important to remember that no one method appears to be effective with all dyslexic learners, although all methods seem to work for some learners.

A learner should be referred to a specialist when applying a range of appropriate teaching methods has not helped or produced the rate of progress you would expect. It might be appropriate to refer a learner when:

- difficulties appear to be severe and/or persistent
- the learner appears to be underachieving
- there are examination considerations or issues of progression (for example into higher education)
- the learner appears to be concerned, frustrated or distressed about their progress
- the teacher is uncertain how best to teach the learner.

What can you do to help people with dyslexia to learn?

Many of a dyslexic learner's needs can be met within their usual learning situation, with or without specialist support. Indeed, non-dyslexics may well benefit from the range of methods used to teach dyslexics.

More detailed advice for teachers of literacy and numeracy will be found in *Access for All*, *Broadening Access* and *Making the Curriculum Work for Learners with Dyslexia*, which relate to the adult literacy and numeracy core curricula. This Framework draws from *Access for All*, but does not duplicate the detailed information to be found there.

General principles of good practice

The following are some general principles to follow when providing teaching or support to dyslexic learners:

- Be explicit – dyslexic learners are often very literal.
- Explain the reason for suggesting any approach and encourage learners to evaluate whether or not it works for them – they may not yet know how they learn best.
- Create an environment where making mistakes is seen as part of the learning process.
- Teach (choose activities, prepare materials, set tasks) to the level of difficulty the learner has, but interact with the learner at their level of intelligence.
- Tell learners in advance what the structure of any learning session will be.
- Explain the conventions; dyslexic learners need to know when a requirement is simply a convention, such as the layout of an essay or a newspaper article, or spelling patterns that do not seem logical.

Involve learners in their learning:

- Listen carefully to what dyslexic learners tell you about their learning. How they describe the processes of reading and writing will tell you a lot about their different approaches.
- Help learners to understand dyslexia by exploring their strengths and the strategies they use.
- Explore their typical difficulties (many of which will be common with other learners) and what has and has not worked in the past.
- Promote self-confidence by giving learners the experience of success and positive feedback.
- Use approaches that encourage self-directed and independent learning so that learners feel in control of their learning.

Develop ways of supporting dyslexic learners:

- Do not focus exclusively on literacy deficits. Consider the learner's personality, motivation, cognitive strengths and successful learning experience as well as their particular dyslexic characteristics.
- Make sure you are using a range of multisensory methods.
- Learn different ways to present information and make it accessible.
- Offer supportive, staged help when requiring learners to read or produce written work.

Allow more time:

- Give plenty of opportunities for overlearning, practice in meaningful contexts and revision.
- Allow time for discussion and reflection.
- Plan ahead and be flexible in your deadlines.

How can you help with reading?

- Listen to the learner describing their experience of reading in order to understand their individual experience.
- Review the reading load and guide learners to the most important sections that need to be read.
- Avoid the use of text-dense material where possible; space helps understanding for all learners.
- Include graphics such as pictures, diagrams and cartoons in handouts to provide reference points and visual clues.
- Print handouts on paper of the colour your dyslexic learners prefer.
- Be aware that some fonts are more difficult to read than others. This varies from learner to learner, but Arial, Comic Sans and Tahoma are generally the clearest.
- Enlarge text where appropriate – never reduce the size of print.
- Identify, explain and discuss new vocabulary when it arises. Give word lists with clear definitions.
- Encourage learners to note specialist vocabulary and its meaning in a personal dictionary.
- Avoid requiring learners to copy from the board or OHT. Use

black/white boards only to give examples, elaborate a point, or provide key words or names. Avoid using a cursive script on the board – make sure your writing is legible, large and clear, and read out what you have written.

- Where possible, guide the learner towards audio-visual sources such as learndirect or Open University programmes, television documentaries, videos and the Internet.
- Use DARTs to focus on specific, difficult aspects of text.
- If appropriate, provide or encourage the use of a reader or scribe/note-taker either in class or in preparation work.
- Give handouts prior to the lesson so that dyslexic learners can familiarise themselves with the text.

How can you help learners to make notes?

- Explicitly discuss the process and purpose of note-taking with the learners. Make sure they know the different ways of making notes.
- Remind learners regularly of the importance of labelling and dating their notes.
- Provide skeleton notes in advance, giving the headings of the content you plan to cover. Do not present too much information on one sheet.
- Read extracts of text to the group, encouraging learners to highlight key points and underline unfamiliar vocabulary. Learners should be encouraged to highlight and underline the text, and to make notes in the margin when reading.
- Use mind maps and simplified diagrams in handouts and on the board.
- Offer a back-up, such as a separate handout, cards summarising key points, or a 'study buddy' system where a fellow learner allows access to their notes.
- Write specific terminology and key points on the board.
- Allow the use of a tape/MiniDisc recorder if the student feels this is useful.

How can you help learners with their writing?

- Demonstrate and explain what is expected when doing an assignment or learning activity. Offer models of written work (essays, reports, letters).
- Offer help with how to plan, structure and organise work. Find ways to free learners to compose without constraint – using tape-recorders, computers, or writing their ideas down for them. Use writing frames and other scaffolding techniques.
- Teach learners how to edit their work.
- Offer explicit direction on how to proofread and provide opportunities to practise. Dyslexics should be encouraged to separate the process of writing from that of proofreading. Allow time between the two; if possible do something else in between. Encourage proofreading three times: once for content and organisation; once for grammar, expression, sentence structure, etc.; and once for spelling. Proofreading each other's work can be beneficial, but ensure that there is no risk of humiliation.
- Make sure that dyslexic learners have enough space to write so that their motor movements are not hindered. Check that the lighting is sufficient for the learner and offer them a choice of position where possible.
- Some dyslexic learners prefer to work from the back to the front of files and exercise books.

How is dyslexia assessed?

There are different types of assessment activity which have different purposes and involve different people. These include in-house specialists, educational psychologists and external dyslexia specialists. It is important to make a distinction between screening and diagnostic assessment.

Dyslexia screening is a relatively simple, quick method of indicating whether learners might have dyslexia. Staff who are not specialists can carry out screening and tests, such as the Adult Dyslexia Organisation's checklist, which can be used by learners to assess themselves. The Adult Basic Skills Strategy Unit's diagnostic assessment materials include a dyslexia screening test and the Dyslexia Institute's *Dyslexia Adult Screening Test* is also available.

Many organisations carry out basic skills screening designed to assess the level of a learner's literacy or numeracy skills. This is not the same as a dyslexia screening.

Diagnostic assessment for dyslexia, on the other hand, is in-depth assessment designed to identify dyslexia and the pattern of individual strengths and weaknesses. It should help learners understand how they learn and give them recommendations for support. These assessments need to be carried out by qualified staff – either trained specialists from within your organisation, or external specialists such as educational psychologists.

Be sensitive on the issue of assessment. Some learners will be eager for assessment, having felt for years that there was something wrong but never having that feeling acknowledged. However, some learners who have been encouraged back into learning after previous negative experiences may be highly resistant to being 'sent' for assessment. You need to present the assessment as an opportunity for the learner to gain understanding, to

'Often people say, "Oh, right…", they might be angry, they might be sad, there might be all sorts of reactions, but it takes a lot longer before they start to really understand how exactly this has caused the problems. Once they know why they are having such difficulty, then you can find ways round it. You can use their strengths and say, well this is a problem, it's going to nearly always happen, we are finding our way round it and it's the same thing that makes you good at art or whatever it is you are good at.'

Teacher of learners with dyslexia

access additional support, or to benefit from special arrangements, for example in examinations. In this way, learners who have struggled throughout their educational careers may positively welcome the opportunity.

Learners will be empowered when they understand clearly the outcomes of the diagnostic assessment and can use the information to advise their teachers about what will help them to learn effectively. Teachers need to act on this information and to ensure that their teaching approaches match what the learner needs. This is what the Disability Discrimination Act requires. All staff working with the learner need to be aware of what they can do to help the learner learn effectively.

What about assessing for dyslexia in learners who are multilingual?

Until recently, the area of multilingualism has received little recognition in relation to dyslexia. Some believe that people for whom English is an additional language tend to be under-identified as having dyslexia (Hutchinson *et al*., 2001). Differences in cultural background, difficulties with English and the possibility that learners may not write in their first language may mask dyslexia. Cline and Reason (1993) stress that assessment for dyslexia is an equal opportunities issue.

Several areas of difficulty are highlighted by Sunderland (2000). It may be difficult to tell whether a learner's difficulties are due to dyslexia or to the fact that they are learning English. Knowledge of their own language may affect how they use English and if a learner's prior schooling has been limited, this is likely to affect performance in an assessment. It is important to consider the extent to which cultural bias contributes to difficulties in understanding text.

Research shows that it is possible to diagnose dyslexia in adult learners even when they are in the process of learning English. To check, it is necessary to ask learners about difficulties they may experience in their first language as well as in English. The structure of the learner's own language also needs to be taken into account. For example, does the student still experience difficulties even if their first language is phonetically regular? Diagnosis should take account of the length of time the learner has been in England, the

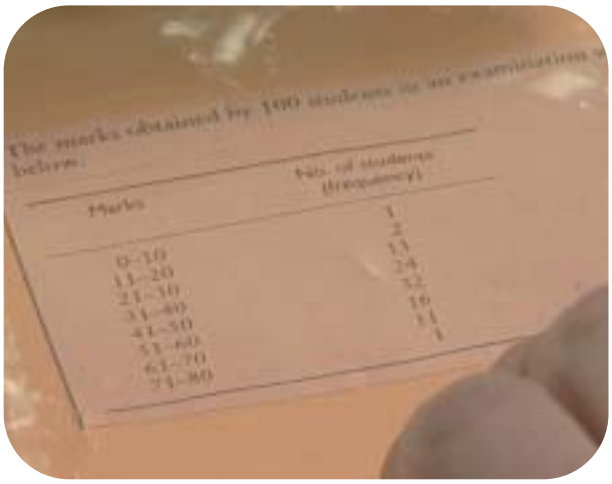
amount of time s/he has spent studying English and her/his level of spoken English compared with her/his reading and writing skills. Assessments such as reading passages need to be carefully chosen to ensure that they are culturally familiar to the learner.

What are the differences between dyslexic difficulties with maths and dyscalculia?

If the difficulties that most of us associate with dyslexia are compared to the skills needed to succeed in maths, a considerable overlap is obvious. Most of the difficulties experienced by the dyslexic learner affect the skills required to succeed in maths.

Perhaps the only weakness commonly associated with dyslexia that does not affect maths is that of spelling. Mathematicians use symbols where possible rather than words. Obviously these symbols have to be understood and memorised, but spelling is not of major importance.

On the other hand, perhaps the only skill needed to master maths that does not appear as a dyslexic weakness is that of understanding 'numerosity'. Numerosity means recognising the size of a number and its value relative to other numbers. This basic understanding underpins all work with numbers and their relationships to one another. The lack of numerosity is often at the core of current definitions of dyscalculia. It seems to be the key difference between dyscalculia and dyslexic difficulties with maths.



For practitioners, however, the picture is further complicated by dyslexic learners' underlying mathematical ability. Dyslexic learners, like any other people, include those who are mathematically able and those who are not. There are dyslexic learners who can enjoy maths and have a general mathematical ability despite the difficulties their dyslexia gives

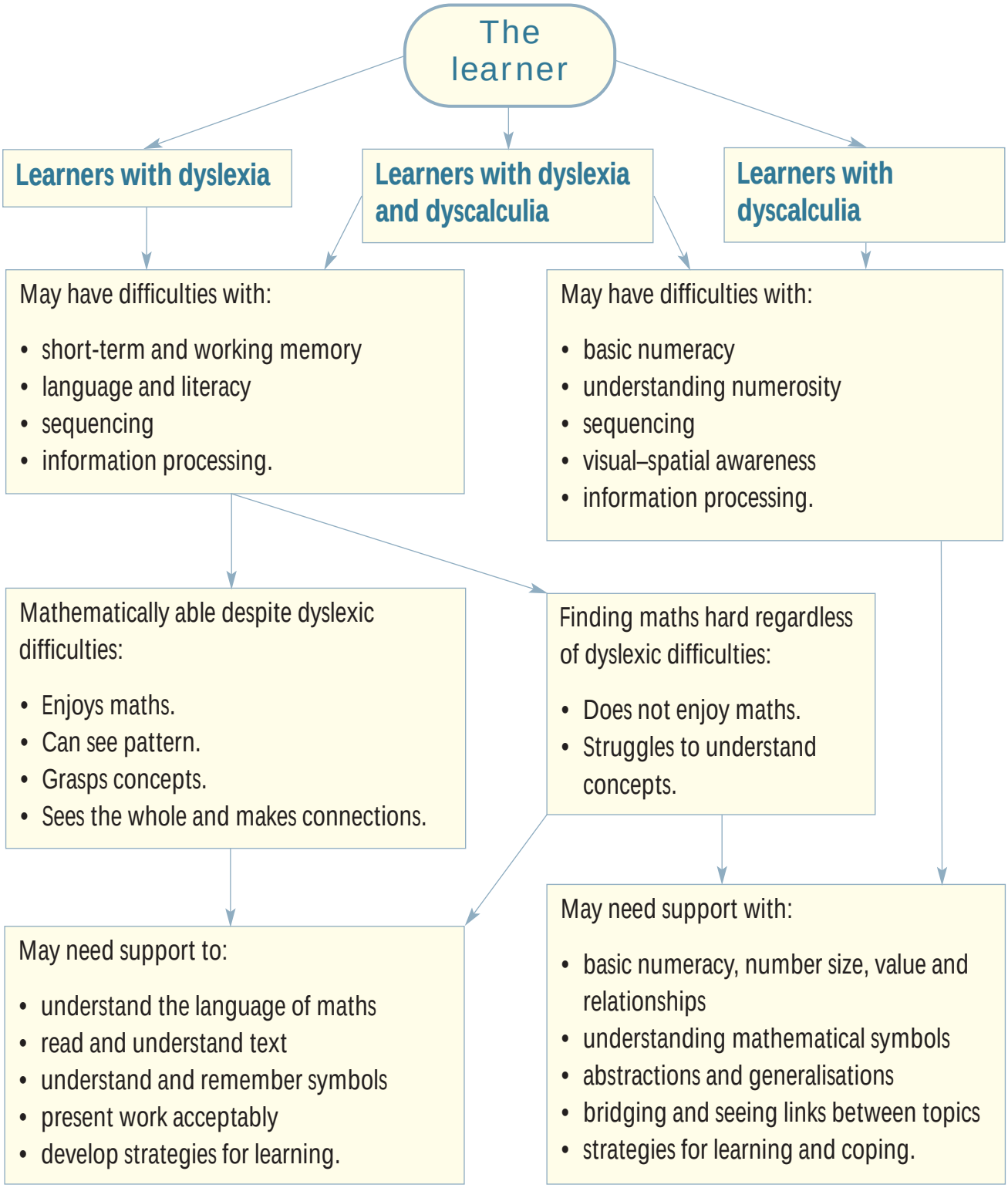
them. They can see the patterns and how numbers fit together and understand concepts if they are presented in accessible ways. Then there are others who, even if they were not dyslexic, would find maths uncongenial and hard to learn. This is a factor that affects the support that dyslexics may need. The diagram on the next page attempts to set out how these various factors combine.

How does dyslexia affect maths?

Dyslexic difficulties are most likely to cause the learner problems in maths in the following ways:

- ***Short-term and working memory***
  Difficulties with short-term and working memory will affect the efficient learning of number bonds, multiplication tables, mental calculation, etc. However, dyslexic learners can draw on their ability to see patterns and the big picture to compensate.
- ***Language decoding and comprehension***
  Poor decoding and comprehension skills may make it difficult for a dyslexic learner to understand written verbal problems in maths and to master the technical language of the subject.
- ***Sequencing***
  With the advent of the word processor, sequencing in literacy is less problematic for dyslexics than it once was; essays can be reordered and sections changed, both during and after writing. In maths there is no choice as to where to begin to solve a question. It cannot be reordered during or after the solution has been reached. Difficulties in sequencing mean that many dyslexic learners may understand the concepts involved in a maths question and know what has to be achieved, but are unable to correctly sequence the procedures to achieve the right answer. They may also find it difficult to explain how they arrived at the answer, even when they are successful.
- ***Speed of information processing***
  Slow information processing will mean that work in the classroom often goes too fast to allow for sufficient practice and consolidation. Dyslexic learners may need more time for understanding the question and for overlearning.

Learning maths: learners with dyslexia and learners with dyscalculia



How can you help learners with dyslexia to learn maths?

Of course, the principles of good practice apply to the teaching of maths as much as to any other teaching. Specific points relating to the Adult Numeracy Core Curriculum are listed below. *Access for All* is another useful resource. This section draws on the Department for Education and Skills document *The National Numeracy Strategy – Guidance to Support Pupils with Dyslexia and Dyscalculia*.

Number

- Use multisensory methods to help learners with the basics, such as counting accurately, distinguishing number symbols that are similar in shape and recognising number patterns. The use of fraction walls, circles, or other visual aids may help. Squared paper helps with organisation and accuracy. Work with concrete materials wherever you can.
- Allow time for overlearning of key number facts.
- Learners benefit from being shown number patterns that are extensions of earlier knowledge, for example 3 + 2 = 5, 43 + 2 = 45.
- Dyslexic learners may find the transfer of a learned sequence, say, *90, 80, 70…* to a modified sequence *92, 82, 72…*, challenging. Base ten blocks or coins may help illustrate which digit changes and which remains constant.

Calculations

- Encourage learners to use jottings to prevent them losing track mid-process.
- Mental calculations often favour working with the most significant digit first. It may be useful for some learners to apply this approach to written calculations.

- Calculators help with the speed of processing and with difficulties remembering symbols and operations.
- Get learners to talk through what they are doing as they work, always using the same mathematical language. This helps not only the process of calculation but the mastering of the language.
- Take care not to overemphasise the mechanics of maths at the expense of the meaning. A 'big picture' visual overview on the board or flipchart can draw on dyslexic learners' strengths and build confidence in the idea that maths is conquerable.

Solving problems

- Explain mathematical vocabulary. Wherever possible, use images or give examples from a real context. Make sure language problems are sorted out before learners attempt to solve a problem.
- Only use abstract terminology once learners have understood the relevant concepts. Use informal or colloquial 'translations' alongside formal vocabulary.

Measures, shape and space

- Dyslexic learners may find drawing shapes challenging. Support such as joining dots or modelling in plasticine adds a multisensory approach.

Handling data

- The points on a grid and the x- and y-axes of graphs can be confused by some dyslexic learners. A simple mnemonic – 'along the corridor and up the stairs' – may help.
- Diagrams are easier to interpret if different colours are used to represent the data.
- Learning and using the terms *mode*, *median* and *mean* is difficult to master as they all begin with the same letter. Use separate coloured index cards with the words and their meanings written on them.

What do we know about dyscalculia?

The Department for Education and Skills defines dyscalculia as

> 'A condition that affects the ability to acquire arithmetical skills.

> Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence.'
> (*The National Numeracy Strategy: Guidance to Support Pupils with Dyslexia and Dyscalculia*)

Dyscalculia is therefore fundamentally different from dyslexia, though its characteristics may overlap. Learners may, of course, have both dyslexia and dyscalculia. Like dyslexia, dyscalculia is not caused by poor or interrupted teaching, nor by low intelligence, although both of these may result in the appearance of characteristics similar to those of dyscalculia.

Dyscalculia appears to be a difference relating specifically to number. This means that dyscalculic learners do not have the difficulties with language that are associated with dyslexia. In fact, their language ability may be above average.

'We use spiral learning, that's going back and revisiting what you've done…the cumulative bit. Traditionally, maths teaching has been that you do something and then you leave it behind… and links across certain topics aren't made. Maths can be taught in very much a linear fashion, you see maths as a set of strands and they have little to do with each other. We try and work across those strands and show that number goes across, we get students to have a feel for number.

Maths…gets abstract very quickly, so link it to a practical activity or their experience wherever you can. Make them aware of the kind of errors they are likely to make – they might miss out a step in a sequence, you have to think of how their dyslexia is likely to impact on them.'

Teacher teaching numeracy to learners with dyslexia

Our present understanding of dyscalculia and its effect on learning mathematics is more limited than our understanding of dyslexia and its effect on learning mathematics. Current definitions are primarily descriptions of the characteristics of particular learners. They offer little help to practitioners in understanding the causes. The lack of an ability to recognise numerosity may be inborn. We do know, however, that individuals can acquire through brain injury what we might label 'dyscalculia', that is, the loss of the ability to recognise numerosity.

Some researchers suggest that there may be several subsets of mathematical difficulties other than the number-based definition of dyscalculia given above, although each of these would require further investigation. They include difficulties in:

- procedure and sequencing
- algebra
- geometry
- trigonometry.

There is, to date, little or no specific research into difficulties in these areas, although research into difficulties with numerosity may shed more light on them.

How common is dyscalculia?

Findings in studies into the incidence of difficulties in basic number skills range from about 6 to 7% of school-age children (Gross-Tsur, Manor and Shalev, 1996; Badian, 1983; Kosc, 1974) to 3.6% (Lewis *et al*., 1994), but these figures do not separate learners with maths difficulties from learners with maths and literacy difficulties. The research by Lewis *et al*. (1994) using nine to ten-year-olds included the finding that 1.3% of children of normal ability had specific arithmetical difficulties, but normal reading.

There is currently no assessment tool available to teachers for dyscalculia and those educational psychologists who are interested in the field have only the standard psychology tests used for literacy assessment.

This means that at present we have no way of knowing how many learners may have dyscalculia.

Diagnosing dyscalculia in adult learners

A recent computerised screening test from Professor Brian Butterworth is available for children and this is due to be followed by one for adults. Butterworth is a leader in this field of research and his screening test is based on his current definition of dyscalculia. Further assessment and screening tools from other researchers may be forthcoming. In the meantime, diagnosing dyscalculia in adult learners presents particular challenges.

The maths that most adults retain after they leave school is the understanding of number. Once we leave school, the maths ability we retain is increasingly directed by our needs. Most adults do not need to use algebra or trigonometry. We do, however, need basic numeric ability to:

- add and subtract, multiply and divide
- work with simple fractions, decimals and percentages
- adapt these topics to cope with money, weights, measurement, bank statements, timetables and so on.

Our other mathematical knowledge tends to fade because we are not practising it regularly. Therefore, because it relates to difficulties with number, dyscalculia might be expected to have a significant impact on adult learners.

But identifying it clearly is not easy. Adults use strategies such as calculators for convenience and speed when making calculations. The use of such strategies means that the time we need to perform such calculations without the calculator increases because of our lack of practice. Adults' performance on a test for difficulties in maths might be slower and poorer than their actual ability – with a bit of revision and practice. This makes such test results unreliable as assessments of ability.

How can you help learners with dyscalculia?

There are no comprehensive answers to this question. At present teachers can only do their best with the knowledge and tools available.

Like dyslexia, dyscalculic symptoms may be aggravated by low ability, poor health, poor teaching,

interrupted schooling and emotional or social problems. These aspects need to be understood and addressed by teachers. However, as we understand it at present, dyscalculia is not the result of any of the above. Dyscalculia will persist despite the disappearance of these problems.

What teaching methods work for learners with dyscalculia?

There is at present no research on the way that dyscalculic learners are most effectively taught and supported. Currently the recommendation is that good practice for dyslexic learners is drawn on in teaching dyscalculic learners. Teaching should be structured, cumulative and multisensory, allowing time for the learner to see, say and do. However, it may well be that dyscalculic learners are those for whom even such methods may not work.

In his book *The Mathematical Brain* (1999), Butterworth links the use of fingers to the development of basic number skills and describes how dyscalculic learners rely on counting on fingers to perform even the simplest calculation. It may be that an approach that develops this strategy could offer the beginnings of a compensatory approach. Other multisensory techniques used in dyslexia or dyscalculia may also be useful. In the Davis method, for example, learners use clay to make number arrays and to form the digits themselves.

However, to date, no research exists to indicate whether any method or approach is really successful.

Self-confidence and self-esteem

An important consideration in maths and dyslexia or dyscalculia is self-confidence and self-esteem. The strongest predictor of an individual's performance in maths is the individual. Those who succeed in

maths have the confidence to take risks to solve a new problem. A learner with a low, or non-existent, success rate will only tackle problems within their known success range. This means there may be little or no progress in learning.

Often, therefore, working with dyslexic/dyscalculic learners will mean looking at the confidence and self-esteem of the learner before any teaching can take place. Work needs to be structured to begin at a level at which learners can succeed and then move, slowly, step by step, into new or previously unsuccessful areas.

Relevance

Most individuals with dyslexia can see the need to develop their reading and spelling skills, but many adults who have difficulties with maths cannot see the relevance of basic numeracy. Maths and numeracy teachers may have to spend time showing how central number is to adult life. Teaching materials and activities need to be clearly relevant to each learner.

Theories of dyslexia

This section is written for literacy, numeracy and ESOL teachers who are not dyslexia specialists. It provides an overview of current theories of dyslexia.

Some theoretical background will enable tutors to understand the nature of the difficulties faced by dyslexic learners and how these might influence approaches to teaching and learning. This section also provides a basis for further study and professional development.

There are many different theories of dyslexia. Individual researchers pursue particular avenues of exploration. It is important to remember that research is ongoing and that our knowledge is still partial.

It might be assumed that dyslexia theories have led to the development of associated teaching and learning approaches, but this is not always so. Teaching and learning approaches have often been developed from observation and experimentation by practitioners themselves; the links between theory and practice are not straightforward.

Making sense of the different theories

It is generally argued that the difficulties associated with what we call dyslexia are caused by developmental abnormalities. But there is no consensus among experts on a definition of dyslexia – nor is there agreement on its exact causes.

There is a way of thinking about dyslexia which helps to understand the complexity. It is known as a "causal modelling framework" (Frith, 1997). This framework, which is widely used, suggests that three levels of description are useful for a better understanding of dyslexia:

- Biological (genetics and neurology)
- Cognitive (information processing)
- Behavioural (primary characteristics such as reading and spelling).

A summary is provided below of theories of dyslexia at the biological and cognitive levels. There are also tables in the Resources section (p.75) that chart the current theories and

show where these have implications for practice.

At the behavioural level, these biological and cognitive factors can result in difficulties in:

- learning to read
- phonological tasks
- naming
- speech development
- balance
- time estimation
- memory
- spelling
- phonic skills
- motion detection.

The introduction to this document explores how such difficulties translate into learning behaviours and suggests appropriate responses to them by teachers.

The review ends with a brief summary of a social interactive model of dyslexia.

Summary of theories

Biological theories

Genetic factors

Various researchers have sought to identify the genetic basis for dyslexia. A lot of research has focused on the heritability of reading sub-skills and on locating gene markers for dyslexia on particular chromosomes.

The language areas of the brain

Early research involving post-mortem examinations revealed differences in the structure of the brains of dyslexic individuals, particularly in the language areas, from those of non-dyslexic individuals. New technologies such as positron emission tomography (PET) and magnetic resonance imaging (MRI) have enabled researchers to identify differences in the structure of the living brain and the active processes within it.

The cerebellum

A recent theory is that a difference in structure or dysfunction in the cerebellum (the 'hind brain', thought to be responsible for dexterity and automaticity) offers an explanation for all the manifestations of dyslexia. It affects speech processing, as well as

more general motor control processes including time estimation and balance. Information from the language area of the brain and the magnocellular regions of the brain is processed through the cerebellum, and weaknesses in any or all of these areas could account for the different types and degrees of dyslexia.

Magnocellular/transient systems

Literacy difficulties may be a result of the impaired development of a system of large neurones in the brain (magnocells) that is responsible for timing sensory and motor events. The visual demands of reading draw on the visual magnocellular system and any weakness can lead to visual confusion of letter order and poor visual memory for the written word. There may also be an auditory equivalent that is essential for meeting the phonological demands of reading. A weakness here can lead to difficulties such as the confusion of letter sounds.

Cognitive theories

Phonological processing difficulties

Although dyslexia can manifest itself in many ways, there may be a single cause: a phonological deficit. Some researchers assert that phonological processing difficulties are fundamental to dyslexia and can be found in all individuals with dyslexia. Other researchers accept the phonological deficit theory but see phonological problems as a symptom of dyslexia, while the cause is related to brain structure.

Visual difficulties

Dyslexic people may be unable to process fast-incoming sensory information adequately. This could explain visual difficulties such as unstable binocular vision and unsteady fixation when reading. It might result in visual confusion of letter order, which can lead to poor memory of the visual form of words. Again, this may be a symptom of a deeper cause.

Temporal or timing difficulties

Phonological, visual, or motor difficulties may all be indicative of an underlying temporal or timing difficulty, rather than alternative explanations for dyslexia. These timing difficulties may also have their origin in brain structure.

Automaticity

Some tasks may be less 'automatic' for dyslexic individuals and may take up more of their concentration and attention than is the case for non-dyslexic individuals. Lack of automaticity in basic skills such as literacy and numeracy could mean that dyslexic people are more likely to experience processing overload when they are required to carry out new or complex tasks. They may need far more practice at any skill before they achieve automaticity. This condition is linked with differences in the structure of the cerebellum.

Working memory

Working memory is used to hold new information in the mind for a short time before it is rejected or transferred into long-term memory. Some theorists regard inefficient working memory as being a key underlying factor in dyslexia.

'Difference' model

A lot of research focuses on the deficits associated with dyslexia. It may be more beneficial to refer to cognitive differences, as opposed to deficits, as some of these differences may enable dyslexic individuals to have particular strengths, such as good conceptual and creative higher-order thinking skills.

Social interactive theory

The social interactive theory of dyslexia is an additional level of description. It focuses on how society's reactions to dyslexia make the differences into a disability.

The particular social values that impact on dyslexia involve:

- viewing some learning differences (especially those involving literacy difficulty) as reflecting deficits in the learner
- valuing certain forms of literacy over other forms and thus those who can access these forms over those who cannot
- using certain sorts of literacy skills as a proxy for intelligence and educability, so that those people who lack such skills are deemed unintelligent or uneducated
- ideas that link speed of information processing to intelligence, so that those people who do not process information as quickly as others are seen as unintelligent

- assumptions about short-term memory and retrieval of information that associate lack of intelligence with any observable delay.

This model acknowledges biological and cognitive differences and the relevance of individual experience. However, it argues that social perceptions and values effectively construct a disability from them.

What do theorists agree on?

Cognitive difference

There is a general agreement that dyslexia is the result of brain differences leading to a cognitive difference in processing the information that the brain is receiving from the senses. Someone with dyslexia and/or dyscalculia may experience difficulties to a greater or lesser degree with processing this information. In some contexts, such as reading and writing, this difference can be disabling.

Research into the magnocellular system has led to some agreement that a more general cognitive deficit in timing may underlie dyslexia and that this can affect all brain modalities (visual, phonological, or motor).

Information processing

Through recognising the importance of cognitive processes, many theorists advocate interventions that explicitly address the dyslexic learner's information processing.

Physiological basis

There is agreement that the manifestations of dyslexia have a physiological basis and that future brain imaging studies (using MRI techniques) will be useful.

Phonological processing difficulties

There is a dominant view that phonological processing difficulties are fundamental to dyslexia and can be found to a greater or lesser degree in all individuals with dyslexia. Views on the underlying causes vary.

Where are there areas of disagreement?

Definitions of dyslexia

Some researchers use a discrepancy definition, that is, a clear discrepancy between an individual's general level of ability and their reading and writing attainment. They argue that this is a clear-cut way of identifying individuals with dyslexia. Others argue that this type of definition tends to favour more 'intelligent' people and is not useful for adolescents and adults, as obvious discrepancies (for example between reading age and chronological age) tend to diminish as learners get older. Some argue that since there is no objective measure of intelligence, this approach is fundamentally flawed. Discrepancy definitions can lead to bias in who is identified and to the under-identification of some groups of people.

Biological level

There are differing views as to what must be happening in the brain to account for difficulties at the cognitive level. It is difficult to establish clear reasons for these differing views, apart from the initial interests and subsequent findings of particular researchers. It is more likely that some dyslexic people have deficits in one part of the brain and others in different parts. Some may have deficits in all three areas.

Cognitive and behavioural levels

For some theorists, the main focus is a phonological processing difficulty, producing difficulties with reading, spelling, naming and other phonological tasks. Others refer to various processing difficulties and a 'syndrome' of manifestations at the behavioural level. This is often based on clinical work, that of Professor Tim Miles being a prime example.

Until recently, the phonological deficit hypothesis was the consensus view of the majority of dyslexia researchers. Some researchers now claim that dyslexic individuals show deficits in a wide range of domains including visual processing difficulties. Indeed, some claim that visual processing difficulties are more significant than phonological difficulties.

Sub-types of dyslexia

'Phonological' and 'surface' dyslexia are often said to represent distinct sub-types. People with phonological dyslexia experience difficulty decoding words, while those with surface dyslexia have difficulty accessing sight vocabulary. Miles and Miles (1999) disagree with the idea that a particular individual remains of the same sub-type throughout life. Some researchers (such as Ellis, 1993) suggest that perceived differences relate to reliance on particular compensatory strategies, not differences in underlying impairments.

Fawcett and Nicolson (2001) speculate that different sub-types within dyslexia may have different underlying deficits or differences in brain function. Future research may reveal a magnocellular sub-type, a cerebellar sub-type and various mixed sub-types, each corresponding to a different 'profile' of skills. Ongoing research into the role of the cerebellum and the magnocellular system may shed more light on sub-types.

In the mean time, educators need to be sensitive to the wide range of ways (some more subtle than others) in which dyslexic people may have difficulties. It highlights the importance of viewing dyslexia not merely as a literacy difficulty but of recognising, for example, that some aspects of motor and organisational skills may be affected. Each individual should be encouraged to explore his/her own learning style and teaching should be geared towards his/her strengths.

Difference model

The notion of a 'gifted' side to dyslexia is still controversial. There is a lot of research into the deficits or weaknesses of dyslexic people but relatively little into whether they have particular strengths. A lot of the research in this area is based on personal histories. It could be argued that this is a very positive approach, as it involves listening to the voices of those directly concerned. However, more empirical research or hard evidence may be needed to prove that there is a strong and consistent link between dyslexia and creative, visual thinking and to support the claim that dyslexic people operate in a 'right-brained' way.

Studies have shown that whereas the brains of most non-dyslexic people are asymmetrical (larger on the left), dyslexic people's brains show symmetry. As the right hemisphere has compensated for the deficit in literacy-related processing skills, there may be a superior development of the brain regions responsible for other skills (particularly visuo–spatial skills), which are not language-based (Krupska and Klein, 1995). However, this does not provide conclusive evidence that students who favour right hemispheric processing will necessarily have superior visual skills. Further research into the magnocellular and parvocellular systems of dyslexic people could make a significant contribution to the debate (Stein, 2001).

Some critics argue that dyslexic strengths are produced by environmental influences. Early school failure may force dyslexic individuals to look for opportunities to succeed in other fields and problems with literacy may bring about unconventional coping strategies and modes of thinking. Artistic talents may be equally distributed across the population, but simply more visible among dyslexic individuals, as talented dyslexic people are restricted to non-verbal domains.

It is important to remember that no two dyslexic people are the same and there is no evidence that all individuals with dyslexia will show the same traits.

Incidence and gender differences

Estimates of the incidence of dyslexia vary depending on the definition used. Some people think that there are more dyslexic males than females. This has been questioned because various studies have used different criteria (Miles and Miles, 1999). It may be that dyslexia affects both sexes equally, but that many females are not identified because they can compensate better than males due to differences in the way they process language. It is also claimed that girls exhibit less attention-seeking behaviour and are thus less likely to be identified in school (Riddick *et al*., 2002).

Approaches and programmes used by specialists

This section is written for literacy, numeracy and ESOL teachers who are not dyslexia specialists, though specialists may be interested in the information included on the range of different approaches. It includes information on approaches and programmes used by dyslexia specialists in post-16 education and training.

You may find that learners you come into contact with will have experience of one or more of these approaches. This section will give you some background information and understanding about such approaches or programmes. It is intended to be largely for reference. It is not intended to equip you to use specialist approaches without further training, although it may help you to identify ways in which you could support the approaches used by specialists with your learners.

Although dyslexic learners are often taught in ways that are different from the ways in which non-dyslexic learners are taught, this does not have to be so. Many of the methods described in the approaches below might be, and indeed sometimes are, used successfully with non-dyslexic learners.

Many specialists have developed their own ways of working with adult learners, drawing eclectically from a number of different approaches or sources. Others follow specific programmes, with or without their own adaptations. It is important to remember that no one method appears to be effective with all dyslexic learners, although all methods seem to work for some learners.

This section describes the main approaches and programmes currently in use in post-16 education. Some of these approaches – multisensory techniques, for example – are well established and widely used. Other approaches or programmes are newer or less widespread. They may be relatively untried and untested and some have been criticised by other specialists.

At **www.dfes.gov.uk/readwriteplus/understandingdyslexia**, there are additional materials illustrating a range of different approaches. These include two examples of structured cumulative approaches, two examples of learning styles approaches, a multisensory approach to learning number, the Davis approach in use, an approach using coloured overlays and an approach using technology. On the website, you can hear learners and teachers talking about how the approaches work, see pictures of the approaches in use and look at other related teaching materials.

Inclusion in the list below does not imply recommendation. All approaches found to be in use have been included, on the grounds that you may need the information.

There is no generally accepted classification system for the approaches and programmes, but they are presented here in four broad groupings.

Structured cumulative approaches

- The Orton–Gillingham approach
- The Alpha to Omega programme
- The Hickey Multisensory Language Course
- The Units of Sound programme
- The Write/Right to Read programme

Person-centred approaches

- A learning styles approach to teaching dyslexic adults
- The Davis counselling approach

Physiological approaches

- Auditory Integration Training and the Tomatis Listening Programme
- The Fast ForWord language programme
- The A.R.R.O.W. programme
- The Meares–Irlen approach
- The TintaVision programme
- The Dyslexia, Dyspraxia and Attention Disorder Treatment
- The Brain Gym approach

Approaches using technology

- Using mainstream ICT-based teaching programmes
- Using mainstream ICT facilities
- Using specialised assistive technology
- The integrated approach to using technology to support dyslexics

Structured cumulative approaches

The Orton–Gillingham approach in practice

This is a multisensory approach with auditory, visual and kinaesthetic elements reinforcing each other. The Orton–Gillingham approach involves using simultaneous multisensory instruction. A dyslexic learner is taught to see the letter A, say its name and sound and write it in the air – all at the same time. The approach requires intense instruction with ample practice.

The method is structured, sequential and cumulative. A teacher trained in this method introduces the elements of the language systematically. Learners begin by reading and writing sounds in isolation. Then they blend the sounds into syllables and words. They learn the elements of language – consonants, vowels, digraphs, blends and diphthongs. They then proceed to advanced structural elements such as syllable types, roots and affixes. As learners learn new material, they continue to review material that has been covered to ensure that the learning is secure. The teacher addresses vocabulary, sentence structure, composition and reading comprehension in a similar manner.

Teachers start at the very beginning, with the aim of creating a solid foundation and presenting one rule at a time. Each rule is practised until the learner can apply it automatically and fluently when both reading and spelling.

Teachers try to ensure the learner is not simply recognising a pattern and applying it without understanding. When confusion of a previously taught rule is discovered, it is re-taught from the beginning.

History of the Orton–Gillingham approach

Dr Samuel Orton (1879–1948) was a neurologist working with stroke victims in Iowa. He was influenced by the kinaesthetic work of Helen Keller and Grace Fernald. In 1925 Orton began research into reading difficulties. He noticed that a boy who was having difficulty learning to read was displaying similar difficulties to some of his 'stroke' patients who had lost the ability to read. He went on to study 15 more children. He identified that there was a syndrome that made learning to read difficult but was not due to brain damage, which he called 'strephosymbolia' (meaning 'twisted symbols'). This term was later dropped in favour of 'dyslexia' ('difficulty with words').

This led to his work with teacher Anna Gillingham. Anna Gillingham combined Orton's teaching methods with her analysis of the structure of the English/American language. With Bessie Stillman, she wrote what has become the Orton–Gillingham manual: *Remedial Training for Children with Specific Disability in Reading, Spelling and Penmanship*. First published in 1935/6, this work is updated and republished regularly.

Current usage of the Orton–Gillingham approach

Nearly all alphabetic programmes designed to remediate dyslexic type literacy difficulties are based on this programme. The Orton–Gillingham approach underpins many current approaches; any programme which starts by teaching l, t, p, n, s, d (though not necessarily in that order) is Orton–Gillingham-based. It was designed mainly for children, but has been adapted for use with adults.

The Orton–Gillingham manual is not widely used in the UK. However, most dyslexia specialist teachers of children use the multisensory methods pioneered by this method. Many structured, cumulative, multisensory programmes, such as Alpha to Omega, that are used to teach decoding and phonics are based on the original Orton–Gillingham programme.

To learn this programme sufficiently well to teach adults with understanding, a practitioner must attend an accredited training course and then gain experience by supervised practice.

Where can practitioners find out more information?

Several websites can be found by typing 'Orton–Gillingham' into a search engine such as Google. The International Dyslexia Association (www.interdys.org) was founded in 1949 in memory of Dr Samuel Orton, who died in 1948.

The Alpha to Omega programme in practice

The book *Alpha to Omega* provides a structured multisensory teaching scheme for teaching reading and spelling.

History of the Alpha to Omega programme

Alpha to Omega was devised by Professor Beve Hornsby, a psychologist and speech therapist in London. Hornsby had an in-depth knowledge of phonetics and linguistics relevant to the teaching of speech and language skills. He wrote *Alpha to Omega* with Frula Shear and Julie Pool. It was the first complete teaching programme based on structured, sequential phonetic and linguistic concepts to be published in Britain.

Current usage of the Alpha to Omega programme

Along with Hickey, *Alpha to Omega* and its activity workbooks have been used widely for a long time and have been added to and extended since they were first developed.

The Hickey Multisensory Language Course in practice

The Hickey Multisensory Language Course is a multisensory learning programme for reading, writing and spelling. It claims to be suitable for any age range from infants to adults and can be used for individual or small group teaching.

The course is initially teacher intensive, but learners are gradually encouraged to become more independent and to work out how to read and spell words from first principles.

The learner is taught how to read and spell by learning how to analyse language and build up regular words,

sound by sound. Much overlearning is built into the programme and a variety of methods are used during each lesson. Direct teaching and periods of independent learning are built into each session.

Though it is a mainly phonic method, this approach integrates the learning of high-frequency words as sight vocabulary for reading. Learners are also shown how to use multisensory strategies for spelling high-frequency words. During the structured part of a lesson, learners are not expected to read or spell anything they have not previously been explicitly taught.

This approach is rarely used on its own, more often being part of an integrated, negotiated learning programme.

History of the Hickey programme

Kathleen Hickey went from the UK in the 1930s to the USA to see the Orton–Gillingham methods in practice and to train on alphabetic phonics. On returning to Britain, she became the first Director of Studies at the Dyslexia Institute in 1972. She developed the programme during the early 1970s and it was first published as the *Kathleen Hickey Language Kit*.

Current usage of the Hickey programme

Along with *Alpha to Omega*, the Hickey programme is one of the most widely used programmes. The Hickey approach is used by most Dyslexia Institute-trained teachers.

The Units of Sound programme in practice

Units of Sound is a structured, cumulative and multisensory programme for reading and spelling that involves a high level of independent work by the learner. Each 'unit of sound' is introduced separately, then used in word blocks, then sentences. Visual and auditory patterns in words are pointed out to learners at the beginning of the process. For example, in the 'unit of sound' *-ry* in the block of words *carry*, *marry*, *berry*, *sorry*, *worry*, *hurry*, the auditory pattern is a short vowel sound followed by *r* and the long *e* sound at the end of each word. The visual pattern is 'vowel followed by double r then y'. The sound for the unit *-ry* is given to the learners at the beginning of the session. Learners then have to read the words, having

had both visual and auditory patterns pointed out. The teacher 'check-reads' in the following lesson, to establish whether the learner has covered the unit of sound successfully.

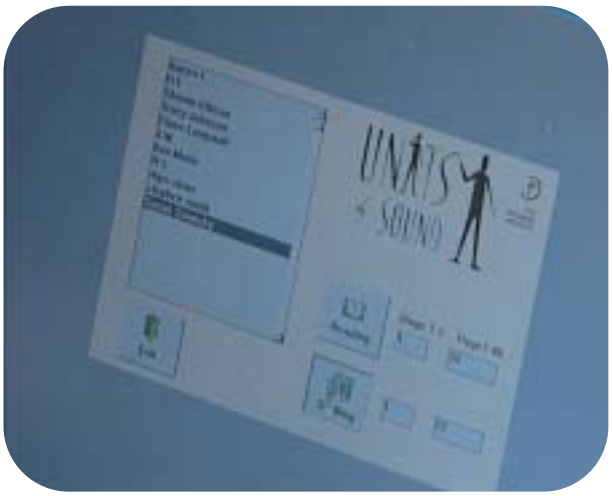
The programme starts with 'consonant–vowel–consonant' words and works through to adult-level reading. The learner is placed separately for reading and spelling and does not have to start from the beginning. Because the programme is on CD-ROM, learners can practise and overlearn as much as they feel they need without being dependent on a teacher.

Version 4 includes:

- self-recording for reading
- words split into syllables and read in syllables option
- dictation sentences
- visual memory spelling exercises.

History of the Units of Sound programme

Walter Bramley developed the programme following five years of developing audio-visual materials for the army. Early work was trialled



within the Army School of Preliminary Education at Cosham. Later trialling included learners of all ages.

Units of Sound was published in 1972–3.

Current usage of the Units of Sound programme

Units of Sound is used within the Dyslexia Institute by specialist teachers and in schools (junior/secondary) by specialist teachers, support assistants, classroom teachers and special educational needs (SEN) teachers. In further education colleges, it is used by teachers of learners with learning difficulties and disabilities, specialist teachers and support assistants.

It is used in over 2000 institutions, although the majority are schools. The amount of use within an institution varies enormously, from a few learners to hundreds.

Where can practitioners find out more information?

Units of Sound is available from the Dyslexia Institute:

DI Trading Ltd.
Park House, Wick Road
Egham, Surrey TW20 0HH

Tel: 01784 222300

There are currently four routes for training in using the programme. For information on a *Units of Sound* training day or the Dyslexia Institute course contact:

Educational Development
2 Grosvenor Gardens
London SW1W 0DH

Tel: 020 7730 9202
Fax: 020 7730 0273

For information on the post-graduate Dyslexia and Literacy Certificate by distance learning that includes *Units of Sound*, contact:

The Training Office
The Dyslexia Institute
Park House, Wick Road
Egham, Surrey TW20 0HH

Tel: 01784 222304

www.dyslexia-inst.org.uk

The Write/Right to Read programme in practice

Write/Right to Read is a structured, cumulative, multisensory language programme based on the Hickey methodology.

The *Write/Right to Read* programme was developed specifically for delivering one-to-one in a basic skills setting with adults. It is designed to be used by support tutors and trained volunteers. It was developed in response to a need expressed by many learners for a solid foundation of language skills. It is used as one of a range of approaches available to practitioners with dyslexic learners after diagnostic assessment.

The *Write/Right to Read* programme comprises 30 modules of systematic drills, worksheets and reinforcement games and activities. These are delivered in different ways depending

on individual circumstances, such as the time available and the learner's profile of cognitive strengths and weaknesses. Some learners may follow the whole programme systematically from start to finish. With others, teachers will analyse gaps in learners' strategies and language awareness to create a fast-track route through the programme.

History of the Write/Right to Read programme

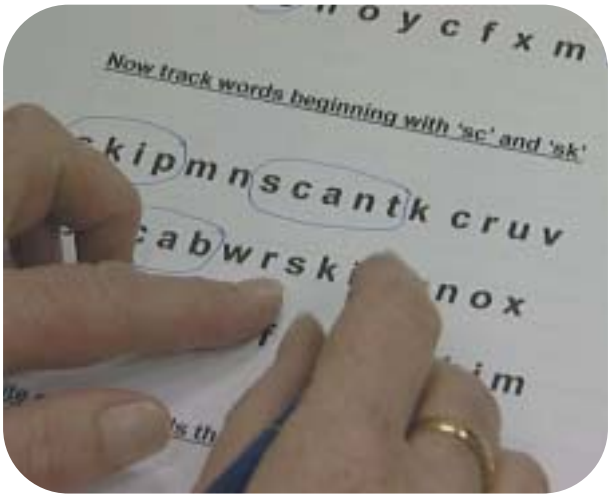
The programme was first developed in the late 1980s with funding allocated for an Adult Dyslexia Project. It was developed for use by basic skills tutors and volunteers who specialise in its delivery through in-service training and ongoing support. Its development was led by Janet Anderson, then Principal of Link into Learning, Cornwall County Council's basic skills service, and Cathy Diggle, who drew on their Dyslexia Institute qualifications.

Current usage of the Write/Right to Read programme

Write/Right to Read was written in 1988. It has been in use for 15 years across the counties of Cornwall and Durham. It has been accredited by OCN and is mapped to the Adult Literacy Core Curriculum.

It is used throughout Cornwall's 20 centres and in some outreach programmes, including with offenders in the probation service. Over 200 tutors have been trained over the years and hundreds of learners have worked through the programme.

Durham Adult Basic Education has also used *Write/Right to Read* across the county alongside other structured, multisensory language programmes. Further education colleges, higher education institutions and secondary schools are currently exploring the programme.



Qualified adult basic skills practitioners are trained through an in-service training system, completing modules in Dyslexia Awareness and Introduction to *Write/Right to Read* (with options in Dyslexia and Maths, Dyslexia and ICT, top-down approaches, Study Skills, etc.) and receiving one-to-one on-the-job training by specialist tutors.

Where can practitioners get more information?

Helen Brauer
Link into Learning
Laity House
Higher Lux Street
Liskeard PL14 3DJ

Person-centred approaches

A learning styles approach to teaching dyslexic adults

This approach emphasises matching teaching to the dyslexic learning style. It is best envisaged as a conversation between teacher and learner. It uses a learner's strengths to maximise learning and to support and circumvent individual weaknesses. It is also based on knowledge about how adults learn, so the teaching of spelling is, for instance, always based on the learner's own writing. The approach is essentially eclectic. It aims in this way to help dyslexic adults become confident and successful learners.

The approach is based on the following criteria:

- Relevant to learners' individual needs and goals.
- Immediate experience of success.
- Enabling learners to become aware of their own best way to learn.
- Enabling learners to take charge of and transfer learning to other situations.

‘The key element of any support programme would be identifying their strengths and weaknesses, because I do not want to reinforce weakness. So, for example, if somebody cannot hear sounds, I do not flog a phonics-based programme. I rely on a lot of interaction with the students and that’s why I love working with dyslexic students because they give me all the materials I need.’

Dyslexia specialist support teacher

It generally begins with an individualised spelling programme because:

- most dyslexic adults find that spelling is a major problem that interferes with their ability to express themselves in writing and to carry out common tasks
- success in learning spellings is easy to demonstrate and so gives learners confidence in themselves as learners
- spelling is a contained and focused context for investigating the learners’ learning style and effective strategies for learning; it also helps adults understand how dyslexia affects their learning
- spelling often helps reading, especially for those with auditory processing problems
- the ‘Look, Say, Cover, Write, Check’ strategy used in a structured way helps develop self-checking skills.

The spelling programme is based on words from the learner’s own writing. Teacher and learner select words together. They are prioritised according to usage, relevance and importance for the learner. Confusing patterns are avoided and words are linked with those that have a similar pattern or that demonstrate word building. This develops the learner’s

knowledge of letter patterns and word structure and the ability to generalise. The teacher and learner then explore individual strategies for remembering, based on an error analysis and the learner's processing and cognitive strengths. Words are practised over the week using 'Look, Say, Cover, Write, Check'. They are then tested the following week and retested without practice the next week in dictated sentences. This shows whether they have been retained in the learner's long-term memory and can be spelled in context. If words are not remembered, teacher and learner explore the reasons and find a better strategy for remembering before the words are re-learned. Learners are then supported through the use of error analysis marking to find and correct in their writing any errors in words they have learned.

The learning styles approach emphasises:

- getting the 'right' strategy for remembering, using learners' strengths
- practising to secure the spelling in the long-term memory

- the link between spelling and writing; fluency in writing is the aim and learners need to write regularly using their spellings
- developing self-checking skills.

Other approaches that suit the dyslexic learning style are introduced where needed, such as extending visualising techniques or mind mapping. Particular strategies to help reading may be explored; for example using coloured acetate overlays, or, for someone with poor comprehension, taping a piece of reading and listening to it before reading it again. Teachers also use common scaffolding techniques such as DARTs, writing frames and kernel sentences.

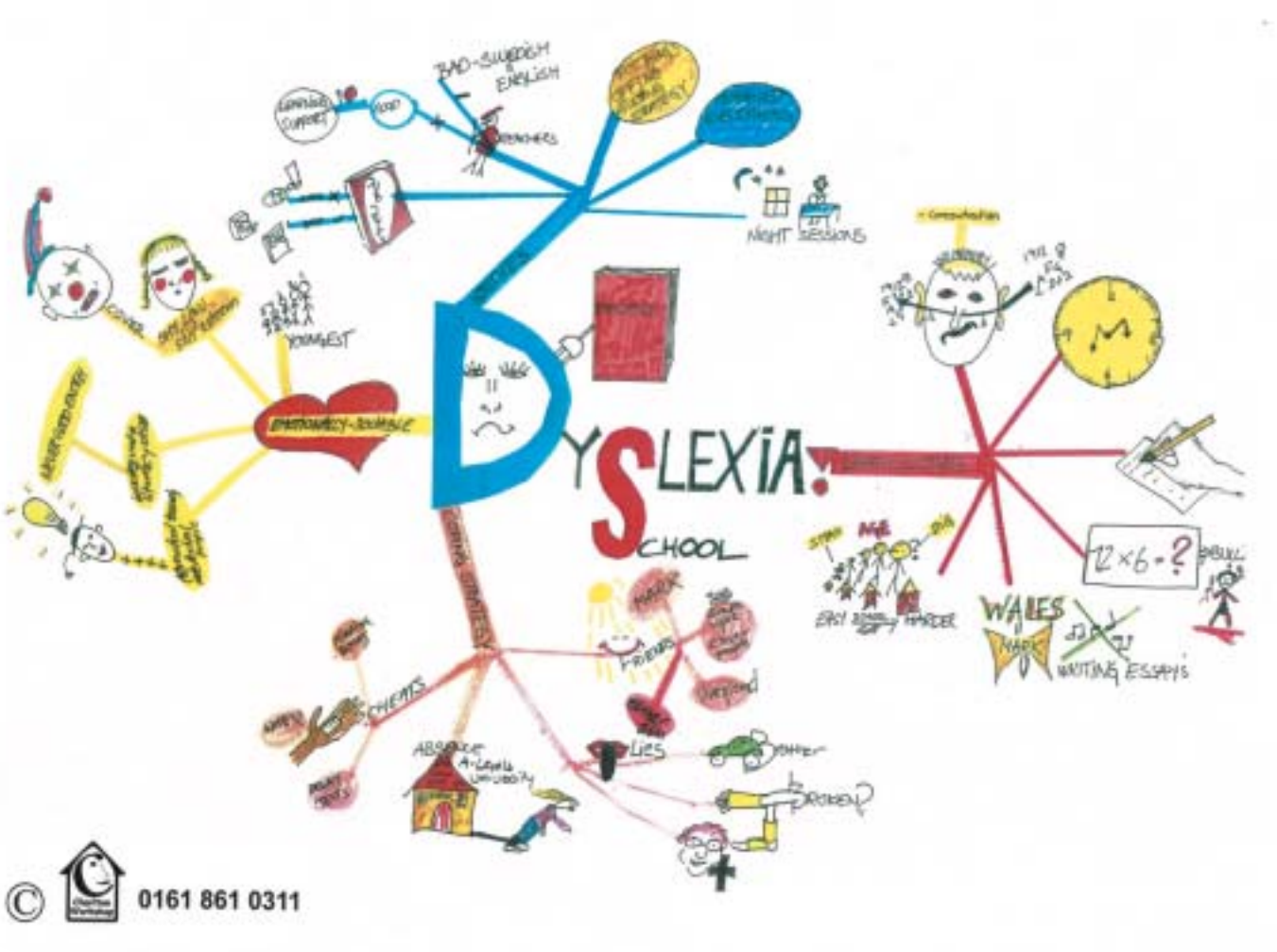
Other approaches and resources used for developing effective strategies

Mind map reproduced with permission of Chorlton Workshop. See www.dyslexic.org

include computer software, plastic letters, drawing or clay modelling, highlighters and coloured pens or paper.

History of the learning styles approach

The learning styles approach grew from the work of Grace Fernald and Margaret Peters and was adapted for adults by Robin Millar at the London Language and Literacy Unit. Her successor, Cynthia Klein, and other practitioners continued the development of work with dyslexic adult learners in the 1980s. The work emphasised approaches based on the idea of dyslexia as a difference rather



Mind map reproduced with permission of Chorlton Workshop. See www.dyslexic.org

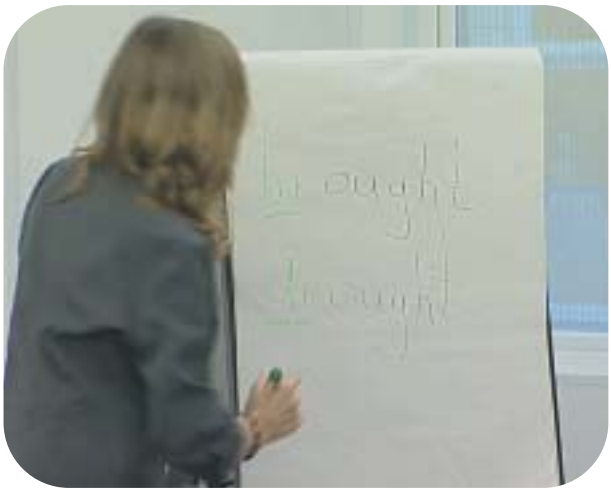
than a deficit and on learners finding their own right way into words. The approach uses learners' strengths rather than focusing on their weaknesses. It sees dyslexic learners as having strong needs to learn in particular ways. Neurological studies of dyslexia as difference and the work of Ron Davis and Tom West have added to the picture of a dyslexic learning style.

A national development project in 1990 stimulated the design and piloting of the Certificate in Adult Dyslexia Support; this became a channel for listening to dyslexic teachers who attended the course and for extending practical knowledge about how dyslexics learn.

Current usage of the learning styles approach

The learning styles approach, as advocated by Cynthia Klein, is widely used by dyslexia specialists in adult and further education. It is taught through the Certificate in Adult Dyslexia Support course which is delivered nationally and is open to experienced teachers of adults. The Certificate in Adult Dyslexia Support is a specialist qualification that is now common in adult and further education.

Since 1999, when the London Language and Literacy Unit transferred to London South Bank University, around 500 teachers have completed the Adult Dyslexia Support course. Some 240 now hold the Certificate in Adult Dyslexia Support.



Where can practitioners find out more information?

LLU+
London South Bank University
103 Borough Road
London SE1 0AA

Tel: 020 815 6290

www.lsbu.ac.uk/lluplus

The Davis counselling approach

The Davis approach to working with people with dyslexia is based on the principle that dyslexic strengths and difficulties share the same root – the dyslexic thinking style. Dyslexics tend to think primarily through pictures and images rather than through the internal monologue used by verbal thinkers.

People who think in pictures tend to use global logic and reasoning strategies, capturing the whole picture rather than working through a process in sequential steps. When they are confused or intrigued by an object or situation, they will mentally move around and explore it from different viewpoints or angles. From this, they develop many abilities and talents in areas such as spatial awareness, creativity, practical skills, lateral thinking and problem-solving.

However, picture thinkers may become confused by things that do not make sense to their non-verbal thinking style. With two-dimensional symbolic objects, such as alphabet symbols, they may not make the automatic sound–symbol connection. They may be less likely to use a phonic approach to reading or spelling, grouping a word like 'leaf' not with other words with similar sounds, but with 'feather' because they both float.

Functional high frequency words for which there is no instant mental picture also cause confusion. For example, the word 'dog' easily conjures up a picture, but it is difficult to make a picture for a word like 'the', apart from seeing the letters of the word itself. Davis practitioners refer to these words as 'trigger' words – the words that trigger confusion.

People with dyslexia become confused and stressed when this picture thinking process does not work. They will concentrate harder and become more tense, until the intense concentration causes disorientation. At this point, the senses become distorted and the brain will no longer receive accurate messages. This may manifest itself in print instability – substitutions, reversals, transpositions, or omissions in reading or writing letters, words and numerals. Many dyslexics commonly garble or mishear words or the sequence of words in sentences. Their internal sense of time can also become distorted, their motor control

can appear delayed or clumsy and balance and motion may be affected.

A Davis practitioner works with learners individually. A self-assessment process draws out their strengths, weaknesses and goals. Learners are then guided through a programme tailored to their need. A Davis programme will contain many elements and will be based around two key practices.

The first is to help the learner to establish a mental focusing tool that s/he can use to bring their mind back on track when disorientation occurs. These are simple visual or kinaesthetic mental exercises. Gradually, the learner becomes aware of moments of disorientation as they occur and learns to use the orientation process automatically whenever it is needed.

The second key practice is to work with the learner to deal with those things that triggered the disorientation in the first place. Typically, this will include work on alphabet, punctuation symbols, trigger words and other areas such as numbers.

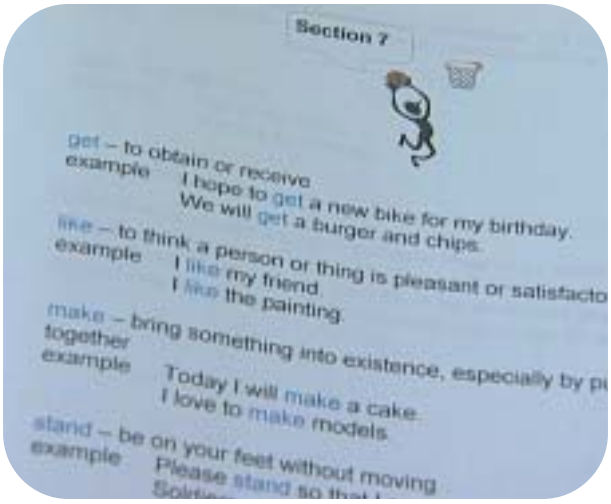
The learner masters trigger words by making models of them in clay. They usually start by making and working on a clay alphabet and set of punctuation symbols. They use their focusing tool to make sure they are perceiving the letters accurately. This may be the first time a learner has perceived the alphabet accurately and can really get to know it.

They may move on to tackle trigger words (such as ‘a’, ‘the’, ‘of’) by discussing the meaning of the word and making a model of that meaning, together with the word itself. The combination of accurate perception and the elimination of confusion leads to improvements in areas like reading performance.

There are further specialist techniques for reading, maths concepts, handwriting and attention deficit difficulties. Strategies to help the learner address stress and energy levels, balance and coordination can also be used.

History of the Davis counselling approach

These methods have been used since the 1980s in the USA, when Ronald Davis, himself severely dyslexic, began to discover ways to overcome his difficulties and founded the Reading



Research Council. Between 1981 and 1995 around 1500 students, adults and children, received a five-day Davis dyslexia programme at the centre. In those early years, practitioners also visited the centre and learnt Davis methods through an informal apprenticeship and applied or integrated methods within their own practice, as they felt appropriate.

Training and delivery of the programme was standardised in 1995 with the establishment of Davis Dyslexia Association International. Since that time, approximately 400 individuals in 29 countries worldwide have undertaken the full training programme and currently 312 of these are licensed as qualified facilitators. The methods are used in Germany, Switzerland and the Netherlands, as well as in the UK, USA, Canada and Australia.

The methods have been used in the UK since 1997. There are currently 26 qualified facilitators working in the UK and several others who are part way through the process. Additionally, there are many teachers, parents and others who have completed the first stages of the training.

Current usage of the Davis counselling approach

Trained Davis practitioners work in many countries worldwide. In Britain, there is an association of trained practitioners (known as facilitators) and training is available. Most facilitators work privately, although some are now working in schools and colleges. In the private sector, a client will work with a facilitator on an intensive 30-hour programme, usually over a week, with follow-up. In colleges and schools, the work will often be spread out over a longer period.

Training consists of a series of four- or five-day courses and a number of assessed assignments. Training is offered at different levels, from a four-day introduction to full qualification.

Where can practitioners find out more information?

www.davistraining.co.uk provides full information on courses and costs. Alternatively, people may write to:

Richard Whitehead (Director)
DDA UK
The Corner House Offices
High Street
Cranbook
Kent TN17 3DF

Tel: 08700 132945
Fax: 08700 469658

Email: uk@dyslexia.com

Detailed information on Davis methods, the organisation and research articles can be found at www.dyslexia.com

Physiological approaches

Auditory Integration Training and the Tomatis Listening Programme

This approach may be referred to as auditory training, auditory stimulation and listening therapy. It derives from a belief that the ability to process auditory information is an essential skill in learning how to read. Many people with dyslexia have been found to suffer from auditory processing deficits.

The approach is based on the work of Dr Alfred Tomatis, who said 'The voice can only produce what the ear can hear.'

It is essentially a training programme that claims to improve auditory perceptual and processing skills by using therapeutic music. It uses specially produced CDs containing

activities and sounds to exercise and tone tiny muscles in the middle ear.

Dyslexics may have difficulty in differentiating sounds with similar frequencies. When listening to the name 'Bob', a dyslexic person might not be sure if it was 'Bob' or 'Bop' or 'Pop'. This slows their rate of language processing.

To address this problem, the Tomatis approach retrains the ears to hear these differences more clearly. This is achieved by listening to specially recorded music. The idea is that once someone can hear the sounds clearly, their spelling will improve.

The Tomatis Listening Programme also claims to help people with dyslexia to process auditory information better. People who are right-ear dominant are more likely to pay attention because they can process verbal information faster. Information is passed directly to the left brain, which specialises in processing language. Dyslexics, however, tend to be left-ear dominant, so that the information is received by the right brain. That part of the brain has no language centre and, therefore, the information has to be rerouted, causing delay. In the transfer from the right brain to the left brain, some of the higher frequencies can also be lost. These are the frequencies that are key to distinguishing similar sounds.

History of the Tomatis Listening Programme

In the 1960s, Dr Alfred Tomatis, an ear, nose and throat specialist, began to develop interventions designed to improve auditory skills by specific exercises involving listening to music. These developed into the Tomatis Listening Program in the 1970s. It gained prominence particularly in the 1990s, when many publications described and examined the approach.

Current usage of the Tomatis Listening Programme

The Tomatis method is used not only with dyslexic learners, but also more widely in 250 centres around the world, although its use is not widespread in the UK.

The International Association of Registered Certified Tomatis Consultants holds an annual convention.

Where can practitioners find out more information?

- The Rocky Mountain Learning Systems website: www.rmlearning.com/Tomatis.htm
- The International Association of Registered Certified Tomatis Consultants: www.iarctc.org

The Fast ForWord language programme

This is a teaching programme that focuses on helping learners become more fluent at processing rapidly changing sounds. Its underlying hypothesis is that dyslexic learners' brains can be taught to operate more like those without dyslexia. The programme offers training designed to help learners hear sounds in words by exaggerating and slowing them down.

Learners undertake computer exercises designed to develop a wide range of critical language skills including phonological and phonemic awareness, fluency, vocabulary, comprehension, decoding, working memory, syntax, grammar and other skills. It is an intensive programme, with learners doing the exercises for 100 minutes a day for four to six weeks. The exercises are presented in the form of computer games that reward learners when they correctly recognise sounds or accurately follow on-screen directions. The exercises are adaptive, becoming more difficult as the learners' listening skills improve.

History of the Fast ForWord programme

Dr Paula Tallal and Dr Michael Merzenich, a neuroscientist, found that acoustically altered speech sounds help people differentiate phonemes. A programme to address the difficulties dyslexic children had with rapid processing of speech sounds was developed along these lines. A study by Dr Tallal and John Gabrieli at Rutgers University in California researched the impact of the programme. Brain imaging scans of the learners who participated in the training showed that critical areas of the brain used for reading were activated for the first time and that they began to function more like non-dyslexic readers.

Current usage of the Fast ForWord programme

Fast ForWord is an American programme used in schools and with adults. It has been offered in the UK for the past four years in a limited way. Since 2003, *Fast ForWord* products are now more widely available in the UK through local professionals who are being trained to administer the programme themselves with their own clients.

Where can practitioners find out more information?

Scientific Learning Corporation
300 Frank Ogawa Plaza – Suite 500
Oakland, CA 94612-2040
USA

Tel: +1 888 665 9707
Fax: +1 510 444 3580

Email: info@scilearn.com

Fast ForWord in the UK:
www.innovative-therapies.com

The A.R.R.O.W. programme

The A.R.R.O.W. approach is based upon the premise that most dyslexic people have an intact hearing system – but they may have other auditory problems, notably with listening. There is evidence that there are normally hearing students of all ages and abilities who experience severe problems when listening to speech in background noise. These auditory problems have a significant effect upon their progress in terms of reading and spelling.

Listening is an acquired skill. It involves focusing and maintaining auditory attention. The listener needs to select the spoken word and then reject any relevant input such as background noise. Some mature motivated learners maintain auditory attention for 45 minutes or more. In younger or easily distracted learners, such attention may only be a few minutes in length. A.R.R.O.W. works on the premise that auditory attention is trainable.

A.R.R.O.W. stands for Aural – Read – Respond – Oral – Write. The technique has been developed from the use of the self-voice – a recording of the learner's own voice while reading. The recording of the learner's self-voice forms the basis of the A.R.R.O.W. work.

Trained A.R.R.O.W. teachers and assistants provide a total of two

'Well, because many dyslexics tend to be visual, I took a visual approach but I also found that backing it up with audio work was very helpful. One of the methods I looked into was A.R.R.O.W., a method centred… around using a tape recorder (to record the learner reading). It also uses text, so it does have a visual aspect.

It's very much a whole word approach to start with. The basis of the work is centred on the self-voice…it's more effective and important for the students to hear their own voice while they're reading than it is to hear the tutor's voice.'

Teacher who uses an A.R.R.O.W.-based approach

hours one-to-one tuition time. These two hours of tuition time can be split up as necessary. The learners are required to work a further four hours, a little at a time, on their own, in order to complete a programme.

The teacher establishes a starting point with the learner and then makes a recording of the learner's voice. The work includes 'precision spellings' – word families, frequently used words and words that sound similar and have a similar letter pattern and dictation of passages of information.

Teachers report literacy and listening improvements and that learners' self-esteem rises, as does handwriting and their general classroom performance. Learners quickly learn how to attend more effectively.

History of the A.R.R.O.W. programme

A.R.R.O.W. began as a practical tool first developed by Dr Colin Lane in 1975 at a mainstream middle school

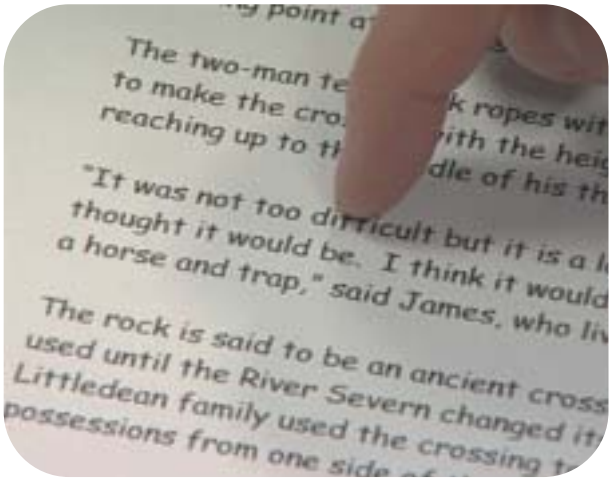
where he was working as a teacher of hearing impaired children. A.R.R.O.W. was first used with dyslexic learners in 1984. A.R.RO.W. has been used with a growing number of adult dyslexic learners since 1990, mainly in further education colleges and also within community-based projects for adult learners with literacy problems.

Current usage of the A.R.R.O.W. programme

It is estimated that over 30,000 students nationwide have used A.R.R.O.W. in a range of settings including schools, colleges and hospitals (with stroke patients).

A.R.R.O.W. provision may be available through mainstream education, within specialist A.R.R.O.W. centres at schools or colleges, or from tutors operating privately. A.R.R.O.W. is used in the UK by teachers, speech and language therapists, psychologists and teaching assistants. Between 40 and 50% of LEAs have the system in a selection of schools and colleges and over 800 tutors have been trained since 1992.

A.R.R.O.W. Tutor Training programmes are accredited as an Advanced BTEC Award for A.R.R.O.W.



tutors. The training programme is essentially practical – a mix of attendance at an A.R.R.O.W. centre, use of the technique with trainees' learners and a report.

Where can practitioners find out more information?

The A.R.R.O.W. Centre
Bridgwater College
Crypton House
Bristol Road
Bridgwater
Somerset TA6 4SY

Tel/Fax: 01278 450932

The Meares–Irlen approach

The term 'Meares–Irlen syndrome', sometimes known as 'scotopic

sensitivity syndrome', is a condition characterised by symptoms of visual distress and visual perceptual distortion. This includes glare from the page, headaches when reading, sore eyes when reading and print instability. The distortions can include blurring, movement of letters, words doubling, shadowy lines, shapes or colours on the page and flickering. The syndrome is said to be particularly prevalent in people with dyslexia (Irlen, 1991; Evans *et al*., 2001) but others may also suffer from it. People who suffer from this syndrome may have some or all of the following characteristics.

General reading characteristics:

- Skips words or lines.
- Reads slowly and hesitantly.
- Reads with many errors.
- Reads with poor comprehension.
- Avoids reading.
- Reads in dim light.
- Misreads some letters and words, e.g. p, q, b, d; c, n, u; t, f: was/saw; who/how; ate/tea/eat.

General writing characteristics:

- Writes uphill or downhill.
- Writes with unequal spacing.
- Makes errors with copying.

Some learners, many of whom are dyslexic, find that using a coloured overlay can help them to read more fluently, with less discomfort and fewer headaches. It may also help to improve comprehension. Some learners are prescribed coloured glasses, which work in the same way as the overlays. If the learner finds using an overlay helpful they will also need to write on coloured paper and change the screen specification when using a computer. Teachers may have to alter the colour of marking pens and the pens used on the whiteboard. It is therefore important that the learner is screened as early as possible so that they benefit from being able to see clearly what the teacher is showing them and what they themselves are reading and writing. The colour of the overlay is specific to the individual (Wilkins *et al*., 1994). There is therefore no 'best' colour for all learners.

Teachers can help the learner to decide which is the best colour

> 'We do the Irlen test if the student has visual discomfort; in the last four or five years, we've been testing students for light sensitivity and visual distress. Now we do it earlier and earlier.
>
> For instance, in a pre-GCSE group, there was one student who didn't want to be tested and she said, "Oh no, it's fine on white paper," but I just dropped the acetates over the page and she literally jumped back in her seat and said, "Ah, I don't believe it…that is so clea…the letters have stopped moving around!"'
>
> Teacher who uses coloured overlays

overlay to use. No special training is required and companies producing overlays provide helpful guidelines. If the learner requires coloured glasses, they need to be referred to an optometrist. Overlays, coloured paper and extra photocopying costs can be claimed via additional support funding.

History of the Meares–Irlen approach

Evidence has emerged since 1980 that colour could help with reading. The early work was done with children. Olive Meares, a New Zealand teacher, described the difficulty some children had with glare from the page and the way in which this glare could be reduced by coloured filters placed over the page (Meares, 1980). Helen Irlen, a psychologist from California, found that these distortions could be alleviated by the use of coloured overlays or glasses (Irlen, 1991). She set up Irlen Institutes in many Western countries.

Professor Arnold Wilkins began research into the claims that overlays helped reading in 1989. With colleagues, he developed an instrument – the Intuitive Colorimeter – to study the effects of colour.

Research on groups of children showed a significant improvement in their rate of reading using the chosen overlay. Although most research has used cohorts of children, there have been recent studies on groups of adults (Robinson and Conway, 2000; Evans and Joseph, 2002). More than one-third of the sample demonstrated

a significant benefit (more than 5% improvement in the rate of reading) when using coloured overlays. These results suggest that the prevalence of Meares–Irlen syndrome in this adult population is similar to its prevalence in children.

Research into the way in which alteration to the specification of the computer screen can affect the user's reading speed, comprehension and the elimination of script errors was started in Leeds in 2001.

Current usage of the Meares–Irlen approach

Coloured overlays have been used increasingly by teachers of adults in recent years. Learners report improvements not only in rate of reading and comprehension but, for some, in the ability to be able to read at all. Overlays have the advantage of being inexpensive.

Assessment by a trained tester to determine which colour of overlay or glasses are needed is available commercially though organisations such as TintaVision (see opposite).

Where can practitioners find out more information?

There are a number of websites giving general information and the results of the latest research:

- www.essex.ac.uk/psychology/overlays
- www.ioosales.co.uk
- www.ceriumvistech.co.uk

Training is offered by the Irlen Institute. The Institute of Optometry holds fairly regular seminars and the Colour and Vision Sensitivity Forum at the Institute of Optometry meets every two to three months.

The TintaVision programme in practice

TintaVision is a company that offers testing to identify the best colour of overlay or filter for individuals. Research by the TintaVision company on problems in access to text identified two distinct problems that can occur in isolation, or together. They are:

- the inability to accurately detect the edges of or decode black text on a white background

- the inability to sustain decoding for a significant time.

Both of these display themselves in a wide variation of intensity.

TintaVision has designed a process using computer software that can identify the colour of filter that maximises the rate of reading and edge detection for individual learners. Once identified, the appropriate filter is selected and learners use the filter as much as possible. The effect is cumulative. Learners are also given colour coordinates to use as a background colour on a computer. This has the same effect as the filter when working on screen.

After six to eight weeks, users are re-tested and, if necessary, a change of filter is provided.

History of the TintaVision programme

TintaVision built on the work of Professor Arnold Wilkins at the University of Cambridge. The company developed a set of quantitative protocols based on screening results from hundreds of dyslexic learners in London. This is the basis for the software currently in use.

Current usage of the TintaVision programme

TintaVision is used by Local Education Authorities as an intervention for dyslexic learners. Clients range from primary pupils to pensioners and include more than 3000 university students.

Where can practitioners find out more information?

Tintavision
6 Market Gate
Market Place
Market Deeping
Peterborough PE6 8DL

Tel: 0845 130 5552
Fax: 0845 130 5553

Email: enqs@tintavision.com

Dyslexia, dyspraxia and attention disorder treatment

The Dyslexia, Dyspraxia and Attention Disorder Treatment (DDAT) Centre's treatment aims to counteract weaknesses in the cerebellum by stimulating cerebellar activity with exercises such as throwing a beanbag from one hand to another and standing on a wobbly board.

Results at the DDAT Centre have yet to be verified by rigorous research, but there is a strong body of evidence linking the cerebellum and dyslexia. Motor development programmes, brain exercises and work to correct inner-ear imbalance have long had a place in dyslexia treatment.

Dr Rod Nicolson from Sheffield University, a proponent of the cerebellar approach, said the early results from DDAT were 'extremely promising'. However, he issued a note of caution: 'A key issue to bear in mind is that even if, as we believe, cerebellar deficit does underlie the problems of dyslexia, that does not necessarily mean that treatment aimed at the cerebellum will in itself help reading.'

History of dyslexia, dyspraxia and attention disorder treatment

The DDAT Centre was established in 2001 by Winford Dore, a businessman whose daughter is dyslexic.

Current usage of dyslexia, dyspraxia and attention disorder treatment

The DDAT Centre offers private treatment aimed mainly at parents of children and has attracted a lot of attention since its inception.

Where can practitioners find out more information?

- Dyslexia, Dyspraxia and Attention Disorder Treatment Centre: www.ddat.co.uk

The Brain Gym approach

Brain Gym was developed from the principles of physiotherapy and focuses on individuals and their inefficient learning areas. It is based on the premise that physical movement, language acquisition and academic achievement are inter-dependent.

The programme consists of intensive structured phonics, mental maths, syllabification, puzzles and shapes requiring visual discrimination, auditory discrimination techniques, short-term memory exercises and novel approaches to literacy and numeracy. The central exercise involves physical routines using chalk on a chalkboard: this activity integrates a number of brain functions and encourages automaticity.

History of the Brain Gym approach

Paul Dennison, a remedial education specialist in California, developed Brain Gym over a period of 25 years by exploring with learners the effects of specific movements on the ability to learn academic skills.

He came to the conclusion in 1975 that most learners experiencing difficulty in school were actually sufficiently intelligent for the tasks required of them. The deficits he found were in their physical and perceptual abilities, such as spatial awareness, a concept of wholeness and closure, the ability to focus attention and perceive an organisation or structure.

In 1980 he synthesised his work and begin teaching around the world. The current *Brain Gym Handbook* was developed in collaboration with a number of international educational kinesiologists.

Current usage of the Brain Gym approach

Brain Gym is now used in schools and in further education in the UK, though not widely with adults.

Where can practitioners find out more information?

The Brain Gym website is at www.braingym.org.uk

Approaches using technology

Using mainstream IT-based teaching programmes

Learners with dyslexia have long been encouraged to use language and literacy related software or e-learning programmes. Usually these are generic and intended for discrete learning and use. While not designed specifically for dyslexics, such programmes offer some clear advantages to dyslexic learners, as they address some of the most commonly recognised characteristics of dyslexia.

They are structured and sequential, although this also means they can be prescriptive and inflexible. It is not easy to achieve a fit with what learners need to learn – programmes can be too broad or too specific.

They can also be multisensory, offering sound, colour, movement and sometimes humour – all of

which are helpful to dyslexic learners. Sometimes they are also interactive.

Such programmes can offer the benefit of privacy, allowing learners to learn from their mistakes and repeat and practise learning points as often as they feel they need. However, virtual learning environments (VLEs) are seen by some as a threat to this advantage since the progress of learners is continuously monitored.

As with all technological solutions, these programmes are not always available when and where they are needed and, despite their multisensory appeal, the quality of the teaching within them is unpredictable.

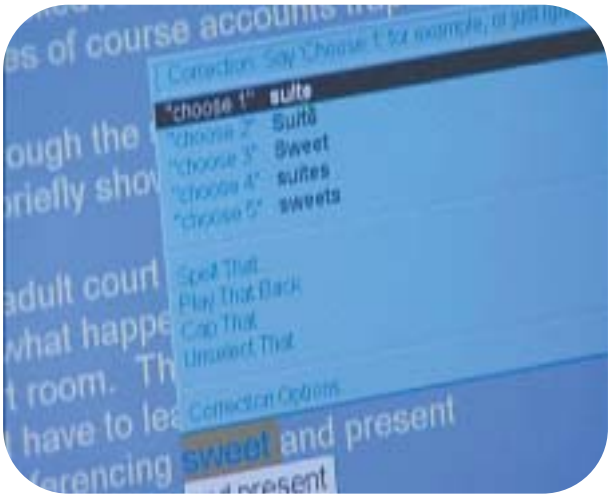
Using mainstream ICT facilities

Exploiting the facilities offered by mainstream ICT has been another approach used to support dyslexics for a comparatively long time, though it develops constantly as mainstream technology itself develops. There are many facilities that can help to overcome barriers to learning experienced by dyslexics.

- ***Word processing.*** When word processing, it is possible to change the screen colour, font style and size, line and character spacing, and to help the learner find a format of text they feel comfortable using. Word processing takes the labour out of writing, drafting, editing and correcting. Spelling may be easier when forming the letters by hand is not required. Having neatly presented work is very satisfying and learners have immediate visual feedback of what they have written.
- ***Spell checks, dictionaries and thesauruses.*** While not the total answer to all dyslexics' problems with words, such facilities – especially where they have speech capability – make a contribution to removing barriers to word exploration and understanding.

- ***Electronic diaries.*** These are useful in helping dyslexic learners to organise and plan.
- ***Scanners, digital cameras, recorders and mobile phones.*** All these give dyslexic learners the opportunity to record and communicate ideas visually, or with minimal text.
- ***Voice recognition.*** Systems such as IBM Via Voice convert speech into written text, of obvious help to all who find writing difficult.

These facilities are inclusive; as they are mainstream facilities, learners do not feel they are having to use a different tool from other learners. And what was once specialised technology – such as voice recognition or visual rather than verbal communication – is becoming increasingly mainstream.



There are some drawbacks. As with any tools designed to be used by everyone, they are not always able to match the learning style or the specific learning requirements of individuals with needs different from the average. Dyslexics who find phonics difficult are likely to be frustrated by a voice recognition system that offers a phonetic interpretation of a word it does not recognise. Learners with specific learning needs may find that the generic facilities do not do exactly what they want.

Training in the use of the full range of facilities available is not always in place, or if it is, it often involves attending training sessions separate from the purpose for which they are needed, making it hard for learners to apply their learning in context.

Using specialised assistive technology

The table overleaf lists appropriate specialised assistive technology.

This technology begins to make possible a match between the learner's learning style and their specific learning requirements.

DragonDictate	Voice recognition software that operates at word level. It is often used with:
Keystone	Speech output software
Kurtsweil	Optical character recognition (OCR) program, used with a scanner to scan or read text and produce voice output
TextHELP!	Adds speech output, word prediction and spell check facilities to most Windows programs
Dragon Naturally Speaking	Voice recognition software that recognises continuous speech
INSPIRATION	Mind-mapping software
Mind Manager	Mind-mapping software that can be used with speech recognition

There are rapid and measurable literacy gains, whether the main aim is literacy improvement or not.

The technology can have high status with other learners, it is up to date, interactive and multisensory, and can be empowering.

But it is expensive and there are considerable training requirements to be taken into account. Organising these can create more barriers, such as when learners are not allowed to embark on a course until they have been trained in the use of the assistive technology.

The integrated approach to using technology to support dyslexics

The most sophisticated approach to using technology to support dyslexic learners is an integrated approach, where all the above facilities are harnessed to create an individualised learning medium.

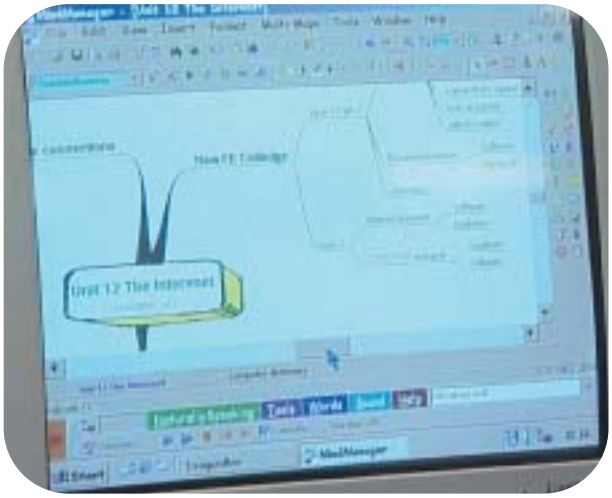
The advantage of an integrated approach is that it enables the learner to be successful in doing what they want to do. It enables them to work on what is meaningful for them. It removes the need to focus on areas of weakness – things they cannot do or

can do only with difficulty, which for some learners can result in boredom, apathy, or disaffection. Learners report feeling that, for the first time, they have 'wings'.

History and current usage of technological approaches

Multimedia approaches for learning with learning difficulties and disabilities has a history as long as that of educational multimedia. The development of specialist assistive technology appropriate for a post-16 context has grown most noticeably during the last 15 years. The existence of additional learning support funding in further education has undoubtedly stimulated demand and may have acted as a catalyst for change.

> 'Computing is really an extension of ourselves…the computer is formed around our senses. Now if you could see into the future, really, technology is becoming more and more modular in relation to our senses. It can both support the senses and people, but also help them to learn to be reflective on their learning. Rather like a friend, it reflects the facts to you that you may not want to hear.'
>
> Teacher who uses technology



The developing use of specialist assistive technology with dyslexic learners in general further education was led by Bilston College; it is now fairly widespread. The development of a fully integrated approach started at City and Islington College.

Where can practitioners find out more information?

LLU+ at London South Bank University specialise in approaches to dyslexia. They run the Certificate in Adult Dyslexia Support and are developing

a Centre of Excellence for ILT and dyslexia. Contact:

Dr Ross Cooper
LLU+
London South Bank University
103 Borough Road
London SE1 0AA

Tel: 020 815 6290

www.lsbu.ac.uk/lluplus

Resources

This section is designed for those who teach literacy, language and numeracy and are not specialists in the field of dyslexia, although dyslexia specialists may also find it useful. We hope it will provide useful information for existing teachers and for teachers in training. It should also act as a resource for further professional development for teachers who might want to work towards a specialism in dyslexia support and for teachers in training.

It comprises:

- ***Theory tables: more detailed information on theories of dyslexia***
  These offer much more detailed information on each current theory of dyslexia, including:
  - brief descriptions of the theories
  - details of underpinning research
  - listings of the main texts
  - key players in the field
  - implications for practice.

- ***Further reading: where to find out more about dyslexia and dyscalculia***
  This is a detailed listing of the publications and articles that have been drawn on in the research. It has been organised into three sections:
  - Practical guides
  - Theoretical but accessible texts
  - Academic texts.

- ***Glossary***
  This includes terms relating to literacy, language and numeracy, to dyslexia and to the approaches described in this document.

Theory tables: more detailed information on theories of dyslexia

Dyslexia theories → Biological level → Genetic factors → Genetic linkage theory

Name of theory: Genetic linkage theory

Description

There is a genetic vulnerability to dyslexia in some individuals.
Recent research has confirmed the view that dyslexia can run in families.

Key players

- Pennington
- Grigorenko
- Cardon

Underlying theory

Grigorenko *et al*. (1997)

Six extended families with dyslexia genotyped:

- Strong linkage for phonological awareness to chromosome 6.
- Weaker linkage for single-word reading to chromosome 15.

Fagerheim *et al*. (1999) examined 36 members out of a family of 80 and established the existence of a relevant gene on chromosome 2.

Implications for practice

The locus for dyslexia is susceptibility, i.e. it is neither necessary nor sufficient to produce the disorder. This is why there does not always appear to be a genetic link.

Fagerheim *et al*. (1999) suggest that 'a molecular test for dyslexia would allow earlier diagnosis of children at high risk for dyslexia. This in turn would permit institution of therapy while the language areas were at an earlier, more plastic stage of development…'

Text references

- Cardon *et al*. (1994). Quantitative trait locus for reading disability on chromosome 6. *Science* 266: 276–9.
- Fagerheim, T. *et al*. (1999) A new gene (DYX3) for dyslexia is located on chromosome 2. *Journal of Medical Genetics* 36: 664–9.
- Fisher, S. and Smith, S. (2001) Progress towards the identification of genes influencing developmental dyslexia. In A.J. Fawcett (ed.) *Dyslexia: Theory and Good Practice*. London: Whurr.
- Grigorenko, E.L. *et al*. (1997) Susceptibility loci for distinct components of developmental dyslexia on chromosomes 6 and 15. *The American Journal of Human Genetics* 60: 27–39.
- Pennington, B.F. (1999) Toward an integrated understanding of dyslexia: Genetic, neurological and cognitive mechanisms. *Developmental Psychopathology* 11: 629–54.
- Stein, J. and Monaco, T. (1998) Blind to dyslexia no longer. *Times Educational Supplement*, 27th February, p.20.

Dyslexia theories → Biological level → Structure of the brain → Brain-cortical malformations

Name of theories: Brain-cortical malformations; thalamic changes

Description: Brain-cortical malformations explain meta-phonological deficits, speed of processing of auditory information and problems with working memory. Thalamic changes explain low-level sound processing deficits.

Key players

- Galaburda

Underlying theory

Dyslexia is associated with a deficit in the conscious awareness of the phonological structure of language. This deficit is either primary (linguistic) or relates to anomalies in low-level processing of sound (sensory-perceptual).

Implications for practice

Research is ongoing. Teachers are advised to develop phonological awareness. Galaburda said, 'in order to learn to read you must become consciously aware of the little bits of sounds in words.' Fluent reading and comprehension cannot take place until reading accuracy has been established, therefore phonological awareness needs to be developed.

Speak with plenty of pauses to allow for slow processing.

Text references

- Galaburda, A. (1999) Developmental dyslexia: a multilevel syndrome. *Dyslexia: An International Journal of Research and Practice* 5: 183–91.

Dyslexia theories → Biological level → Structure of the brain → Left hemisphere

Name of theory: The insula-disconnection syndrome

Description

The insula forms a bridge between Wernicke's area (thought to be involved in the recognition of complete written words) and Broca's area (breaks the same words down into segments and creates a mental image of their sound).

Key players

- Frith
- Paulesu

Underlying theory

Research by Paulesu, Frith and colleagues indicated that Wernicke's and Broca's areas were working in isolation in dyslexic adults, so instead of rapidly knowing what a written word sounds like, they have to think about each word they see and consciously translate it from one form to another.

Implications for practice

Dyslexic people may get round the problem by using other pathways in the brain and problems may only be manifest under stress. This may be a mixed blessing as it could contribute to people remaining undiagnosed and getting little recognition for the fact that they have to put much more effort than others into work that involves using language.

Teach in a multisensory way to activate Wernicke's and Broca's areas simultaneously. Non-dyslexic people learn in a multisensory way automatically; dyslexic learners need to be trained to see and hear words as they learn.

Text references

- Paulesu *et al*. (1996) Is developmental dyslexia a disconnection syndrome? Evidence from PET scanning. *Brain* 119: 143–57.
- See also Carter, R. (1996) Dyslexia's broken bridge. *New Scientist*, March.

Dyslexia theories → Biological level → Structure of the brain →Left hemisphere

Name of theories: Deficit in left hemisphere processing; hemispheric symmetry

Description

The theories suggest that there are differences – of processing or of structure – between the right and left hemisphere of the brain. This adds to the 'right- and left-brained' learning styles debate.

Key players

- Geschwind and Galaburda
- Bakker

Underlying theory

In Brunswick *et al.*'s (1999) research, PET scans of the brains of young dyslexic adults while performing word and non-word recognition tasks showed less activation than a control group in the left posterior temporal cortex, suggesting that there may be some deficits in left hemisphere processing among individuals with dyslexia.

Hemispheric symmetry suggests that the balance between the two halves of the brain is different in dyslexic people due to structural differences between the hemispheres. Brain mechanisms available for interaction with the environment are therefore likely to be different.

Implications for practice

Can have implications for learning (and teaching) to read.

Bakker (1990) identifies different types of readers – 'perceptual', with a right hemisphere processing style (may have good comprehension but poor reading accuracy) and 'linguistic', using the left hemisphere (reads accurately but can be over-reliant on left hemisphere and may not show the comprehension levels of the 'perceptual' reader).

Text references

- Bakker, D.J. (1990) *Neuropsychological Treatment of Dyslexia*. New York: Oxford University Press.
- Brunswick, N. *et al*. (1999) Explicit and implicit processing of words and pseudo words by adult developmental dyslexics: a search for Wernicke's Wortschatz? *Brain* 122: 1901–17.
- Galaburda, A. (1989) Ordinary and extraordinary brain development: anatomical variation in developmental dyslexia. *Annals of Dyslexia* 39: 67–80.
- Geschwind, N. and Galaburda, A. (1985) Cerebral lateralization. Biological mechanisms, associations and pathology. A hypothesis and a program for research. *Archives of Neurology* 42: 428–59.
- Robertson, J. (1997) Neuropsychological Intervention in Dyslexia. Paper delivered at the 4th BDA Conference, University of York, April 1997.

Dyslexia theories → Biological level → Cerebellum → Cerebellar impairment

Name of theory: Cerebellar impairment/deficit hypothesis

Description

This is a relatively new theory that suggests difficulties are more wide ranging than just phonological deficit.

There is growing evidence that the cerebellum is directly involved in acquiring language dexterity.

Cerebellar dysfunction from birth offers a coherent explanation of all the manifestations of dyslexia, including the core phonological difficulties.

This affects speech processing as well as more general motor control processes, including time estimation and balance.

Deficits in motor skill and automatisation point clearly to the cerebellum. Poor quality handwriting in dyslexic individuals can be explained by the cerebellar deficit hypothesis, as it is a motor skill requiring precise timing and coordination of the muscles.

Cerebellar deficits can also cause problems with time estimation, organisation and pronunciation of unfamiliar words.

Key players

- Fawcett
- Nicolson
- Stein

Underlying theory

Dyslexic individuals show deficits in tests of cerebellar function. This hypothesis provides a causal explanation for dyslexia, subsuming the phonological deficits theory within a broader framework.

Early findings by Levinson arguing for mild cerebellar impairment tended to be discounted due to shortcomings in research methodology (Silver, 1987) and also the belief that the cerebellum was not involved in language related skills.

Studies by Fawcett and Nicolson have provided behavioural evidence that a significant number of dyslexic children (between the ages of 8 and 18) show traditional signs of cerebellar impairment, such as problems with posture, muscle tone, or limb movements.

Researchers acknowledge that groups were small and therefore results may not generalise to other groups. Further research will establish the prevalence of cerebellar symptoms in larger populations of dyslexic people, and in people who have dyslexia in addition to other conditions such as attention deficit hyperactivity disorder.

Fawcett and Nicolson (2001, p.101) suggest that, 'Future research may reveal a magnocellular sub-type, a cerebellar sub-type and various mixed sub-types.'

Implications for practice

Dyslexic learners need many more learning opportunities than other learners for them to become fluent and automatic. Learning should be in short bursts and carefully structured. Teachers need to be aware that dyslexic learners with cerebellar problems may understand quickly but will need much overlearning to achieve automaticity.

Cerebellar impairment could cause the 'phonological core deficit' in dyslexia and can explain the double deficit hypothesis (Wolf and Bowers, 1999). Difficulties will include problems with reading and spelling because they involve a combination of phonological skills, fluency, automaticity and multi-tasking.

Related approaches: DDAT exercises; educational kinesiology (Brain Gym); behavioural optometry; coloured overlays.

Text references

- Fawcett, A. and Nicolson, R. (1999) Performance of dyslexic children on cerebellar and cognitive tests. *Journal of Motor Behaviour* 31: 68–78.
- Fawcett, A. and Nicolson, R. (2001) Dyslexia: the role of the cerebellum. In A.J. Fawcett (ed.) *Dyslexia: Theory and Good Practice*. London: Whurr.
- Fawcett, A., Nicolson, R. and Dean, P. (1996) Impaired performance of children with dyslexia on a range of cerebellar tasks. *Annals of Dyslexia* 46: 259–83.
- Nicolson, R. and Fawcett, A. (1999) Developmental dyslexia: the role of the cerebellum. *Dyslexia: An International Journal of Research and Practice* 5: 155–7.
- Nicolson, R. *et al*. (1999) Motor learning difficulties and abnormal cerebellar activation in dyslexic adults. *Lancet* 353: 43–7. (Adult-focused brain research – provides evidence to support the idea that the behavioural signs of cerebellar impairment reflect underlying abnormalities in cerebellar activation.)
- Silver, L.B. (1987) The 'magic cure': a review of the current controversial approaches for treating learning disabilities. *Journal of Learning Disabilities* 20: 498–505.
- Wolf, M. and Bowers, P.G. (1999) The double-deficit hypothesis for the developmental dyslexias. *Journal of Educational Psychology* 91: 415–38.

Dyslexia theories → Biological level → Magnocellular/transient systems

Name of theory: Magnocellular theory of developmental dyslexia

Description

This is a relatively new theory and research is ongoing.

Literacy difficulties may be a consequence of impaired development of a system of large neurones in the brain (magnocells) that is responsible for timing sensory and motor events. The visual demands of reading require the capabilities of the visual magnocellular system and any weakness can lead to visual confusion of letter order and poor visual memory for the written word. There may also be an auditory equivalent that is essential for meeting the phonological demands of reading. Weakness here can lead to auditory confusion of letter sounds and weak phonology.

Visual motion sensitivity is important for reading.

There is a tendency for those with poor motion sensitivity to have unstable binocular control and unsteady visual perceptions when trying to read.

Key players

- Stein
- Richardson

Underlying theory

This offers a significant contribution to the sub-types debate.

Stein (2001) speculates that the weak magnocellular systems of dyslexic people may result in the emergence of a more efficient parvocellular system. These advantages to the parvocellular system could explain the holistic talents of

dyslexic people 'because stronger links between distant parvo cells might bind the products of their processing together in a more efficient manner in dyslexic than in ordinary brains' (p.31). The magnocellular pathway is the transient channel enabling flicker or rapid change detection. The parvocellular pathway is the sustained channel, enabling detection of stationary detailed patterns. Researchers have discovered that dyslexic individuals perform worse than non-dyslexic individuals on tasks such as flicker detection (testing the efficiency of the transient channel), but equally well on tasks that test their sustained channel.

Variations in magnocellular sensitivity are likely to be under genetic control.

The cerebellum receives a heavy magnocellular input and itself contains magnocells. The cerebellum is thought to contribute to the control of steady eye fixations during reading and to 'inner speech'.

Implications for practice

Visual and auditory transient sensitivity can be measured in young children and improved by appropriate sensory training. Perceptual training (see for example Merzenich *et al*., 1996) may only work when the brain is still very plastic.

Diets poor in polyunsaturated fatty acids (PUFAs) may further impair the development of magnocellular neurones.

However, some researchers remain unconvinced that there can be a causal connection between a person's motion sensitivity and their reading ability.

Text references

- Evans, B. (2001) *Dyslexia and Vision*. London: Whurr.
- Jennings, A. (2000) Behavioural optometry: a critical review. *Optometry in Practice* 1: 67–78.

- Merzenich, M.M. *et al*. (1996) Temporal processing deficits of language-learning impaired children ameliorated by stretching speech. *Science* 271: 77–81.
- Somerville, S.M. (2001) Dyslexia, Dyspraxia and ADHD – Can nutrition help? *Patoss Bulletin* 14(1): 5–8.
- Stein, J. (2001) The Magnocellular Theory of Developmental Dyslexia. *Dyslexia: An International Journal of Research and Practice* 7: 12–36.
- Stein, J. and Walsh, V. (1997) To see but not to read: the magnocellular theory of dyslexia. *Trends in Neurosciences* 20: 147–52.
- Stein, J., Talcott, J. and Witton, C. (2001) The sensorimotor basis of developmental dyslexia. In A.J. Fawcett (ed.) *Dyslexia: Theory and Good Practice*. London: Whurr.

Dyslexia theories → Cognitive level → Magnocellular/transient systems

Name of theory: Phonological processing difficulties

Description

Phonological processing is the way people process sounds within words. A person may have adequate hearing but can find it hard to identify, sequence and reproduce sounds within a word.

There can be difficulties with rhyme, sound blending and non-word repetition. Processing of incoming verbal information, by phonological storage and retrieval, is essential to other short-term verbal memory tasks.

Phonological processing deficits persist into adulthood, even when literacy skills are in the average range (Paulesu *et al*., 1996; Brunswick *et al*., 1999; Griffiths and Frith, 2002).

Key players

- Snowling
- Frith
- Bryant and Bradley
- Goswami, Stackhouse and Wells
- Stanovich

Underlying theory

Genetic/brain difference – the area affected may be the perisylvian region of the left hemisphere (Frith, 1997).

Some theorists (e.g. Fawcett and Nicolson) claim that cerebellar impairment can cause the 'phonological core deficit'.

Until recently, the phonological deficit hypothesis was the consensus view of the majority of dyslexia researchers. Some now claim that dyslexic individuals show deficits in a wide range of domains (see Fawcett, A.J. (ed.) (2001) *Dyslexia: Theory and Good Practice*. London: Whurr).

Stanovich, although a strong promoter of the phonological impairment hypothesis, recognises that visual processing deficits may occur alongside phonological deficits in some individuals.

Hanley (1997) claims to have found examples of dyslexic students who showed no significant phonological difficulties and experienced difficulties that were more visual than phonological.

Some critics claim that people may use verbal strategies to solve so-called visual problems and the differences in performance between dyslexic people are due to the severity of their phonological impairment and the way in which this interacts with other cognitive factors (Snowling, 1995).

Implications for practice

Need for phonological skills training.

Text references

- Brunswick, N. *et al*. (1999) Explicit and implicit processing of words and pseudowords by adult developmental dyslexics. A search for Wernicke's Wortschatz? *Brain* 122: 1901–17.
- Fawcett, A. and Nicolson, R. (2001) Dyslexia: the role of the cerebellum. In A.J. Fawcett (ed.) *Dyslexia: Theory and Good Practice*. London: Whurr.
- Frith, U. (1997) Brain, mind and behaviour in dyslexia. *Dyslexia* 5(4): 192–214.
- Griffiths, S. and Frith, U. (2002) Evidence for an Articulatory Awareness Deficit in Adult Dyslexics. *Dyslexia* 8: 14–21.

- Hanley (1997) Reading and spelling impairments in undergraduate students with developmental dyslexia. *Journal of Research in Reading* (Special Issue: Dyslexia in Literate Adults) 20(1): 22–23.
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- Paulesu, E. *et al*. (1996) Is developmental dyslexia a disconnection syndrome? Evidence from PET scanning. *Brain* 119: 143–57.
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- Snowling, M.J. and Nation, K.A. (1997) Language, phonology and learning to read. In C. Hulme and M. Snowling (eds) *Dyslexia, Biology, Cognition and Intervention*. London: Whurr.
- Stanovich, K.E. (1993) Introduction. In D.M. Willows, R.S. Kruk and E. Corcos (eds) *Visual Processes in Reading and Reading Disabilities*. New Jersey: Lawrence Erlbaum Associates.

Dyslexia theories → Cognitive level → Phonological processing difficulties → Sub-types

Name of theory: Sub-types

Description

Phonological and surface dyslexia represent distinct sub-types.

They each represent opposing ends of a 'Phonological Impairment Continuum'.

Phonological dyslexics experience difficulty decoding words.

Surface dyslexics have difficulty accessing sight vocabulary.

Key players

- Everatt
- Zabell
- Coltheart

Underlying theory

Fawcett and Nicolson (2001) speculate that different sub-types within dyslexia may have different underlying deficits or differences in brain function.

Miles and Miles (1999) contest the idea that a particular individual remains of the same sub-type through life. Some researchers (e.g. Ellis, 1993) suggest it is to do with reliance on particular reading strategies. See Riddick (1996).

Implications for practice

Tutors need to recognise a learner's position on the 'continuum' and respond accordingly.

Practitioners need to be aware of the wide range of ways (some more subtle than others) in which dyslexic people may have difficulties. It highlights the importance of not seeing dyslexia merely as a literacy difficulty but appreciating that some aspects of motor and organisational skills, as well as numeracy, may be affected.

Text references

- Coltheart, M. *et al*. (eds) (1980) *Deep Dyslexia*. London: Routledge.
- Coltheart, M. *et al*. (1983) Surface Dyslexia. *Quarterly Journal of Experimental Psychology* 35A: 469–95.
- Riddick, B. (1996) *Living With Dyslexia*. London: Routledge.
- Zabell, C. and Everatt, J. (2001) Subtypes of Dyslexia in Dyslexic Teenagers and Adults. *Proceedings from the 5th BDA International Conference, University of York 18th-21st April 2001*.

Dyslexia theories → Cognitive level → Phonological processing difficulties → Double-deficit hypothesis

Name of theory: Double-deficit hypothesis

Description

Dyslexic people not only have a deficit in phonological processing but also in central processing speed.

Some individuals have fundamental difficulties in developing sufficiently rapid processing rates for fluent reading and reading comprehension. Processes underlying naming speed represent a second core deficit in dyslexia, largely independent of phonological processes. This suggests new sub-types that can be characterised by the presence, absence, or combination of the two core deficits in phonology and naming speed.

Key players

- Wolf

Underlying theory

Fawcett and Nicolson (2001) suggest that this can be accounted for by the cerebellar deficit hypothesis.

This is a recent theory. It was described in Fawcett and Nicolson (2001, p.12) as 'the major newcomer to the cognitive level accounts'.

Contributes to the sub-types debate.

Implications for practice

Teaching which develops phonological skills and fluency can move dyslexic learners along the continuum from Frith's 'Logographic phase' into her 'Alphabetic phase' of literacy development.

Text references

- Fawcett, A. and Nicolson, R. (2001) Dyslexia: the role of the cerebellum. In A.J. Fawcett (ed.) *Dyslexia: Theory and Good Practice*. London: Whurr.
- Wolf, M. and O'Brien, B. (2001) On issues of time, fluency and intervention. In A.J. Fawcett (ed.) *Dyslexia: Theory and Good Practice*. London: Whurr.

Dyslexia theories → Cognitive level → Visual difficulties → Visual processing difficulties

Name of theory: Visual processing difficulties

Description

Dyslexic people may be unable to process fast-incoming sensory information adequately.

This could explain visual difficulties such as unstable binocular vision and unsteady fixation when reading, hence visual confusion of letter order which can lead to poor memory of the visual form of words.

Key players

- Stein

Underlying theory

Visual processing difficulties may be indicative of impairment in the visual magnocellular system (a pathway made up of large neurones known as magnocells, by which information is passed from the eyes to the brain).

Research with children has revealed that dyslexic individuals compared to non-dyslexic individuals do worse at tasks like flicker detection that test the efficiency of their transient channel (the magnocellular pathway, enabling flicker or rapid change detection), but equally well on tasks that test their sustained channel (the parvocellular pathway, enabling detection of stationary detailed patterns).

Implications for practice

Evans (2001) states that there is convincing research evidence to suggest that about two-thirds of dyslexic people have a deficit of the visual magnocellular

system, but stresses that this does not necessarily mean that it impairs a person's performance in everyday life. He comments that there is no known treatment for the magnocelluar pathway deficit. However, research into polyunsaturated fatty acids supplements suggest improvements in reading can result.

Stein *et al*. (2001) claim that visual transient sensitivity can be measured in young children and improved by appropriate sensory training, but they do not state what this would entail.

Some critics claim that people may use verbal strategies to solve so-called visual problems and the differences in performance between dyslexic people are due to the severity of their phonological impairment and the way in which this interacts with other cognitive factors (Snowling, 1995).

Sometimes conventional optometric problems (e.g. long sightedness) are responsible for symptoms. In some cases, eye exercises are more appropriate than coloured overlays (Evans, 2001).

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Dyslexia theories → Cognitive level → Visual difficulties → Visual distractions

Name of theory: Visual distractions

Description

Certain people are subject to perceptual distortions of text, such as unstable print, 'halo effect', swirling movements on the page, etc. For some, the distortions can disappear when the page of text has a particular colour.

Some children have scotopic sensitivity (Irlen syndrome) that results in excessive glare and print distortions when reading.

Key players

- Wilkins
- Irlen

Underlying theory

May be caused by Meares–Irlen syndrome, or by binocular instability.

Implications for practice

Tinted overlays cannot cause phonological difficulties to disappear but can reduce pattern glare and other forms of discomfort. Reading can become less physically stressful and learning to spell easier once words stabilise. Pumphrey and Reason (1991) suggest that improvements using overlays may be the result of 'placebo effects'.

Irlen lenses are expensive, though overlays are not.

It is possible that there is more likelihood of benefit when there is migraine in the family (Wilkins, 1995).

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Dyslexia theories → Cognitive level → Visual difficulties → Visual tracking

Name of theory: Visual tracking

Description

Research on eye fixations suggests that dyslexics have a high incidence of right to left tracking.

Key players

- Pavlidis
- Stein and Fowler

Underlying theory

That unstable binocular control is a feature of dyslexia and may be one cause for reading difficulties.

Implications for practice

Reading is to do with left-to-right tracking. Research suggests that someone with dyslexia has less efficient control over eye movements.

Use of monocular occlusion for remediation to give reading gain.

Binocular instability may not be the sole cause.

Text references

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Dyslexia theories → Cognitive level → Temporal or timing difficulties

Name of theory: Temporal or timing difficulties

Description

Dyslexia may be due to a flaw in a specific brain circuit that handles rapidly flowing auditory information (Miller and Tallal, 1995).

Visual and phonological difficulties may both be indicative of an underlying temporal or timing difficulty. It could be the case that dyslexic people are unable to process fast incoming sensory information in any domain (Stein and Walsh, 1997).

Key players

- Stein
- Wolf
- Frith
- Tallal

Underlying theory

Possibly due to magnocellular difference (auditory or visual).

Only transient processing is affected – dyslexic people have good sustained (parvocellular) processing systems that enable them to perform many cognitive tasks as proficiently as those without dyslexia.

Implications for practice

A.R.R.O.W. and Fast ForWord techniques

Sound therapies that filter, enhance or 'spectrally activate' sound. Sound therapies that filter or enhance sound may help to tone the muscles of the middle ear.

These problems might encompass different modalities, not just auditory perception.

Reading is particularly affected because it requires highly efficient and accurate processing at extremely high speed.

Dyslexic individuals need more time to learn or process information or output their response. Speak with plenty of pauses to allow for slow processing of auditory information. Break words into syllables and use rhyme.

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Dyslexia theories → Cognitive level → Automaticity

Name of theory: Automaticity

Description

Many tasks are made up of a number of sub-skills. If the sub-skills are to be performed simultaneously, most of them must become automatic, rather than conscious so that performance becomes effortless.

'…automaticity refers to the ability to perform an action automatically without focusing upon it' (Mortimore, 2003, p.50).

Lack of automaticity, particularly in literacy and numeracy skills, means that dyslexic individuals are more likely to encounter processing overload when asked to carry out new or complex tasks. A wide range of skills can be affected, including motor skills.

Key players

- Fawcett and Nicolson

Underlying theory

Cerebellar deficits may account for automatisation difficulties displayed by dyslexic people in various areas of skill.

The literature is not unanimous on the processes or brain regions involved in complex skill learning.

Fawcett and Nicolson (1994) propose the twin hypothesis that dyslexic children incur dyslexic automatisation deficit and conscious compensation hypothesis, meaning that not only do they have difficulty in acquiring automaticity, but also in many cases they are able to mask this deficit by working harder. Deficits,

however, will still be noted in situations where compensation is not possible.

This is still an area of debate which challenges the phonological processing deficit hypothesis.

It contributes to the sub-types debate – different sub-types within dyslexia may have different underlying deficits or differences in brain function.

Implications for practice

Educators need to be aware that dyslexic individuals may not readily consolidate new learning and are likely to need many more exposures before they can remember a particular teaching point. They are also likely to find it difficult to change inappropriate learning habits.

Teachers should understand that even when a skill has apparently been learnt, it may be lost if there is interference from competing activities. For instance, a learner may know how to spell a word when he thinks about it but, because it has not been fully automatised, the spelling will break down when he writes it while thinking about other things.

There is a wide range of subtle ways in which people may have difficulties. It particularly affects the learning of sequences of words or numbers.

It is important not to view dyslexia simply as a literacy difficulty – some aspects of motor, organisational skills and numeracy may be affected.

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Dyslexia theories → Cognitive level → Working memory

Name of theory: Working memory hypothesis

Description

Inefficient working memory has long been implicated as an underlying factor in dyslexia.

Working memory is used to hold new information in the mind before it is discarded or transferred into long-term memory.

Memory processing involves four major components:

- audio memory (includes phonology)
- visual memory (includes the orthography or forms of words)
- movement or procedural memory (sometimes called habit memory, for example riding a bike)
- semantic memory (deals with meaning).

A person with dyslexia can experience a weakness in any of these channels and this will put pressure on the others (Mortimore, 2003).

Key players

- McLoughlin
- Baddeley
- Gathercole

Underlying theory

Brain imaging studies have located the components of working memory in the brain – the central executive in the frontal lobes, the visual–spatial sketchpad

('inner eye') in the right hemisphere and the phonological loop ('inner ear') in the left hemisphere (Carter, 1998).

McLoughlin *et al*. (2002) have proposed a definition based on working memory theory:

'Developmental dyslexia is a genetically inherited and neurologically determined inefficiency in working memory, the information-processing system fundamental to learning and performance in conventional educational and work settings. It has a particular impact on verbal and written communication as well as on organization, planning and adaptation to change' (p.19).

Implications for practice

It is an oversimplification to see memory processing in terms of the simple two-stage 'storage box' where information is transferred from a short-term to a long-term memory store (Mortimore, 2003).

It may be that dyslexic learners make less efficient use of phonological codes and hence have more limited short-term memory capacities.

Pickering (2000) has concluded that dyslexic people:

- have particular problems with the phonological code in working memory. They seem to use it less efficiently and have problems translating visual information into phonological form, which affects their ability to learn new words when reading (this links to research into Broca's/Wernicke's areas)
- have difficulty with phonological repetition, for example repeating multisyllabic or non-words
- do not seem to use phonological memory strategies as readily as others. They have difficulty retaining phonological information using rehearsal or repetition. They do not easily attach verbal labels to pictures and they have difficulties with lists.

Given these phonological processing weaknesses, many dyslexic individuals may develop strong compensatory processes and come to rely more on visual codes for memory processing. This is linked to the idea that dyslexic people may have superior visuo–spatial skills.

McLoughlin *et al*. (2002) suggest that an explanation of the working memory system can help dyslexic adults understand:

- their ability to recognise faces but have trouble remembering names
- their ability to recognise landmarks/places but not follow directions (both may be due to competence in the visual–spatial sketchpad but weakness in the phonological loop)
- having good days and bad days (this could be due to the impact of a 'heavily loaded' central executive on the phonological loop).

The phonological loop is thought to play a part in dyslexic people's difficulties with the procedural aspects of maths (McLoughlin *et al*., 2002).

Recent research has suggested a link between the phonological loop and temporal processing and also time perception (Venneri, 2000). This may explain why some dyslexic people have problems with time keeping/management.

Mortimore (2003) suggests that dyslexic learners may have difficulties in another area of memory function: automatisation. Dyslexic people may have difficulty maintaining material in temporary memory storage while carrying out another skill, so a person may need to focus on decoding or working out letter–sound links, thus reducing the attention available for the process of understanding what has been read. This links to research into automaticity.

When considering approaches, the individual's learning style and particular strengths need to be taken into account. Some memory strategies may add more information to be memorised along with the target facts. This can simply result in overload.

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Dyslexia theories → Cognitive level → Difference model

Name of theory: Difference model

Description

Many dyslexic people experience their dyslexia as a difference in how they think and learn.

This model centres on the specialisation in processing styles of the left and right hemispheres of the brain (Klein and Morgan, 2000).

Many dyslexic people are holistic thinkers who benefit most from 'right brain' approaches to learning and teaching.

There may be a higher incidence of dyslexia among artistically gifted individuals.

Key players

- Klein
- Krupska
- Morgan
- Davis
- West
- Mortimer
- Everatt

Underlying theory

Centres on the specialisation in processing styles of the left and right hemispheres of the brain.

Research suggests that left hemispheric differences in processing language are common in dyslexics (Galaburda, 1999) and personal histories support the view that dyslexic people tend to have a right hemispheric 'processing style'.

Wolff and Lundberg (2002) found that signs of dyslexia occurred more frequently among art students than in students on in non-art programmes at Göteborg University, Sweden. When dyslexic individuals are confronted with phonological tasks they show different activity patterns in their brains as compared to non-dyslexic individuals (Pugh *et al*., 2000) – Wolff and Lundberg suggest that this results in a different distribution of talents.

Research by Rippon and Brunswick (1997) and Rippon, Brunswick and Garner (1997) that attempted to find relationships between hemispheric laterality, left/right handedness and reading and spelling skills, was inconclusive.

The work of Galaburda (1993) and Best and Demb (1999) suggests that the majority of non-dyslexic brains are asymmetrical (larger to the left in the planum temporale, an area vital to language processing) whereas dyslexic brains show an atypical symmetry.

Hynd and Heimenz (1997) found links between extreme phonological processing difficulties and symmetrical plana.

Some research examines the role of the corpus callosum in suppressing one of the hemispheres during processing for a particular type of task. It has been found that problems in the left hemisphere pathways disrupt verbal memory, whereas right-hemisphere problems get in the way of visual memories (Steffert, 1996).

Stein (2001) speculates that the weak magnocellular system (transient channel) of dyslexic people may result in the emergence of a more efficient parvocellular system (sustained channel, enabling detection of stationary detailed patterns). These advantages to the parvocellular system could explain the holistic talents of dyslexic people.

Implications for practice

Much of the research literature in the field of dyslexia focuses on a deficit model of weaknesses. This model is important as it highlights positive characteristics.

Much of the evidence for the difference model comes from case studies and anecdotes. It could be that early school failure forces some dyslexic individuals

to look for opportunities to succeed in other fields. Also, problems with literacy may bring about unconventional coping strategies and modes of thinking. Artistic talents may be equally distributed, but just more visible among dyslexic people as talented dyslexics are restricted to non-verbal domains.

The difference model has implications for educators in terms of offering more 'right brained' approaches to learners. It is important that educators are aware of learning styles and metacognitive strategies that can enhance the learning process across the curriculum.

It must be remembered that no two dyslexic people are the same and it is dangerous to assume that all individuals with dyslexia will show the same traits. It is important to encourage each individual to explore his/her own learning style and to teach to his/her strengths.

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Glossary

A

Affix — A morpheme that can be added to the beginnings of words (prefix) or to the ends of words (suffix) to change the meaning.

Assistive technology — Technology (equipment, programmes or adaptations) that allows learners with learning difficulties or disabilities to access literacy or learning in general.

Auditory processing — Brain activity to distinguish and interpret what is heard.

Automaticity — Being able to perform an action without having to concentrate on it.

B

Blend — A combination of two or more phonemes, particularly at the beginnings or ends of words, such as *st*, *str*, *pl*, *nd*.

C

Cerebellum — Part of the brain that principally coordinates balance and language dexterity.

Check read — Where a teacher checks that a learner has covered work successfully and is ready to progress. It involves checking first that the learner can decode accurately

	and fluently and then asking questions on the text to check the learner's understanding.
Cultural bias	Where the meaning of a text or image can only be fully understood by those who share a common culture.
Cumulative	Where each step follows on from and builds on the one before. Cumulative programmes need to be followed in a set order.

D

DARTs	Directed Activities for Reading Texts – exercises to help learners engage with particular aspects of text. May involve highlighting, cutting and pasting, and moving text around.
Decoding	Working out what a word says by using phonological information, syllable division and spelling rules.
Digraph	Two letters representing a single sound, such as *ai*, *ph*.
Diphthong	A vowel sound that consists of two vowel sounds combined, such as *ou* in sound or *oi* in boil. Often thought of as a single sound.

E

Error analysis	A technique for identifying a learner's specific difficulties by analysing and categorising the errors made. Can be used for spelling, writing, numeracy or reading.

GLOSSARY

G

Global — A way of thinking or learning where mental pictures or images rather than words are used and problems are approached by looking at the whole rather than in a step-by-step way. Also known as holistic thinking.

Grapheme — The letter or letters that make up a phoneme.

I

Information processing — Brain activity to distinguish and interpret information coming through the senses.

K

Kernel sentences — A simple sentence used as the basis for exercises on building complex sentences by adding elements such as adjectives, adverbs, or clauses.

Kinaesthetic — Relating to voluntary bodily movement. Tracing over the shape of letters on the page, or drawing them in the air are examples.

L

Language experience — Using the learner's own words as the basis for learning. A teacher writes down what the learner says and the learner then uses that text to work on spelling, reading, or writing.

Long-term memory — Where learning is stored. Information in the long-term memory can be recalled (remembered) when needed.

Look Say Cover Write Check	A multisensory technique for learning spellings.

M

Mind mapping	A way of recording ideas and the links between them as they arise. Sometimes known as spidergraphs. It enables learners to capture and organise what they want to write before thinking in detail about how they need to write it.
Mnemonic	A device to help with memorising, for example spellings or sequences, such as the months of the year or telephone numbers.
Modalities	Channels – visual, auditory and kinaesthetic – through which information enters the brain.
Morpheme	The smallest unit of meaning in a language. A word may consist of one morpheme (house, happy) two morphemes (house/ing, un/happy) or three or more morphemes (house/keep/ing, un/happi/ness).
Motor control	Being able to match physical actions to perform tasks, such as coordinating hands, feet and eyes when driving a car.
Multisensory	Using visual, auditory and kinaesthetic modalities, sometimes at the same time.

N

Numerosity	The ability to recognise the size of numbers and their value relative to other numbers.

O

Overlearning — Repeated practice to ensure a learning point is consolidated and transferred to long-term memory.

P

Phoneme — The smallest unit of sound in a language. English has around 44 phonemes (depending on accent). Phonemes may be represented as one, two, three, or four letters as with the vowel sound in *to*, *shoe*, *through*.

Phonetically regular — Where each symbol or letter always represents the same sound. English is not a phonetically regular language.

Phonic — Relating to vocal or speech sounds. *Phonics* refers to a method of teaching reading and spelling that is based on establishing the link between the sound and its graphical representation.

Prefix — A morpheme that can be added to the beginnings of words to change the meaning.

Print instability — When print seems to move on the page or appear distorted in some way – blurred, faint or wobbly, for example.

R

Reversal — When letters or numbers are perceived or written backwards or upside down as in *was* for *saw* or *6* for *9.* It is particularly common with the letters *b/d*, *p/q*, *n/u*.

Root word — The base morpheme to which prefixes or suffixes may be added. In the words *unclear*, *clearing*, *cleared*, the root word is *clear*.

S

Scaffolding — Techniques such as DARTs or PQ4R (Preview, Question, Read, Reflect, Recite, Review) for teaching reading comprehension or writing that support learners by giving them a structured approach.

Sequential — Proceeding progressively in a prescribed order.

Short-term memory — The memory required to 'hold' information in your head and/or manipulate it as you perform a task. Holding a telephone number in your head as you write it down is an example.

Specialists — In this document, it refers to those whose main role is the support of dyslexic learners and who have been trained specifically for that role.

Substitution — When one morpheme or letter is used in place of another as when reading *coming* for *come* or *breakfast* for *breaking*.

Suffix — A morpheme that can be added to the ends of words to change the meaning.

Syllable — Each beat in a word is a syllable. Dividing longer words into syllables can help learners understand word structure.

T

Transposition — When the position of symbols, letters or numbers in a sequence is altered, as in *1957* for *1975*, or *gril* for *girl*.

W

Writing frame — A structured prompt or template to support writing in different formats such as reports, letters, or essays. It may take the form of an opening phrase for each paragraph and suggested vocabulary.

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(* glossary entry)

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