**SECTION A: UNDERSTANDING DYSLEXIA**

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| **Definition**   * Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling. * Characteristics features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed. * Dyslexia occurs across the range of intellectual abilities. * It is best thought of as a continuum, not a distinct category, and there are no clear cut-off points. * Co-occurring difficulties may be seen in aspects of language, motor co-ordination, mental calculation, concentration and personal organisation, but these are not, by themselves, markers of dyslexia. * A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well-founded intervention.   (Rose, 2009, p. 32) |

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| **Early development**  A family history of dyslexia is a significant risk factor (Shaywitz, Gruen, & Shaywitz, 2007). Early difficulties with language warn of potential future literacy difficulties (Siegel, L. 2006). In particular, glue ear in the first two years is strongly linked with auditory and phonological processing impairments. Peer (2005), found that 70% of dyslexic children in her study had a history of early onset glue ear. Any early signs of other processing differences should raise awareness that the child’s literacy development may need careful monitoring. (Astle, D., Bathelt, J., the CALM team & Holmes, J. 2017; Misheva, E. 2018). |

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| **Other factors**  Literacy is language in a written form, so factors which impact on language, such as having English as an additional language, or having a developmental language disorder (DLD) will play a part (Reid, 2016).  Health and physical development are also factors to consider, as a child who has been persistently poorly may have fallen behind, and failure to thrive may indicate other issues to investigate, for example, poor diet, sleep patterns etc., which will all affect a child’s readiness to learn.  Children’s attitudes and dispositions, as well as learning identity as a reader will also play a part. Early experience of difficulties will affect a child’s self-esteem, and compensatory protective strategies may lead to reluctance to participate and create further barriers to progress.  Developments in the understanding of neurodiversity (Dyslexia Matters 2019), alert practitioners to the possibility that children presenting with one deficit may have others, which might become more apparent at a later stage of development. For example, a child with early signs of poor motor development (dyspraxia) may later display difficulties with reading comprehension when they struggle to organise their thoughts, and with motor planning to write their responses (Kindersley, 2019). They might also experience difficulties with visual tracking and directionality, which could affect early reading, learning the reading direction, and blending. |

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| **Phonological awareness**  Phonological awareness is the awareness of individual speech sounds which make up words. To begin with, children learn language as phrases and whole word units, which become more refined as more words are acquired. Children become aware of onsets and rimes, syllables, and finally, individual phonemes.  Phonics is the process of teaching reading and writing by attaching letter labels to represent phonemes, so includes teaching children to orally blend and segment words as well as to select the correct letter patterns to represent those phonemes.  Phonology is concerned with the sound patterns in language, for example, the way sounds are organised, and the structure of words, rather than the actual acoustic properties of abstract sounds, which may vary according to the position of the phoneme within a word. |

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| **Auditory processing**  Auditory processing encompasses all sound signals coming in to the ears, while phonological processing refers to the processing of speech sounds. Auditory processing is an exceedingly complex cognitive activity, concerned with making sense of the sounds all around us, unpicking those which have meaning from general environmental noise. Auditory signals stimulate the auditory nerve which encodes the sounds into patterns of activation, and templates of auditory codes are stored so that sounds can be recognised when heard again.  Phonological processing, rather than general auditory processing problems, are implicated in reading difficulties (Hornickel & Kraus, 2013; McArthur, Ellis, Atkinson & Coltheart, 2008; Mody, Studdert-Kennedy & Brady, 1997). |

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| **Memory**  Working memory refers to the limited capacity system conceptualised by Baddeley (1998; 2000), A simplified model of working memory, shown in figure 1, illustrates how the central executive oversees the phonological loop, which stores speech-based input, and the visuo-spatial sketchpad, which stores visual information. The episodic buffer has a role in retrieving information from long term memory (LTM) and integrating it with contents of working memory.  Central Executive  Visuo-spatial Sketchpad  Episodic Buffer  Verbal Short Term Memory  Long Term Memory  *Figure 1. Model of Working Memory, (after Baddeley, 2000)*  Deficits in verbal short term and verbal working memory are implicated in reading, writing and spelling difficulties. |

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| **Processing speed**  Processing speed is how long it takes for incoming information to be fully processed, and includes visual and auditory/phonological processing, as well as decision and reaction time, and motor planning for output. Slow processing may not be indicative of a learning difficulty in itself, but there are strong links with working memory and other cognitive processes which are difficult to unpick (Dyslexia Matters, 2019). If processing is slow, even if working memory capacity is average, content will be lost if processing takes too long. The cumulative effects of slow processing are that the learner often fails to keep up, and the effects are felt in every lesson, every day. |

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| **Visual processing**  There are several categories of visual processing, any number of which may work inefficiently, with consequential effects on literacy development. Problems with visual perception may result in letter and number confusion, difficulty recognising letters or numbers, or remembering sight words, or being unable to attend to the detail in a visual image (Janarthanan, 2017).  Visual processing problems may extend to poor spatial awareness, difficulty judging speed and distance, and so may have an inhibitory effect on movement, causing problems with directionality and coordination (Kelly, 2019).  Where visual processing difficulties are suspected, children should always be referred to an optometrist. |

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| **Reading development models and dyslexia**  The Dual-Route Cascaded (DRC) (Kohnen & Nickels, 2008; McArthur & Castles, 2011, Castles, Rastle & Nation, 2018) model is useful to conceptualise two parallel processes, phonological and visual, which appear to be used by typically developing readers.  print  feature analysis    letter analysis  **Lexical Route Non-lexical Route**  orthographic lexicon  grapheme to phoneme conversion    phonological lexicon  phoneme buffer    speech  *Figure 2. The Dual Route Cascaded Model (simplified), of word recognition and reading aloud (after McArthur & Castles, 2011)*  The DRC illustrates that for English, two interacting systems, a lexical, or whole word route, where words are instantly recognised by sight, and a non-lexical, or phonological decoding route, account for reading behaviour.  The non-lexical route on its own would not be able to deal with irregular words, like *once* and *aches,* and processing via this route would result in regularisation errors (such as reading *pint* to rhyme with *mint*). Therefore, a visual lexical route is required to process known whole words, which alone could not deal with non-words or unfamiliar regular words.  According to this model, to begin with dyslexic children might read several sight words (similar to Frith’s logographic stage), but difficulties with phonological awareness would impact on developing phonemic awareness and mapping letters into sounds, impairing the phonological route. Ineffective and inefficient decoding would limit text exposure, which would in turn inhibit sight word development. Over time, children might retain sufficient sight words to read reasonably well, but would always struggle with unfamiliar words requiring use of the defective phonological route.  Frith’s (1984) stage model is also useful for conceptualising reading development into three stages:   * Logographic – words are recognised by sight as whole units; knowledge of grapheme/phoneme conversion rules are not necessary. * Alphabetic – some phonological awareness is required, and some simple grapheme/phoneme rules are known, enabling some decoding and writing phonetically plausible words. * Orthographic – this stage requires a great deal of print exposure; words may be recognised by accessing stored representations of whole words or letter strings. Words can be analysed into morphological units.   According to this model, dyslexic pupils with phonological deficits would find it difficult to progress from the logographic stage (Dyslexia Matters Powerpoint, 2019). |

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| **Writing development models and dyslexia**  Writing is a massively complex skill, which reduced to its simplest dimensions is the product of ideation and transcription . Writing can be conceptualised as progressing in stages, similar to Frith’s stages of reading (1984). In the logographic stage, children will use emergent writing, which might be of letter like shapes or letter strings, including letters from their name or other well-known environmental logos or print.  Next, in the alphabetic stage, children will draw pictures and tell stories, adding words which can be decoded using alphabetic principles.  Transitional stages allow children to incorporate more text knowledge into their writing, as they become aware of it, so capital letters will start to appear, full stops appear after every word, then at the end of each line, before assuming their proper place one sentence structure is understood. Word, sentence and text level knowledge needs to be integrated.  Dyslexic children may struggle with ideation, sequencing ideas, remembering them long enough to write them down, and with other aspects of transcription, due to effects of poor phonological working memory.  Where children have co-existing difficulties, they may struggle with the physical act of writing, motor planning, pencil control, writing stamina, legibility, or attention and concentration, so that tasks are hard to start and rarely finished. |

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| **Spelling development models and dyslexia**  There are five stages of spelling development (Dyslexia Matters, 2019). In the first stage, children may write strings of random letters, or letters of interest to them, and tell you what the writing means to them. EYFS practitioners call this emergent writing. During the next stage, children have learned the sounds of some letters, and may use them in their writing. The phonetic stage produces writing which can be read by others. During a transitional stage, children acquire more spelling knowledge until it is eventually mature, and mostly correct.  Dyslexic children find it difficult to progress through the transitional to correct stages, with particular problems learning alternative spellings for sounds and long vowel signals. |

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| **Dyslexia and maths difficulties, as well as dyscalculia**  As dyslexia is a neurodevelopmental disorder, with very few children having impairments restricted to language and literacy, many dyslexic children have co-occurring difficulties with maths. It is rare for maths difficulties, particularly amounting to dyscalculia, to occur in isolation, but the cognitive weaknesses which underpin dyslexia, for example, poor working memory, will certainly impact on the ability to carry out calculations, or solve problems with more than one step (Kindersley, 2019). Maths difficulties may affect number recognition, remembering maths language or number facts, or sequences of operations. |

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| **Study skills and dyslexia**  Dyslexic pupils will likely have working memory deficits which impact on study skills in a variety of ways. Taking useful notes of salient details needs to be taught, as good notes mean the whole text doesn’t need to be re-read. Notes can be in any form as long as they act to retrieve the appropriate memory.  Mind mapping is a very effective method of making notes, with explicit links between points. Mind maps can be elaborate or simple, and a great deal of information can be contained on a small map. The key here is that the information is actually known and understood; the map acts as a revision aid.  The added benefit of mind maps is that they can be used in reverse, to plan the content for a writing task.  During independent reading, the WQRLD acronym (Dyslexia Matters, 2019):  **W**hy am I reading this?  **O**verview  **R**ead  **L**ink  **D**o  may help the dyslexic student by helping them keep in mind the sequence and purpose of operations, so that nothing is missed out. |

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| **Organisation, attention, and coordination**  Difficulties with any or all of the above may stem from underlying working memory deficits, developmental coordination disorder (DCD), or attention deficit hyperactivity disorder (ADHD). All these SpLDs may overlap, and so impact to a greater or lesser degree, and in combination, may have considerable effect on an individual.  DCD does not just affect motor coordination. There may be problems with planning and organising thoughts, which will impact on the ability to remain organised, complete tasks and stay on schedule. ADHD may be experienced in two forms; hyperactive or inattentive, although the same difficulty may present differently in different contexts (Kindersely, 2019).  ADHD affects the executive functions, which include organisation, planning and inhibiting impulses, therefore is a considerable impediment to school-based learning, which requires integration of those skills. |

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| **Differences between dyslexia and Developmental Language Disorder (DLD), the relationship between literacy and learning, and the structure of language**  Both are ‘dimensional’, rather than ‘categorical’, which means that severity may be variable. According to Snowling (2017), both difficulties share phonological deficits to begin with, but children with DLD also have problems with vocabulary and grammar. Although they may be different from the typical dyslexic in that they can decode and pronounce words aloud, they don’t understand what they read, making them ‘poor comprehenders’. Another study (Catts, Adlof, Hogan & Weismer, 2005) found that dyslexic children had greater phonological deficits than children with a language disorder. However, due to potential overlap, some dyslexic children may demonstrate difficulties with aspects of vocabulary and syntax, while children with DCD may have persisting difficulties with phonological skills too, and Snowling (2000) reports that many children with DCD are also identified with dyslexia.  Acquiring literacy is a lengthy process upon which education, schooling and culture all impact. , and is a pre-requisite for academic success. Progressively higher levels of literacy are required to access increasingly dense and difficult academic texts, therefore literacy may enable or limit learning. Becoming literate includes understanding of figurative and poetic uses of language, being able to understand and make inferences, as well as the underlying structure of words.  The structure of English can be examined at the text, sentence and word level. Word level structure provides information about word types (parts of speech), and morphological structure of prefixes and suffixes, as well as changes in inflection endings for verbs, which provide information about meaning. A morpheme is the smallest meaningful unit of sound, e.g **un**happy, the prefix un is a morpheme which changes the word meaning. At sentence level, the different parts of speech need to be arranged into an acceptable order to make sense, following rules of syntax, for example, Wider grammatical rules govern how the text as a whole is put together, including sentence structure, types of simple, complex or compound sentence containing additional clauses, links within and between paragraphs, and coherence throughout the text. |

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| **Effective specialist dyslexia teaching**  Specialist teaching needs to be personalised to utilise each child’s strengths, and to be multisensory, to use as many sensory channels as possible for the input. Multisensory can be as simple as see it, hear it, say it, write it, for some children, while others may require whole body activity (Dyslexia Matters, 2019).  Teaching must begin with a thorough analysis of a detailed assessment. Gaps in knowledge should be identified and filled, new knowledge should build on existing, so that it is contextualised where possible (Dyslexia Matters, 2019).  Evidence from studies (Castles, Rastle & Nation, 2018) suggests that the most effective instruction includes systematic phonics, and the current guidance from the Rose Review (2009) is that synthetic phonics, where letters and sounds are taught in isolation before being blended to make words, are preferable. Instruction should be at the right pace for the pupil, with sufficient repetitions to secure learning, progressing through a logical sequence in small steps, with revision to promote overlearning and development of automaticity.  Where links exist, they should be made explicit, with frequent pauses to recap and consolidate.  All activities should offer maximum potential for success, and to learn from immediate correction of mistakes, so that misconceptions are addressed. |

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| **Impact of EAL and multilingualism on learning and literacy development and how dyslexia and SpLD in the learner’s first language can affect their ability to learn English as an additional language**  Multilingual children may be slower to achieve language and literacy targets in English than children who speak English only, because they are setting up multiple internal lexicons and grammatical and syntactic structures, as well as making links between them.  Factors to consider are the structure and orthographies of the additional languages. English is an alphabetic language with a complex orthography, because we have only 26 letters and 44 phonemes. Other orthographies may be more transparent, so difficulties with decoding and spelling may not arise as early in a child’s educational career as they might in English  For example, a dyslexic child with Spanish as a first language may not struggle to read and write in Spanish initially, due to its transparent orthography, but will begin to struggle at an earlier stage in English, due to the complexity of English spelling rules. Conversely, a child who has been identified as dyslexic in their home language (for example, Swedish) may seem to have an easier path with English literacy. This phenomenon is called ‘differential dyslexia’, and depends on each child’s specific set of impairments, as well as the structure and features of the additional languages. The underlying cognitive challenges, such as poor phonological skills, poor working memory and potential overlap with other SpLDs will still apply (National Association for Language Development in the Curriculum (UK), 2011), and impaired phonology may affect the ability to remember and retain new vocabulary in any language. |

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| **Benefits of ICT and assistive technology for learners with dyslexia**  ICT and assistive technology can be of great assistance for dyslexic pupils. These devices and software programmes assist with the ’secretarial’ aspects of study, and with word recognition, allowing the dyslexic individual to focus on meaning rather than decoding and transcription. They go some way to compensate for the difficulties faced by the dyslexic individual, allowing them greater opportunities to demonstrate their knowledge.  Small voice recorders (sound buttons) can be programmed with sequences of instructions, which the pupils can listen to as necessary. This may help where individuals have poor working memory and struggle to remember sequences of instructions.  Voice recorders can be used to make notes, which can either be transcribed later by the teacher, or via voice to text conversion software. Word processors can be programmed with whole word selections, dictionaries and topic relevant vocabulary (Clicker), and have spell check facilities to enable the dyslexic writer to edit their work.  Scanning pens, such as the C-pen, available with built-in dictionary, or without additional features for exam use, are available to help by providing a text-to-speech facility for single words, whole sentences or paragraphs. These pens may also be used to take notes by scanning text and transferring them to a word processing file. |

**SECTION B: EVALUATING THEORIES OF DYSLEXIA**

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| Cognitive theory 1 | |
| **Phonological Deficit** | |
| Who has researched this theory? Bradley & Bryant, Ellis, Castles, Snowling, Stanovich | |
| What is the theory? Specific impairments in the representation , storage and retrieval of speech sounds impedes literacy development. | |
| Evaluate the evidence base of the theory Studies show that phonological difficulties affect the ability to segment and blend words, and recognise rhyme, and that poor working memory is also implicated. | |
| Strengths of the theory Accounts for poor letter/sound linkage decoding difficulties. | Weaknesses of the theory It does not account for general slow processing and motor, balance and directionality issues observed in dyslexic individuals. |

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| Cognitive theory 2 | |
| Automaticity Deficit | |
| Who has researched this theory? Fawcett and Nicolson, Berninger | |
| What is the theory? Dyslexic individuals have deficits in skills including balance, motor skills, rapid processing and switching attention, which should become automatic with practice. | |
| Evaluate the evidence base of the theory Studies have shown that dyslexic individuals have problems with automaticity of shape recognition, writing and spelling, and visual-spatial working memory. | |
| Strengths of the theory It accounts for some motor and sensory problems and slow processing observed in dyslexic individuals. | Weaknesses of the theory Lack of automaticity in all areas of processing contributes to accounts of all observed behaviour. |

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| Brain-based theory 1 | |
| **Magnocellular deficit** | |
| Who has researched this theory? Stein, Everatt, Chase, Hogben | |
| What is the theory? A sensory deficit theory of ‘brain level’ processing including visual and auditory information. | |
| Evaluate the evidence base of the theory Studies have shown that dyslexic individuals need visual stimuli to be presented for longer, and for longer gaps between stimuli than typically developing peers. Similar studies have shown that there are also problems for auditory perception for sounds presented close together. | |
| Strengths of the theory It accounts for problems with phonological awareness, if closely presented sounds cannot be untangled, as well as slow visual processing. | Weaknesses of the theory It does not account for visual persistence and blurring effects sometimes reported by dyslexic individuals. |

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| Brain-based theory 2 | |
| Procedural Learning Deficit | |
| Who has researched this theory? Nicolson and Fawcett, West, Shanks, Hulme | |
| What is the theory? A general impairment in the procedural system, which is responsible for learning *how* to do things, affects learning across all areas. | |
| Evaluate the evidence base of the theory Studies have shown that some dyslexic individuals may have worse procedural learning than controls, which means they may take longer to learn how to do things than their peers. In Typically developing individuals, a lengthy learning period usually results in the process becoming automatic, which may take longer for the dyslexic learner. | |
| Strengths of the theory It accounts for the comorbidity deficits often observed alongside dyslexia, as well as intact systems for learning facts. | Weaknesses of the theory Individual variation in attention is a confounding variable, according to West, Shanks & Hulme. |

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