Dyslexia, Dyscalculia and Maths Learning Difficulties

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This chapter is written from a UK perspective. However, I know from lecturing and speaking with teachers in many countries across the world, including Singapore, that many, if not most, of the issues discussed in this chapter are experienced internationally.

As our knowledge of the theoretical bases of learning difficulties has improved so has awareness in schools. The key to meeting the demands that that awareness brings lies in training teachers. I believe that it would be beneficial to include our knowledge of why some children find learning difficult in all teacher-training so that it is available at that critical interface between learner and teacher.

The concept of the co-occurrence of learning difficulties and their influences on children and adults is now recognised. This was not always so. I was unaware when I started to work in the field of dyslexia (in 1981) that my dyslexic students could also have very significant difficulties with maths as well as with language.

At that time we in the UK were unaware of Asperger syndrome. We didn't understand ADHD or dyspraxia. Although Kosc had written about dyscalculia in 1974 few teachers were aware of its existence (although they were well aware of under-achievement in maths). Not so very long ago people argued, often quite vehemently, as to whether dyslexia was 'dyslexia' or 'specific learning difficulty' or even 'specific learning difficulties/dyslexia' (and that's before we get to the discussions on 'difficulty' and 'disability'). These arguments did not include anything about the influence on learning maths.

There was a long definition of 'Learning Difficulties' (LD), the alternative term for dyslexia in the USA, published in 1988. As you read it, note how comprehensive it

is with regard to the influences, factors and co-occurrence issues involved in LD:

> *Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition of listening, speaking, reading, writing, reasoning or mathematical abilities or of social skills. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions (e.g., sensory impairment, mental retardation, social and emotional disturbance), with socio-environmental influences (e.g., cultural differences, insufficient or inappropriate instruction, psychogenic factors) and especially with attention deficit disorder, all of which may cause learning problems, a learning disability is not the direct result of those conditions or influences. (Kavanagh and Truss, 1988)*

After an initial flurry of interest from the Department of Education in the UK, interest in dyscalculia seems to have waned somewhat. The definition that the Department of Education published dates back to 2001:

> *Dyscalculia is a condition that affects the ability to acquire mathematical 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.*

Even though this definition is somewhat succinct, it is informative. My understanding of the various features covered in the definition are that:

It states that these learners have problems with numbers and thus the quantities represented by the symbols. This infers problems at the very early stages of maths and thus, for children, almost the first maths experiences they meet. The use of the word 'intuitive' suggests an inborn ability to deal with numbers/quantities. This should not preclude successful intervention for the majority of learners. We have to remember that there is often a big difference between what children can repeat or chant and what they understand.

"Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers and have problems learning number facts and procedures."

'Learning number facts and procedures' could suggest that a key approach to maths involves memorising facts and procedures. There is evidence to support that this interpretation is applied in UK schools (for example, DCSF, 2008). An over-reliance on memory without understanding is ineffective for any learner, but is very detrimental for many, particularly those with

learning difficulties. There is further evidence that maths education in the UK is not effective for around 25% of learners (Rashid and Brookes, 2010 and the OECD Report, 2013). This leads into the part about performing maths tasks mechanically and without confidence and probably infers that there is no ability to appraise answers for validity and correctness. The skill of estimation and its use for the evaluation of answers is not a natural one for many learners. This vital life-skill area of maths has, therefore to be taught, and in an empathetic way, that is a way that is appropriate to the learner.

WHY CHILDREN MAY NOT LEARN MATHS

The answer to my question to teachers, from across the UK and abroad, *'At what age are enough children giving up on maths in class for it to be noticeable?'* varies, of course, but the most frequent answer I get is *'7 years old*.' Then I meet 18 year old students who know less maths than we expect a 10 year old to know... despite some 13 years of maths lessons. Amazingly, impressively, many still try, often spurred on by the reality that to enter the higher or further education course of their choice, someone has decided that it is 'important' to have a maths qualification. Without maths, there is no access to training as a designer or an artist, for example.

The percentage for whom this is a problem in the UK is around 25 percent, of whom some will be dyscalculic, some dyslexic, some dyspraxic, some all three. Since this has been the situation for over twenty years, it seems obvious to conclude that the way they are being taught is not working.

So what factors are blocking learning? If it starts at 7-years-old, we can't blame algebra, or even fractions, or even division, though these topics probably finish off a lot of children later on when they appear in the curriculum. It could be anxiety. That would be very bad, to have children as young as seven being anxious about maths to a level where they want to give up.

Basically, I don't know a definitive answer and I feel that I should. However, my preliminary research suggests a number of factors:

- Having to do maths calculations quickly.
- Learning facts and procedures (without understanding them).
- The extremely judgmental nature of maths. An answer is right, or it is wrong. The issue here is that failure rarely motivates, especially over-exposure to failure.
- The inconsistencies in early arithmetic confuse children, making bigger challenges on memory and blurring concepts.
- Being asked to do tasks that are beyond the capacity of the child's

working and short-term memories.

- The vocabulary and language of early maths is often everyday vocabulary and language, but used in a maths setting. This is bad for communication and is an example of confusing inconsistencies.

(For a longer discussion on these factors see Chinn, 2012a or Chinn & Ashcroft, 2007)

The combinations of these factors and their relative impact on a child will differ from child to child. Children with learning difficulties in maths are a heterogeneous group.

The significance of early learning experiences is both critical and long lasting. This is known and pro-actively addressed in Singapore, but not in the UK. Geary et al. (2013), highlight the influence of these early experiences on later learning, noting that 'early number system knowledge predicted functional numeracy more than six years later.'

As ever in teaching and learning, communication is critical. In maths, teachers are not merely communicating facts and information, they are communicating concepts. There are a number of essential elements in communication:

- **Short-term memory.** If instructions or information are given out in quantities that exceed the short-term memory of the child, the information will not be remembered by the child, and when short-term memory forgets an item or items, it forgets completely. Thus the communication has failed at the first hurdle.

- **Working memory.** This is the memory that is particularly important for mental arithmetic. Assuming the pupil has enough short-term memory capacity to remember the question, he then has to use working memory to perform the calculation. If the number of steps he uses, or plans to use, exceed his working memory capacity then he will fail the task. If that makes him anxious then the problem gets worse, because anxiety can depress the capacity of working memory even further.

- **Consistency is reassuring.** It makes the general background of life secure, so that a few new experiences can be dealt with. Without that consistency and the security it brings, learning will be less effective. For example, fractions give the impression of inconsistency if they are not explained carefully, in the vocabulary used, in the procedures (which appear as inconsistent) and in developing a number sense of fractions.

- **Speed of calculation.** Having to do maths calculations quickly can challenge children with special needs, who often are slower at processing information. This creates more anxiety, which results in less working memory capacity, more failure, more anxiety, less motivation and the cycle spirals downwards.

- **Long term memory.** Committing basic facts to long-term memory, in particular, times-tables facts appears to be an international problem for a percentage of the student population. Again, I do not know why this task is so very difficult for some children (and adults), but I do know that it is difficult to the level of being impossible, or certainly unproductive in the time spent on the task compared to the gains made. Learning times-tables is something parents can do with their child (which may challenge their relationship). This task, unlike many topics in maths, has not been changed by curriculum 'innovations'. It is consistent and is the same as when the parents were taught. There is a way to deal with the problem constructively and productively that involves the use of strategies that are conceptually based (Chinn, 2009). Another of my surveys in the UK of the teachers who attend my training sessions and lectures is about the percentage of pupils who know these facts at age 10 or 11 years. The responses are rarely lower than 50% and can reach as high as 70%. Once more, if the pupil does not know the answers then it is more experience of failure.

- **Math vocabulary.** The English language vocabulary of early maths is particularly inconsistent, and even misleading and the problem continues as the maths progresses. For example, 1/2, 1/3 and 1/4, which are the first fractions that children will meet and meet most frequently thereafter. They have names that are exceptions to the later pattern of 'fifth, sixth, seventh, etc. They are not, 'twoth, threeth and fourth.' 2, 3 and 4 now mean that the fraction is getting smaller.

It may be that teachers and parents have not recognised and acknowledged these factors with the consequence that the learning environment for children is not efficacious. It is a not uncommon belief in life that just because something makes sense to one person that it automatically makes sense to everyone else.

COGNITION AND META-COGNITION IN MATHS

Maths curricula across the world seem to be moving towards some similarities in pedagogy. One of which is that the curriculum should encourage flexible thinking and meta-cognition or 'thinking about how you are thinking'. There seems to be

some consensus, even if only in principle, that there should be less emphasis on the non-thinking application of formulas (or algorithms).

Usiskin (1998) listed the benefits and attractions of algorithms

- **Power:** An algorithm applies to a class of problems.
- **Reliability and accuracy:** Done correctly, an algorithm always provides the correct answer.
- **Speed:** An algorithm proceeds directly to the answer (the pupil does not have to think).

The seductive power of algorithms is enhanced by the many students who collude with teachers in accepting the use of algorithms. For example, the mantra for dividing by a fraction, 'Turn upside down and multiply' is accepted as avoiding a lot of agony and effort in trying to understand the logic behind the procedure.

There is a problem here for students who do not have reliable mathematical memories. Formulas, procedures and accurate and swift recall of facts will lead to a version of success in number work for those children with strong mathematical memories, but even in this scenario, countries need problem solvers as well as computationally adept pupils (particularly when calculators and computers are readily available). And our brains are designed to forget as well as remember, particularly when the topic is not 'topped up' in memory. I firmly believe that understanding maths enhances the memory for maths. Singapore, a country with a strong reputation for success in maths, overtly encourages meta-cognition.

I was involved in research into thinking (cognitive) style in maths with two colleagues in the USA in the mid 1980s (Bath, Chinn and Knox, 1986). Our literature search showed that two styles of thinking seemed to be recognised and that good problem solvers needed to have access to and use the appropriate thinking style at different stages in problem solving. We labeled our interpretation of the two styles as 'Inchworm' and 'Grasshopper'.

Grasshopper thinkers are holistic, flexible and intuitive. They have very good number and operation senses. They resist documenting their methods. Grasshopper thinkers are answer-oriented. Inchworm thinkers are formulaic, procedural, sequential and literal in their interpretation of numbers. They need to document and want only one way to solve problems. Inchworms are procedure-oriented.

It is possible that some educators under-estimate the impact of this concept. It seems obvious that the way that learners think will be a very critical factor in the way they learn and in the way they are taught. The concept of meta-cognition has

been recognised as a major contributor to success in teaching and learning. The National Research Council of the USA published their findings and research in 'How People Learn' (Bransford et al., 2000). They summarised their research in just three key findings, the third of which is:

"Uncertain learners like the security of the familiar, even if the familiar is not all that successful. Consistency is a key factor in motivation."

The teaching of metacognitive skills should be integrated into the curriculum in a variety of subject areas. Hattie's (2009) study of research into what is effective in education found that meta-cognitive strategies were highly effective in improving learning. He also mentions within this context the use of self-questioning and states that 'the more varied the instructional strategies throughout a lesson, the more students are influenced.' I am often asked if too many strategies are explained, will they cause confusion? My answer is a succinct, 'No', but the way that variety is presented is very critical as to whether or not it is beneficial.

Uncertain learners like the security of the familiar, even if the familiar is not all that successful. Consistency is a key factor in motivation. Teachers may have to do the hard sell on those alternative methods.

There are some potential consequences, in terms of being successful at maths, that are linked to the two thinking styles. If the learner is at either extreme then he will be at risk. It is possible to survive maths as an 'extreme' inchworm thinker, but there are some essential pre-requisite skills that are needed to make this an effective style, for example a good long term memory for sequential information and a good working memory. It is less likely that a grasshopper thinker will survive secondary school maths, particularly when documentation is essential. A grasshopper mathematician is likely to be successful at 'life maths', but probably not successful as an accounts clerk.

Some maths curricula encourage pupils to share their different methods and encourage teachers to present different methods for solving problems. Again, this will require good sales techniques from teachers, because some pupils will just not want to buy into different methods because they think one method is enough and two or more will be confusing (and surplus to requirements). However, each method should illustrate another facet of the concept and, even if the pupil doesn't adopt the new method, an exposure to a different way of perceiving a problem should be beneficial. And there will be a range of needs in any group of pupils.

However, there are persuasive reasons why it is beneficial for learners to be able

to draw on both thinking styles, maybe even in the course of solving a single question. A problem solving sequence might be to start with the over-viewing skills of the grasshopper, moving onto the documenting and procedural skills of the inchworm and finally checking the answer using the appraising skills of the grasshopper. Then there is the situation that some questions and topics lend themselves more to one thinking style than the other, for example, mental arithmetic tends to be a better experience for grasshoppers, whilst algebra is more inchworm friendly.

The ethos of the classroom is another key factor in encouraging or discouraging flexible thinking styles. If learners are encouraged to explore different methods and their efforts are praised and appreciated (children are adept at spotting false praise) then they will generate a learning culture of flexible thinking. This goal also requires a risk-taking ethos in the classroom where pupils can be wrong without losing motivation.

Pupils can be encouraged to share and discuss different methods, but teachers must be aware that there is a need to manage those extreme inchworm thinkers who may be confused by too much choice. Valuing different approaches will encourage flexibility. The maths culture of answering quickly will be counter-productive for these goals. If we are encouraging pupils to read, digest, analyse and comprehend questions, to use meta-cognition, then the culture of speedy answers may discourage them from doing that.

There is almost always more than one way to solve a maths problem, however simple the problem seems to be. Children will become better problem solvers if they can think of 'another way' to solve a problem. This will also help them check their answers and become more confident with those answers. Adults can still learn this skill. Learning to leave the old skill behind for a time while you learn another, almost contradictory skill, is hard for any sports player, for example. It's hard to do in academic activities, too. The old, safe and secure methods are just that, safe and secure. In the early stages of learning, a new skill may appear unappealingly inefficient. Hopefully that changes and the new skill can take its place alongside the old skill.

Finally it should be noted that there may be some inchworm thinkers and some grasshopper thinkers whose thinking style is extreme and totally impervious to change, however skilled the teacher. Then the teacher has to remember the adage, 'Teach the subject as it is to the child as he is.'

MATHS SKILLS AND COGNITIVE STYLE

Three key grasshopper thinker skills an inchworm thinker should adopt:

1. *Inter-relating numbers and the operations, for example, seeing 9 as 1 less than 10, seeing 5 as half of 10.*
2. *Overviewing any problem, for example reading to the end before starting or getting a feel of what the answer might be.*
3. *Appraising their answer.*

Three key inchworm thinker skills a grasshopper thinker should adopt:

1. *Explaining their methods.*
2. *Documenting their methods.*
3. *Accepting algebra!*

REFERENCES

Bath, J. B., Chinn, S. J., & Knox, D. E. (1986). The *Test of Cognitive Style in Mathematics.* East Aurora, NY: Slosson

Bransford, J. D., Brown, A. L., & Cocking, R. R. (eds) (2000). *How People Learn.* Washington DC: National Academy Press

DCSF (2008). *Testing and Assessment. Third Report of the Select Committee.* HC169-1. London: The Stationery Office

DfES (2001). *The National Numeracy Strategy. Guidance to support learners with dyslexia and dyscalculia*. London. DfES 0512/2001

Hattie, J. (2009) *Visible Learning*. London. Routledge

Kavanagh, J. K., & Truss, J. T. (Eds) (1988). *Learning Disabilities: Proceedings of the National Conference.* Parkton, MD: York Press

Kosc, L. (1974). *Developmental Dyscalculia. Journal of Learning Disabilities. 7* (3): 46 -59

Rashid, S., & Brooks, G. (2010). The levels of attainment in literacy and numeracy of 13 to 19-year-olds in England, 1948-2009, *Literacy Today* v32, No 1, Sept 2010, 13 – 24

Usiskin, Z. (1998). Conceptions of school algebra and uses of variables, in Coxford, A and Schulte, AP, (eds) *Ideas of Algebra, K-12*, Reston, VA: NCTM

BOOKS BY STEVE CHINN			
Year	**Title**	**Author**	**Publisher/ISBN**
2012	The Trouble with Maths. A Practical Guide to Helping Learners with Numeracy Difficulties *2nd ed. (The 1st edition won a nasen/ TES book award in 2004)*	Steve Chin	David Fulton/Routledge ISBN 978-0-415-67010-4
2012	More Trouble with Maths. A Complete Guide to Identifying and Diagnosing Mathematical Difficulties	Steve Chin	David Fulton/Routledge/ nasen ISBN 978-0-415-67013-5
2011	The Fear of Maths: Sum Hope 3	Steve Chin	Souvenir Press ISBN 978-0-28564-051-1
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2009	What to do when you can't tell the time	Steve Chin	Egon ISBN 978-1904160-98-4
2007	Mathematics for Dyslexics: Including Dyscalculia' 3rd ed.	Steve Chin & Richard Ashcroft	Wiley 0-470-02682-8
2010	Addressing the Unproductive Behaviours of Students with Special Needs	Steve Chin	Jessica Kingsley ISBN 978-1-84905-050-0

OTHER BOOKS			
Year	**Title**	**Author**	**Publisher/ISBN**
2009	The Elephant in the Classroom; Helping Children to Learn and Love Maths'	Jo Boaler	Souvenir Press. ISBN 978-0-285-63847-1
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2005	Teaching Maths to Pupils with Different Learning Styles'	Tandi Clausen-May	Paul Chapman Publishing. ISBN 1-4129-0358-9
2005	Individual Differences in Arithmetic	Ann Dowker	Psychology Press. 1-84169-235-2
	'Dyslexia, Dyscalculia and Mathematics'	Anne Henderson	Routledge. ISBN 978-0-415-68311-1 pbk) ISBN: 978-0-203-80388-2 (ebk)
2004	Dyslexia and Mathematics' 2nd ed	Tim & Elaine Miles (eds)	RoutledgeFalmer. ISBN 0-415-31817-3
2004	Numeracy and Learning Difficulties.	Peter Westwood	David Fulton. ISBN 1-84312-194-8
2003	Dyslexia, Dyspraxia and Mathematics'	Dorian Yeo	Whurr. ISBN 1-86156-323-X
SCREENER			
2003	The Dyscalculia Screener'	Butterworth, B	GL Assessment. ISBN 978-0-708-71814-8

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Phonological Skills and Dyslexia

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There is unanimous agreement that problems with phonological processing are associated with both dyslexia and problems in reading. The phonological deficit hypothesis has been one of the major hypotheses for over 30 years now, but it is still hotly debated what exactly phonology comprises, and the subsequent implications from theory to practice. This is reflected in differences in the definition of dyslexia. The British Dyslexia Association definition (2007) notes problems in phonological processing, whereas the Rose Dyslexia Review (2009) notes difficulties in phonological awareness. In a recent meta-analysis, Lervag, Lyster and Hulme (2102) examined 235 studies that included phonemic awareness, rime awareness (Goswami and Bryant, 1990) and verbal short-term memory (Gathercole and Baddeley, 1990) in relation to reading. They aimed to resolve the controversy on the comparative role of these components on phonological processing. The findings of the meta-analysis showed that there was a major role theoretically for phonemic awareness as a predictor of reading ability, even taking into account rime and verbal short-term memory.

In educational circles, the concept of synthetic phonics, that is blending together the phonemes or sounds in a word to create a whole, has impressed the UK government to the extent that it has become standard practice in UK schools. In this article we will consider further the role of phonological processing and phonological awareness, not just in reading English but also in the Chinese language, which seems at first glance to be pictorial. Nevertheless, I shall demonstrate that phonological skills can have an impact here as well as in English.

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So what are the differences between phonological processing and phonological awareness? Phonological processing is assessed by a variety of tests related to the abilities to perceive, produce, manipulate, analyse and remember the sounds of spoken language. A widely used approach to assessing phonological processing, especially in children, is the use of phonological awareness tasks. These include skills such as breaking down words into their sound parts, or making judgments about them. For example, knowing that 'cat' can be divided into its 'onset' consonant /k/ and 'rime' unit /at/, and that in turn, its individual sounds (phonemes) are /k/./æ/./t/, or, judging that 'cat' rhymes with 'mat', are all demonstrations of phonological awareness. Although awareness can occur at various levels, such as the syllable, the onset and rime, it is awareness of individual phonemes (speech sounds) that seems to be the skill most critically related to emergent literacy ,

Phonological awareness is a meta-linguistic skill involving knowledge about the sounds that make up words. There are two levels of phonological awareness - syllabic knowledge and phonemic knowledge, At the syllabic level, which is the simpler, awareness is measured by a variety of tasks, including tapping out the number of syllables, counting syllables, and deleting syllables. The development of awareness at the phonemic level (e.g., that cat is /c//a//t/) is far more difficult to acquire (Adams, 1990), and is measured by counting phonemes, dividing words up into a series of phonemes, deleting phonemes, and substituting phonemes. The ability to divide words into onsets and rimes (e.g., that cat may be broken down into /c/, the onset, and /at/, the rime) falls midway in difficulty" between syllabic and phoneme awareness.

So when and why do children acquire their phonological skills? This turns out to be another controversial area. In terms of the acquisition of phonological awareness skills, the ability to count the phonemes in a word develops around first grade for normal readers, but the ability to manipulate these phonemes is developing up to secondary school level (Adams, 1990). A typical progression would be, first, syllable recognition at around three or four years; then an intermediate stage based on recognition of onsets and rimes; and finally recognition of individual phonemes after the age of 6 (Goswami & Bryant, 1990). It is no coincidence that these skills develop at this time, in that early phonological awareness skills provide the foundations for the acquisition of higher levels of meta- phonological skill. Data from illiterate adults (e.g., Morais et al., 1986) suggests that these higher level skills are to some extent acquired through learning to read, and themselves form the foundation of spelling skills.

Within the general category of phonemic awareness, there are considerable differences in the level of ability each task demands. This may explain why some experimental tasks produce either more or less significant results. The sound categorisation tasks, particularly rhyming and alliteration, are amongst the simpler

phonemic awareness tasks (Bradley & Bryant 1978; Stanovich, et al., 1984), because children do not require much knowledge of how to segment phonemes, and the task is simply dependent on the ability to compare and contrast words in terms of similarities and differences in their onsets and rimes. The easiest phoneme deletion task (Stanovich et al., 1984) is deletion of the initial phoneme (for example, say cat without the /c/), with the most complex being phoneme substitution (for instance, replacing the /c/ of cat with /s/ to make sat). The slow development of phonemic awareness has been linked to memory organisation, perception and lexical representation.

"Our work on the Dyslexia adult screening test shows that there are continued problems in segmentation and spoonerisms. … I have even had mature dyslexic students cry when asked to perform a spoonerism task!"

Phoneme awareness helps children to learn the connections between alphabet letters and their sounds and these skills need to develop by the time children begin to learn to read alphabetic orthographies, like English, if they are to learn successfully. Children who cannot learn these connections effectively are limited in the strategies that they can use to read words; for example, they may need to rely on memorising printed words as wholes, or on guessing, and of course this would seriously limit their ability to learn to read new words autonomously (Share, 1999; Byrne, 1998; Hatcher, Hulme, & Ellis, 1994). There is solid evidence dating from the seminal work of Bradley and Bryant (1983), that phonological awareness, as well as a variety of other phonological processing skills, including rapid pronunciation of words, the repetition of nonsense words, and verbal short term memory are impaired in children with dyslexia and the impairments persist into adulthood. For a review of the area see Vellutino, Fletcher, Snowling, and Scanlon (2004).

As noted above, there is a solid literature on deficits in phonological awareness in dyslexic children, but how long do these problems last for children with dyslexia? We ourselves have shown that impairments persist up to the age of 17 years, with skills closest to (but inferior to) the 8 year-old control children I our study, that is children 9 years younger than the oldest dyslexic group (Fawcett & Nicolson, 1995). Our work on the Dyslexia adult screening test shows that there are continued problems in segmentation and spoonerisms – taking the first sound from the first word and swopping it with the first sound of the second word, so that Michael Jackson becomes 'Jichael Mackson'. Somewhat to my surprise I have even had mature dyslexic students cry when asked to perform a spoonerism task! A good way to test phonological skills in adults is to use a timed nonsense passage, in

which the only way to read nonsense words is to break them down into their phonemes and then reassemble them to make an unknown word. In our research in Sheffield with 100 students attending for diagnosis (unpublished data) we found over 70% of dyslexic university students showed difficulties with this task in terms of their accuracy and the extra time needed to complete the passage. Moreover, nearly 60% of these dyslexic university students showed problems in phonological segmentation, by contrast with younger control children who are largely successful at this task by secondary level.

In terms of Chinese learners clearly there is a strong role for morphology in recognising the symbolic basis of the written language. So does this mean that phonological skills are not important in Chinese? A study of Chinese pre-school children at risk for dyslexia, showed impairment in phonological skills, morphological skills and verbal memory in a longitudinal study over a 3 year period (Ho, Leung & Cheong, 2011). It also seems that because of the similarities between symbols, phonological verbal memory is implicated in retrieving the correct pronunciation in reading. There are clear links between phonological awareness and successful spelling. Awareness of tones in Chinese characters in Level 1 predicted English language learning in level 2 (Yeung & Chan, 2013) Moreover, it seems that an alphabetic or phonological approach as in Pinyin can be important in early reading, with maternal input influencing progress, and also in adult learning (McBride-Chang et al., 2012). On the other hand, in order to acquire English as a second language, studies have shown that phonological skills are particularly important in the early years from age 3, with those Chinese children who show the strongest phonological awareness skills, making the most progress with their second language learning (Lei et al., 2012). It may be seen that phonological skills plays an important role in bi-lingual Chinese literacy, in conjunction with morphological and rapid naming skills.

In summary, therefore phonological skills have been shown to be critically important in learning to read, but it is not yet clear what causes these phonological deficits in dyslexia. Moreover, it is not entirely clear whether these are a predictor, a pre-requisite or a consequence of learning to read. It is clear that almost all children who show difficulty in reading how problems with phonology, including both dyslexic children and low achievers. However, it is rare to find a dyslexic child who shows just a 'pure' phonological problem and it is the presence and intensity of co-occurring difficulties that has been implicated in the expression of dyslexia, even in families at risk of dyslexia (Muter & Snowling, 2009). It is clear from the studies analysed by the National reading panel, that phonological training can improve phonology significantly, but this seems to have little impact on speed, which forms a key component of fluent reading. More recent theories of dyslexia such as the cerebellar deficit theory and the procedural learning theory (Nicolson & Fawcett, 2001; 2007) have set out to explain problems in both reading and phonological

awareness in terms of learning and the acquisition of skills. It seems that there is still much to learn about the causes of phonological deficits in dyslexia and other reading problems., and their role in the development of fluent reading

REFERENCES

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT Press.

Bradley, L., & Bryant, P. E. (1983). Categorising sounds and learning to read: A causal connection, *Nature, 301*: 419-421.

Byrne, B., Freebody, P., & Gates, A. (1992). Longitudinal data on the relations of word-reading strategies to comprehension, reading time and phonemic awareness, *Reading Research Quarterly, 27*: 141-151.

Fawcett, A. J., & Nicolson, R. I. (1995). Persistence of phonological awareness deficits in older children with dyslexia. *Reading and Writing: An Interdisciplinary Journal, 7*, 361-376.

Gathercole, S. E., & Baddeley, A. D. (1990). Phonological memory deficits in language disordered children: is there a causal connection? *Journal of Memory and Language, 29*: 336-360.

Goswami, U., & Bryant, P. E. (1990). *Phonological skills and learning to read.* Hitlsdale, NJ: Erlbaum.

Hatcher, P., Hulme, C., & Ellis, A. W. (1994). Ameliorating early reading failure by integrating the teaching of reading and phonological skills, *Child Development 65*, 41-57

Ho, C S., Leung, M., & Cheung, H. (2013). Early Difficulties of Chinese Preschoolers at Familial Risk for Dyslexia: Deficits in Oral Language, Phonological Processing Skills, and Print-related Skills. *Dyslexia, 17*, 143-164

Lei, L., Pan, J., Liu, H., McBride-Chang, C., Li, H., Zhang, Y., Chen, L., Tardif, T., Liang, W. Zhang, Z., & Shu, H. (2012). Developmental trajectories of reading development and impairment from ages 3 to 8 years in Chinese children. *Journal of Child Psychology and Psychiatry, 52*, 212-220

McBride-Chang, C., Lin, D., Liu, P. D., Aram, D., Levin, I., Cho, J. R., Shu, H., & Zhang, Y. (2012). The ABC's of Chinese: maternal mediation of Pinyin for Chinese children's early literacy skills. *Reading and Writing, 25*, 283-300

Melby-Lervåg, M., Lyster, S. H., & Hulme, C. (2012). Phonological Skills and Their Role in Learning to Read: A Meta-Analytic Review. *Psychological Bulletin. 138*, 2, 322–352

Morais, J., Bertelson, P., Cary, L., & Alegria, J. (1986). *Literacy* training and speech segmentation, *Cognition, 24*: 45-50.

Nicolson, R. I., Fawcett, A. J. & Dean, P. (2001). Development, dyslexia and the cerebellum, *Trends in Neurosciences, 24*, 515-6

Nicolson, R. I., & Fawcett, A. J. (2007). Procedural learning difficulties: reuniting the

developmental disorders? *Trends in Neurosciences, 30* (4), 135-141.

Share, D. L. (1999). Phonological recoding and orthographic learning: A direct test of the self-teaching hypothesis. *Journal of Experimental Child Psychology, 72*, 95-129.

Stanovich, K. E., Cunningham, A. E., & Cramer, B. B. (1984). Assessing phonological skills in kindergarten children: Issues of task comparability, *Journal of Experimental Child Psychology 38*: 175-190.

Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): what have we learned in the past four decades? *Journal of Child Psychology and Psychiatry, 45*, 2.40.

Yeung, S. S., & Chan, C. (2013). Phonological awareness and oral language proficiency in learning to read English among Chinese kindergarten children in Hong Kong. *British Journal of Educational Psychology. 83,* 550-568.

Study Skills for Dyslexic Adults in Higher Education

Dr Margaret Meehan

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The student with dyslexia faces many challenges when embarking on a university course. Most first year students in Higher Education (HE) are unprepared for the speed at which the modular system is delivered, that is 10-12 weeks of teaching followed by a three or four week vacation and examinations.

Although the modular system may favour dyslexic students because they can focus for a short time on a small number of specific subjects, it also provides less time to assimilate new material and complete coursework before an examination is demanded.

The first few weeks of term can be exciting but stressful. Students are acclimatising to the transition from school, college or work and possibly a change or move from home life all of which can be disorienting. Sometimes their first assignment deadline may be upon them before they have finished the required preparation of reading and research.

Specialist Tuition for students in HE is specifically tailored to the individual student. The main aim of the tutor is to facilitate the student becoming as independent a learner as possible, effectively making herself redundant. The student-tutor relationship is unique, student-centred and dynamic. In the first meeting with a student, the tutor will have read a Diagnostic Assessment and a Needs Assessment Report which will give the experienced tutor some idea of the student's present strengths and difficulties and what may be required in the way of skills. This view will be modified as a result of a discussion with the student particularly if a significant amount of time may have passed between the dates of these reports and when the student presents themselves for support. The recommendations in

both these reports should be discussed with the student and the student's responses recorded, possibly on an Individual Learning Plan (ILP). The ILP can take various forms and Figure. 1 below is a quick checklist which, after an interview with a student, can help the tutor to build up a picture of how the student approaches the different aspects of study and what they feel is necessary in the short, medium or long term. A plan for the next 2 or 3 sessions may be decided on but this must be flexible as priorities may change over the course of a week and the tutor has to work with whatever the student presents at the time of the session.

If a student is a first year and seeks support at the beginning of the term, it is likely that the delivery of study skills may follow a general pattern of organisation, reading skills, approaches to research, concept mapping, note taking, writing skills, memory techniques, revision and examination techniques. These skills have to be monitored and reviewed at each level of the course as approaches at level 1 will probably need to be modified as the student moves through the higher levels when the volume of reading and writing increases more and the tasks become more complex.

It is important for the tutor to establish in the first meeting with a student whether black writing on white paper is problematic. Most students do not understand the question, but if the tutor says that she finds the text stays perfectly still, the words are discreet and not too close together and that blocks of text are not out of focus, some students are surprised. They realise that they have spent their education trying to read an almost impossible script. A screen for coloured overlays can then be recommended which can lessen the students' effort in reading.

Students present themselves for support at different times in the year and at different levels, so the tutor needs to be flexible and work with the student in the 'here and now' of the session. If students find it hard to attend sessions, support can feel disjointed for both the student and tutor but this does not mean that the student is not progressing in awareness of their own strengths and developing study skills strategies. The tutor has to understand what the student needs and help her to develop strategies to succeed. This can be challenging for the tutor who needs to be creative in adapting skills to the particular way a student works. It is almost as if the tutor has to try and experience how an individual student's brain works and help the student to develop strategies so that she can deliver the assignments that her course requires.

Sometimes the student has little knowledge of dyslexia or why she experiences difficulties in academic and everyday life, and yet such awareness helps the student to work with her strengths. Maximising the student's strengths is the best way for the student to succeed. It is rare to meet a dyslexic student who has a positive view of herself or her academic potential, but an exploration of a student's strengths

provides an opportunity to build up confidence and self esteem. This is particularly necessary as dyslexic students are often assessed through their main area of weakness – writing. Stress generally accompanies a dyslexic student as she progresses through her academic career, but stress exacerbates dyslexic traits and if her self esteem is not maintained a negative spiral can result. To succeed in HE a dyslexic student has to develop good strategies to deal with stress.

A student in HE has many demands on their time and she has to deal with academic, administrative, financial, family, social and personal tasks, so organisation is of paramount importance. If a student is organised, this leaves her free to concentrate on her studies. However, it takes time to be organised and most dyslexic students are so focused on the reading and writing aspects of their courses that other tasks may be overlooked.

How skills are delivered depends how the student works but also on the discipline and demands of the course. Reading skills may cover skimming and scanning techniques to find a particular word or phrase, or gather the general outline of a topic. A ladder read can be a very valuable skill for students with large volumes of reading, for example, English Literature or History (Pavey, et al., 2010). The tutor can demonstrate this skill but the student has to judge when it can be applied.

Students have to read aloud when giving presentations and sometimes a tutor may help a student pronounce jargon words (usually Latin or Greek based). This is usually coupled to a session on spelling these words notably for students on professional courses where handwritten notes have to recorded, for example, nursing students where the spelling of drug names has to be accurate. If a student has a visual learning style chunking the letters and creating a visualisation as a memory aid can be a very effective strategy.

The majority of students will say that their main difficulty is expressing thoughts in writing and the effort involved in this task can be considerable. Good organisation can help to minimise the stress involved in writing. This may involve a Gantt Chart or electronic calendar with reminders to monitor progress. Time must be given to the analysis of the task or assignment question, research skills, the various sections of the assignment, several drafts and proof reading. The type of writing style

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Figure 1. INDIVIDUAL LEARNING PLAN

INFORMATION ABOUT THE STUDENT		
Student Name:	*Student Number:*	*Date:*
Course:	*Time of Appointment & Duration:*	*Contact Number:*

STUDY SKILLS EVALUATION

INDEPENDENT LEARNING SKILLS			
Learning Style	☐	Metacognition	☐
READING SKILLS			
Management of Reading Volume	☐	Prioritising reading	☐
Skimming/scanning	☐	Critical reading skills	☐
Highlighting/summarising	☐	Speed reading	☐
Comprehension	☐	Ladder Read	☐
Coloured overlays	☐		
RESEARCH STRATEGIES			
Analysis of research aim	☐	Time management	☐
Identification of key points	☐	Research mind maps	☐
Effective use of library/search engines	☐	Effective use of abstracts/journals	☐
Summarising	☐	Note Taking	☐
MATHEMATICS			
Mathematics	☐	Statistics	☐
PROOFREADING STRATEGIES			
Structured Proofreading strategies	☐	Editing	☐
NOTE TAKING STRATEGIES			
Mind mapping	☐	Key points in discussions	☐
Generating notes	☐		
TIME MANAGEMENT STRATEGIES			
Organisation of files etc.	☐	Managing deadlines	☐
Managing stress	☐	Procrastination	☐

STUDY SKILLS EVALUATION

COMPOSITION STRATEGIES			
Organisation of material	☐	Planning of written work	☐
Introductions	☐	Conclusions	☐
Critical writing skills	☐	Systematic work	☐
Writing an abstract	☐	Report writing	☐
Structuring written work	☐	Written expression	☐
Paraphrasing	☐	Developing an argument	☐
Maintain a theme	☐	Use of key vocabulary	☐
Scientific writing—instructional	☐	Scientific writing—explanation	☐
Dissertation writing	☐	Thesis writing	☐
Spelling	☐	Punctuation	☐
Grammar	☐	Referencing	☐
Concepts of citing	☐	Plagiarism	☐
EXAMINATION STRATEGIES			
Time management in examinations	☐	Revision	☐
Memory techniques	☐	Presentation skills	☐
Analysing questions	☐	Model answers	☐
Past papers	☐		

A copy of the Individual learning Plan has been given to the student

Has consent been given for the tutor to contact the Mental Health Mentor: *Yes:* ☐ *No:* ☐

Tutor Name/Signature:	*Student Signature:*	*Date:*

Action Plan for Tuition

required varies from module to module and the level at which the student is studying but may include: reports, reflective essays, journals, literature reviews, book reviews, a poster, a dissertation or a thesis. Thus a student may need to develop a wide variety of writing skills.

It is important to help the student establish revision skills at the beginning of each term, so that notes, concept maps or flash cards of each lecture can be stored for later use. Revision may involve memory techniques and these will be unique to the student and how her mind works. If revision is discussed early in the course student can feel more prepared to face examinations.

In a short article it is hard to describe the complexity of working with adult dyslexic students in HE. It is both exciting and challenging working with students but it is also very rewarding.

REFERENCES

Pavey, B., Meehan, M., & Waugh, A. (2010). *Dyslexia friendly higher education.* London: Sage

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Dr Margaret Meehan has a PhD in chemistry and is the coordinator of specialist tuition for the Academic success programme at Swansea University. Margaret is co-author with Barbara Pavey of Dyslexia Friendly Further and Higher Education and Dyslexia friendly toolkit.

Dr Margaret Meehan has worked with adults with Specific Learning Difficulties in Higher Education for over 15 years. Initially supporting dyslexic students who experienced difficulties with mathematics and science, she delivers specialist tuition to students across all disciplines. She was a researcher on an award winning Tempus Project on the Identification and Support in Higher Education of Dyslexic Students (ISHEDS) in the Balkan countries and Wales, and has carried out small research projects on Dyslexia and the Experience of Students in Higher Education; Dyspraxia, Dyscalculia and Mathematics; Dyslexia and Entrepreneurship; and Dyslexia, Welsh and Bilingualism. The co-author of Dyslexia Friendly Further and Higher Education (Sage, 2010). Margaret has also delivered Dyslexia Awareness Training to Universities, Local Authorities and private companies. Margaret's main areas of expertise are:

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Dyslexia in Adolescent Dyslexics and Students

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Many people think that dyslexia is a problem that is found only in children, and mostly in young children at that. However, dyslexia is a difference in the way the brain processes which therefore persists throughout life. It has been legally acknowledged in the United Kingdom (UK) and elsewhere across the world that dyslexic students in higher education continue to need support (Disability Discrimination Act, 1995; 2005; SENDA, 2002).

Students who have had a positive diagnosis of dyslexia in the UK can access the Disabled Students Allowance (DSA), which entitles them to an Assessment of Needs, computers and computer packages, support, and 25% extra time in examinations. Support is also available in Singapore to allow students with dyslexia to achieve up to their potential but the extra time allocated here is 15 minutes in the hour. Moreover, support is not universal in junior high school and the polytechnics or further education centres. We are currently working with research students from the Lee Kuan Yew School of Public Policy on a Policy Analysis Exercise.

DYSLEXIC STUDENTS – RESEARCH STUDIES

The questions:

- Is the profile of dyslexia in adult students the same as in childhood?
- Do they have problems with phonology, and reading and spelling difficulties?

The evidence suggests that no two students present identical profiles! There are continued problems in phonology, speed of processing and also in cerebellar function (Ramus et al., 2003; Reid et al., 2007) particularly in phonology. Spelling, non-word reading, digit span, and writing speed have been identified as a problem

in 95% of small samples (Hatcher et al., 2002). Although phonological skills may be adequate for familiar words, there will be continued orthographic problems, (Kemp et al., 2009), morphological deficits (Deacon, Parrila & Kirby, 2006), and they are more dependent on context than their peers (Corkett & Parrila, 2008). There are different profiles for compensated and uncompensated dyslexia (Birch & Chase, 2004), with no phonological deficits, only non-word reading deficits in the compensated group. There is strong evidence for non-word reading deficits even in well-compensated dyslexic adults (Gross-Glenn et al., 1990; Felton et al., 1990). The answer therefore depends how good their reading skills are and how complex the task they are asked to complete!

"Interestingly, in the UK around 50% of students coming forward for diagnosis have not been identified in school. They have worked so hard that they have managed to achieve well enough to reach university, but it all becomes too difficult when juggling the competing demands of university."

Moreover, there are a number of additional problems for dyslexic students that can extend across the curriculum. Problems have been identified with speed and accuracy in mental and written arithmetic (Simmons & Singleton, 2006). There is slow speed of processing in verbal and non-verbal tasks (Miller-Shaul, 2005). Verbal working memory deficits have been identified, and there are spatial deficits on complex tasks, (Smith-Spark et al., 2007; 2003), and everyday cognitive lapses (Smith-Spark, Fawcett et al., 2004).

This is one of the most striking problems for this age group and it affects their organisation and time management so that it becomes very difficult for them to succeed without support. We have identified problems in a range of learning tasks including consolidation (Needle et al., 2009). All of these difficulties naturally leads to academic and social anxiety (Carroll & Iles, 2006), and more psychiatric problems (Undheim, 2003). This is likely to be a major problem in a country such as Singapore, where expectations and academic standards are exceptionally high.

DIAGNOSIS USING IQ TESTS

Dyslexia has traditionally been defined by a discrepancy between ability (IQ) and achievement (reading ability). This is controversial! It works well for students with high IQ, but successful students may no longer show reading difficulties, and reading tests designed for children are not really suitable for adults. It is now recognised that an IQ test alone is not sufficient to diagnose dyslexia but an IQ test

does give a profile of strengths and weaknesses – dyslexic students tend to know their weaknesses, but not necessarily their strengths!

METHOD OF DIAGNOSIS

An IQ test must be administered by a Qualified psychologist. However, in 2005 the UK Department for Education and Skills Specific Learning Differences working group recommended a battery of tests to be used by other Qualified Professionals to identify Specific Learning Disabilities, such as dyslexia. These tests include literacy (reading, spelling, writing), cognitive processing (working memory, phonological processing, speed of processing), numeracy, motor control and underlying ability along with a history of reading and spelling difficulties. It can be seen that this is a complex process. Interestingly, in the UK around 50% of students coming forward for diagnosis have not been identified in school. They have worked so hard that they have managed to achieve well enough to reach university, but it all becomes too difficult when juggling the competing demands of university.

WHAT PRACTICAL PROBLEMS DO WE FIND DYSLEXIC STUDENTS SHOW?

- Speed of reading and preparing essays
- Residual problems in spelling even for relatively fluent readers
- Difficulty in processing the large amounts of information at degree level in different subjects
- Time management
  - juggling multiple deadlines
  - either putting in greater effort than others of similar ability,
  - or an unrealistic failure to recognise the need to do this!
- Coherence and organisation in written work
- Self esteem and anxiety
- Organising a new environment without support

SOURCE OF THIS DATA AND EXPERTISE

I have had extensive experimental research experience with students over a 20 year period. I ran the student dyslexia assessment service at Sheffield University from 1994-2006 with Rod Nicolson training postgraduate students who were researching into dyslexia. Around 150 students annually presented for diagnosis – around 50% had not previously been diagnosed in school. Assessment included the WAIS, the WRAT and other tests recommended by the SpLD group, plus tests we have found useful in our own research. We were able to see how useful the

recommended standardised tests of reading and spelling were for this group.

Tests we found useful in Sheffield included tests of fluency drawn from the Dyslexia Adult Screening Test (Fawcett & Nicolson, 1998) including One Minute Reading, Phonemic Segmentation/ Spoonerisms, Rapid Naming and One Minute Writing. A passage containing real words and nonsense words, which can only be read by grapheme/phoneme translation, and scored for both speed and accuracy is also particularly useful for relatively skilled readers. These tests of fluency in our view are more diagnostic for dyslexia in high achieving adults. Using the full IQ plus WRAT standardised tests we were only able to identify half the students with difficulties. However, when we added our tests of fluency, we identified all but one of the dyslexic group. A short form IQ using Working Memory and Processing speed in conjunction with fluency tests may be the most useful way forward in terms of costs and efficiency. For countries where diagnosis is not yet established, screening may be a useful way forward

DEALING WITH MULTI-CHOICE QUESTIONS

Recently I have been working with a number of students to help them in dealing with multi-choice questions. These are often particularly stressful for dyslexic students, because they often involve large amounts of reading, a heavy memory load remembering the question while considering each of three or four potential answers. Moreover, these questions often include at least two of the answers which are potentially confusable.

One sure way to be successful, is to make sure that you complete the paper. Help your students to pick out the short questions first, and the ones that they are confident they can answer. If time is running out, advise your students to go through and tick the first answer, and then they have at least a 25% chance of being successful. These extra marks can make all the difference between passing and failing.

Students with dyslexia have a tremendous amount to offer to society, once they have successfully completed the examinations that may limit their progress. However, in order to be successful, most students at this level will need greater support than their peers, and this will be true in school in successfully completing the exams that will allow them to progress. For these students,

"Students with dyslexia have a tremendous amount to offer to society, once they have successfully completed the examinations that may limit their progress."

study skills, time management and practice for exams will be the way forward. They need an understanding of their own processing, and that they can never be the students who leave things to the last minute, because they need to put in more work than others to be successful.

However, dyslexic students also have distinctive strengths in terms of their communication and social skills, as well as empathy and their ability to see the big picture, which can ensure that they are highly successful, once the demands of education are behind them

REFERENCES

Birch, S., & Chase, C. (2004). Visual and Language Processing Deficits in Compensated and Uncompensated College Students with Dyslexia. *Journal of Learn Disabilities, 37* 5 389-410

Carroll, J. M., & Iles, J. E. (2006). An assessment of anxiety levels in dyslexic students in higher education *British Journal of Educational Psychology, 76*, 3, 651-662

Cohen-Mimran, R., & Sapir, S. (2007). Deficits in working memory in young adults with reading disabilities. *Journal of Communication Disorders, 40,* 2, 168 -183

Corkett, J., & Parrila, R. (2008). Use of context in the word recognition process by adults with a significant history of reading difficulties. *Annals of Dyslexia, 58,* 2, 139-161.

Fawcett, A. J., & Nicolson, R. I. (1998). *The Dyslexia Adult Screening Test.* London: The Psychological Corporation.

Felton, R. H., Naylor, C. E., & Wood, F. B. (1990). Neuropsychological profile of adult dyslexic, *Brain and Language, 39*, 4 , 485-497

Gross-Glenn, K., Jallad, B., Novoa, L., Helgren-Lempesis, V., & Lubs, H. A. (1990). Nonsense passage reading as a diagnostic aid in the study of adult familial dyslexia, *Reading and Writing, 2,* 161-173

Hatcher, J., Snowling, M. J., & Griffiths, Y. M. (2002). Cognitive assessment of dyslexic students in higher education. *British Journal of Educational Psychology, 72*, 1, 119-133

Kemp, N., Parrila, R. K., & Kirby, J. R. (2009). Phonological and Orthographic Spelling in High-functioning Adult Dyslexics. *Dyslexia, 15,* 2, 105- 128

Miller-Shaul, S. (2005). The characteristics of young and adult dyslexics readers on reading and reading related cognitive tasks as compared to normal readers. *Dyslexia, 11*, 2, 132- 151

Needle, J., Fawcett, A. J., & Nicolson, R. I. (2006). Balance and dyslexia: An investigation of adults' abilities. *European Journal of Cognitive Psychology. 18* (6): 909-936

Nicolson, R. I., & Fawcett, A. J. (2007). *Dyslexia, Learning and the Brain*. MIT

Bradford press.
Nicolson, R. I., & Fawcett, A. J. (1997). Dyslexia in adults: New developments in diagnosis and screening, *Journal of Research in Reading, 20*, 77-83.
Ramus, F., Rosen, S., Dakin, S. C., Day, B. L., Castellote, J. M., White, S., et al. (2003). Theories of developmental dyslexia: Insights from a multiple case study of dyslexic adults. *Brain, 126*, 841–865.
Reid, A. A., Szczerbinski, M., Iskierka-Kasperek, E., & Hansen, P. (2007). Cognitive profiles of adult developmental dyslexics: Theoretical implications. *Dyslexia, 13,* 1, 1-24
Schiff, R., & Raveh, M. (2007). Deficient morphological processing in adults with developmental dyslexia: Another barrier to efficient word recognition? *Dyslexia, 13*, I 2, 110-129
Simmons, F. R., & Singleton, C. (2006). The mental and written arithmetic abilities of adults with dyslexia. *Dyslexia, 12*, 2, 96-114
Singleton, C., Horne, J., & Simmons, F. (2009). Computerised screening for dyslexia in adults. *Journal of Research in Reading, 32*, 137-152
Smith-Spark, J. H., Fawcett, A. J., Nicolson, R. I. & Fisk, J. (2004). Dyslexic students have more everyday cognitive lapses. *Memory, 12* (2), 174-182
Smith-Spark, J. H., Fisk, J., Fawcett, A. J. & Nicolson, R. I. (2003). Investigating the central executive in adult dyslexics: Evidence from phonological and visuospatial working memory performance. *European Journal of Cognitive Psychology, 15* (4): 567-587
Smith-Spark, J. H., & Fisk J. E. (2007). Working memory functioning in developmental dyslexia. *Memory, 15*, 1 34 - 56
Undheim, A. M. (2003). Dyslexia and psychosocial factors. A follow-up study of young Norwegian adults with a history of dyslexia in childhood. *Nordic Journal of Psychiatry, 57*, 3, 221-226