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Dyslexia: An overview of recent research

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Background

There have been significant advances in research in dyslexia over the last twenty years. This has aided explanations of dyslexia and supported policy and practice. The impact has been considerable, but yet there is still no clear explanation that is universally accepted of what exactly constitutes dyslexia. Identification is still riddled with controversies despite the emergence of a number of new tests to identify dyslexia, or sub-components of dyslexia. Indeed, there is still an ongoing debate on the value of dyslexia as an identifiable syndrome.

Neurobiological Factors

The advances in MRI and other forms of brain imagery have been of great benefit to neuroscientists investigating factors relating to dyslexia. From these studies a number of different factors have emerged focussing on structural and functional brain-related factors. Some of these will be discussed here.

Processing speed

Breznitz (2008) presents the 'Asynchrony Phenomenon' as a means of explaining dyslexia. This implies that dyslexia is caused by a speed of processing gap within and between the various entities taking part in the word decoding process. Breznitz and colleagues devised a program that attempted to train the brain to process information at a faster speed. Implementing this programme resulted in a substantial improvement among dyslexic children in the speed at which information was processed Breznitz & Horowitz, 2007). They also suggested that this improvement was successfully transferred to other material not included in the training program.

Temporal processing

Stein (2008) argues that there is genetic, sensory, motor and psychological evidence that dyslexia is a neurological syndrome affecting the development of the brain. He also provides evidence that the development of magnocellular neurones is impaired in children with dyslexia. Stein argues that the visual system provides the main input to both the lexical and the sublexical routes for reading and therefore this should be seen as the most important sense for reading is vision. This view however is strongly disputed by many because they believe that acquisition of phonological skills is in fact much more crucial for successful reading (Vellutino, Fletcher, Snowling & Scanlon, 2004).

One of the main discoveries about the visual system made over the least 25 years according to Stein is that the different qualities of visual targets are analysed, not one after the other in series, but by separate, parallel pathways that work simultaneously moving forwards in the visual brain. Stein shows that there are two main kinds of retinal ganglion cell, whose axons project all the visual information back to the brain. Ten per cent of these are known as mangocellular cells because they are noticeably larger than the others and cover 50 times greater area than those of the much more numerous, but much smaller, parvocells. He therefore suggests that the great variety of visual, phonological, kinaesthetic, sequencing, memory and motor symptoms that are seen in different dyslexics may arise from differences in the particular magnocellular systems that are most affected by the particular mix that each individual dyslexic inherits. This highlights the individual differences within dyslexia as well as the role of the competing or indeed complimentary theories that constitute dyslexia.

Phonological deficit viewpoints

At present, the dominant causal viewpoint about dyslexia is the phonological deficit hypothesis. This perspective has been derived from the substantial evidence that difficulties in phonological processing, particularly when related to phonological decoding, have been a major distinguishing factor between dyslexics and non-dyslexics from early literacy learning to adulthood (see Beaton, McDougall & Singleton, 1997; Bruck, 1993; Elbro, Nielsen & Petersen, 1994; Rack, Snowling & Olsen, 1992; Snowling, 2000; Stanovich, 1988) and that early phonological training (together with suitable linkage to orthography and literacy experience) improves word literacy and reduces

the likelihood of literacy difficulties (see Bryant and Bradley, 1985; Cunningham, 1990; Elbro, Rasmussen & Spelling, 1996; Olofsson and Lundberg, 1985; Schneider, Küspert, Roth, Visé & Marx, 1997). Children who find it difficult to distinguish sounds within verbally presented words would be predicted to have problems learning the alphabetic principle that letters represent sounds and, hence, should be those children who are most likely to be dyslexic based on the phonological deficit position. If this causal linkage is correct, then the manifestation of dyslexia may vary across languages, since languages vary in the way their orthography represents phonology. Therefore, recent research has attempted to investigate the manifestation of dyslexia across languages to assess the universality of the phonological position as well as to inform international assessment practices.

Dyslexia in different languages

The potential importance of orthographic transparency can be seen in cross-language comparisons of reading ability that contrast scripts varying on the transparency dimension. In the majority of such studies, the rate of literacy learning, particularly word reading/decoding, has been found to increase with the level of orthographic transparency. This has been found in comparisons of different language groups (see the Cost A8 work reported in Seymour, Aro & Erskine, 2003), although differences in terms of the cultural importance of literacy learning or educational practice could also explain these effects. However, similar results have been found amongst bilinguals learning two orthographies of differing transparency (Everatt, Smythe, Ocampo & Veii, 2002; Geva & Seigel, 2000; Veii & Everatt, 2005). Typically, these findings point to word recognition and non-word decoding processes developing faster in the more transparent orthography. This relationship suggests that there may be fewer problems for learners of a more transparent orthography than a less transparent one, which might mean that dyslexia as a word-level literacy learning difficulty may be less evident in languages that use a relatively simple relationship between letters and sounds – i.e., the behavioural manifestation of dyslexia (such as literacy deficits) may vary across languages (see discussions in Goswami, 2000; Symthe & Everatt, 2004; Zeigler & Goswami, 2005). From a practical perspective, assessment measures used to identify dyslexia may have to vary across languages. For example, Everatt, Smythe, Ocampo & Gyarmathy (2004) found that although alliteration and rhyme phonological awareness tasks could distinguish groups of grade 3 children with and without literacy deficits in English, they were less reliable at distinguishing similar groups of Hungarian children. The same reduction in the ability to identify poor literacy learners from their peers has

been found for decoding skills amongst German learners (see Wimmer, 1993), a measure that has often been used in English language dyslexia assessment procedures. These findings suggest the potential need to consider different tests measures in dyslexia assessments across languages, particularly those that vary on the orthographic transparency dimension. Though the same reduction in the relationship between literacy levels and pseudoword decoding can be found in Chinese character reader (Smythe et al, 2008), which is not as easily explained as due to the level of letter-sound regularity.

Educational Factors

Assessment

Siegel and Lipka (2008) reviewed over 100 articles from the Journal of Learning Disabilities from 1968 to 2007 in order to investigate how researchers translated conceptual definitions of Learning Disabilities into operational definitions. They found that the most prevalent components were 'exclusion components' and formula components using discrepancies relating to intelligence and achievement. They concluded that exclusion components were problematic because some areas such as emotional factors cannot be objectively measured and the component of exclusion was often too vague to provide guidance on what areas to assess and the tools to use. They also concluded that the discrepancy formula component was also suspect. Firstly, there were too many variations in the type of tests used. Siegel (1999) found that different tests of the same skill may yield different scores and she found that there was great variation in the choice different school areas/districts made when selecting tests. Secondly, there was debate on the cuttoff point to use in the discrepancy formula, and there was even variation in the cuttoff criteria for average IQ. Furthermore, Siegel and Lipka suggested that IQ scores do not appear to be predictors of the cognitive processes involved in reading, spelling, language skills and memory tasks. Therefore, they concluded that, in the analysis of children with learning disabilities, the IQ test is irrelevant.

Joshi and Aaron (2008) propose an alternate model for diagnosing and treating reading disability. They too are critical of the IQ-reading score based discrepancy model and argue for a model of diagnosing and instructing children with reading difficulties based on the Componential Model of Reading, which considers reading to be comprised of

word recognition and comprehension aspects, which are themselves comprised of processes such as phonological awareness, decoding, listening comprehension and vocabulary. The general idea of this assessment model is to focus on the source of the reading difficulty, then target remedial instruction at this source. By looking at the components of reading, Joshi and Aaron argue that they can obtain a fruitful and accurate picture of the poor reader's strengths and weaknesses and that this has the advantage of leading to directions for remediation.

Intervention

If dyslexia is consider as an educational problem, with difficulties that focus on weaknesses in the acquisition of literacy skills, then the main focus of intervention will be educational and concentrate at improving literacy skills. On the other hand, views that see dyslexia as more than a weakness in literacy acquisition may see intervention as requiring work in areas beyond those directly related to literacy, which may involve non-educational interventions.

Coffield, Riddick, Barmby and O'Neill (2008) suggest that the development of 'dyslexia friendly standards' for all schools within a local authority can provide a useful tool for developing effective in class intervention.

Consistent with the view of the importance of phonological processing for early literacy development, the most comprehensive data related to teaching literacy to those with literacy difficulties, included those diagnosed with dyslexia, revolves around the benefits of phonological training methods, particularly if performed early in the literacy learning process (see discussions in: Blachman, 1997; Torgesen, 2002). The dominant phonological deficit hypothesis is compatible with the success of these methods. Teaching methods that develops skills in grapheme-phoneme translation, as well as provides a basis for building a sight vocabulary, may be successful because they overcome the problems associated with the phonological deficits (see, for example, Hatcher, Hulme & Ellis, 1994).

Another intervention procedure that has developed from the research of those investigating visual-related deficits amongst dyslexics, and for which there are still research programmes ongoing, is that related to the use of food supplements that contain appropriate levels of complex (long chain or polyunsaturated) fatty acids (see Stordy & Nicholl, 2000, for a review of this intervention procedure). The use of such

supplements has been argued to improve visual processing, particularly hand-eye coordination, motion perception and the processing of low contrast visual stimuli (ie, those areas of visual processing often associated with magnocellular pathway functioning). Supplementation is argued to be important due to the lack of these fatty acids in the modern diet and their hypothesised importance in the rapid transmission of ions across cell membranes. This may slow down processing, leading to many of the features associated with speed of processing deficits amongst learning disabled children. However, the deficits in fatty acid uptake described also argue for dyslexics showing the physical features of such a deficiency.

The traditional third general remediation area focuses on motor deficiencies that have been identified amongst dyslexics. These typically focus on training motor movements to develop interactions between and processes within different brain areas. In the case of the Fawcett and Nicolson work (discussed above), the brain area of focus has been the cerebellum (Fawcett and Nicolson, 2001). Recent work by Reynolds and colleagues (Reynolds and Nicolson, 2007; Reynolds, Nicolson and Hambly, 2003) has claimed improvements in motor movement, as well as literacy skills, following an intervention programme (referred to as DDAT since it focuses on dyslexia, dyspraxia and attention-deficit treatment) which is argued to focus on the functioning of the cerebellum. However, this particular work has been criticised due to its design (see commentaries in same journal issues as the papers) with many researchers arguing that these weaknesses make it impossible to make appropriate conclusions about the intervention's effectiveness (see Rack et al, 2007). Despite this controversy, the motor training method has been around for some time (see discussions in Everatt, 1999; Goddard, 1996). Such methods have the attractive feature that the remediation is typically independent of school teaching; meaning that it will not disrupt conventional teaching processes or require extra teaching resources. The child is remediated so that he/she can benefit from normal teaching methods with the rest of his peers. The main problem with such motor-based interventions is that it is difficult to see how they relate to reading difficulties and spelling problems that are not due to poor hand-movement control, since the primary focus of the intervention is usually training in gross motor movement control (crawling or remaining steady on a moving surface) or basic reflexive movements.

Overall, the main theme of such intervention work for present purposes is that it should develop from work with, and research into, dyslexia. As our understanding of

literacy learning problems and dyslexia increases, so we should get closer to identifying the best method to support the learning of the individual. Whether this will be one method used for all, or a multi-method approach has yet to be determined, but the research work and theoretical development should inform and improve practice.

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