IN SEARCH OF DYSCALCULIA

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A research team have been trying to identify children as 'pure' cases of dyscalculia. Children were identified by their teachers and parents as having specific mathematics difficulties. They exhibited some classic symptoms of dyscalculia such as difficulties in acquiring arithmetic skills or understanding simple number concepts. A range of assessment strategies including the Dyscalculia Screener were used to explore their understanding and strategies. No pure cases were found, although the children presented complex patterns of learning difficulties and compensatory strategies. The range of contributory factors suggests the need for new theoretical perspectives to consider learning difficulties and the need to study individual mathematics learning trajectories.

INTRODUCTION

Dyscalculia as a specific learning disability is defined by the DfES (2001:2) as:

> a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers and have difficulty learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically or without confidence.

The prevalence is commonly estimated at 5% and unusually affecting equal numbers of boys and girls. This definition could apply to a large proportion of the population and provides unhelpful identification criteria. Children with a specific learning disability are often identified by a two year discrepancy with their general performance: however this depends on which methods are used to assess which aspects of mathematics. The only agreed characteristic is long term incapacity to learn number facts. Identifying dyscalculia is complex and problematic: for a detailed discussion of issues, see Gifford (2006).

Dyscalculia can co-occur with other disabilities such as dyslexia or dyspraxia or conditions such as epilepsy and Turner's syndrome. These and more general physical difficulties might also cause problems in number learning. Butterworth argues that 'the majority of developmental dyscalculics do not have co-morbid cognitive, physical or affective problems', suggesting that pure cases of dyscalculia should be common (Butterworth & Yeo 2004 p. 5). One approach is to isolate dyscalculia as poor number processing, based on increasing evidence that the brain intuitively represents and compares number values (Goswami and Bryant, 2007). This is the medical model of dyscalculia as a neurological deficit: Kadosh (2007) argues that it is important to identify children so they may receive 'treatment'. The Dyscalculia

Screener (Butterworth, 2003), measures speed in matching numerals with dots and in comparing number values, combined with poor number fact recall.

Ginsburg argues that 'learning disabilities' are socially constructed and that mathematical learning cannot be understood purely as a cognitive process, without considering 'savage inequalities' in schooling (1997: p. 23) and the cumulative nature of difficulties. Butterworth's equating slow number comparison with a 'weak intuitive grasp of numbers' may ignore discrepancies in pre-school experience. In contrast, Ginsburg argues against focusing on mental deficits and recommends longitudinal studies which include children's feelings and parents' and teachers' beliefs about their difficulties.

In order to identify children with pure dyscalculia, we used the criteria of a discrepancy in mathematics compared with English, based on data from a local authority. Other children were identified by teachers, schools and colleagues. The children with significant difficulties as identified by both Key Stage 2 Standard Attainment Tests (SATs) and teacher assessment tended to achieve Level 3 in maths and level 5 in English. This seemed to indicate high achievement in English rather than a severe difficulty in maths. Due to the complexity of eliminating those children whose difficulties were caused by language problems, medical conditions or other disadvantage we found some of the clearest cases were of middle class children. We interviewed children using questions and calculations, some drawn from Wright (2006). For some children we interviewed teachers and parents. We also used the Dyscalculia Screener.

The following cameos exemplify some of the issues found in identification.

CASE STUDY CAMEOS

Jason

Jason was aged six, from a working class background, making progress in literacy but with difficulties recognising numerals and unresponsive to teaching. The Dyscalculia Screener was unsuccessful because he could not consistently use left and right hands for 'yes' and 'no'. Jason could order numerals to 6, match objects and say one more and less using fingers. He explained principles like conservation, saying that the number was the same because we had not added any or taken any away. He subitised 4 dots, but had difficulty recognizing 3 dots. When asked 'how many fingers?' when shown five he counted his own fingers. Jay had been diagnosed with short term auditory memory problems; however the teacher thought he had not been expected to listen at home and was improving. She said that he was given no behavioural boundaries at home and had caused chaos in school every Monday, although his listening and appropriate behaviour was improving. She thought his main problem was confidence and that he had a block with numbers (since he sometimes said the right answer when he did not think first). He was upset that the other children did not like him and thought he was stupid. A girl in his class had said, 'I'm worried Jason will go to jail when he grows up'. The class teacher and the headteacher laughed because he described a snake as 'fick'. It seems that slight memory problems and a socially disadvantaged background may have combined with the middle class school environment to create a dislike of mathematics. Having made progress with literacy, despite 'hating' handwriting, he may have found making efforts with numeracy too demanding. Jason is therefore an example of a child whose working class background makes it difficult to isolate causes of his mathematics difficulties.

Hugh

Hugh, a ten year old son of a primary school teacher, had had difficulties with mathematics since Key Stage One. At the beginning of year 5 he had been assessed at level 2/3 mathematics and 5 in English, but by the end of the year he had achieved level 4c, thanks to a new teacher and a mathematics tutor. In year 6, he was assessed as average by the Dyscalculia Screener, having learned some number facts and reasoning strategies. However he thought there were ten minutes in a quarter of an hour, placed 15 halfway on a 0 –50 number line and had difficulty recognising domino patterns and relating multiplication to division. He could not do problems with fractions, percentages and ratio. His mathematics tutor thought he would achieve level 3, although he actually achieved 4a at the end of year 6.

Interviews with teacher, tutor, mother and Hugh revealed different views about his problems. His teacher thought his problem was confidence and that he needed things explaining to him. Hugh described how he had got behind in year one, his teachers ignored his difficulties and he lost confidence. His tutor thought he avoided numbers and had serious problems with understanding, but had matured and now forced himself to work. His mother thought his problems were due to early language difficulties and glue ear, compounded by poor teachers, one of whom could not remember who he was at parents evening. However, she also felt that he had serious problems with understanding time, although she had taught him and his siblings, who had no difficulty. An alternative view is that he may have a poor self – image as a mathematics learner as the child sandwiched between two high achieving siblings (the elder identified as gifted and talented, and the younger surpassing him). Therefore a cocktail of physical, social and affective factors may have contributed to Hugh's difficulties, as found by other case studies of dyscalculia (Bfuzka et al, 2000; Shalev and Gross-Tsur, 1997). However, his problems are severe or non-existent according to different interpretations, which may be affected by various factors such as tutor sessions being after school when Hugh was tired. It is tempting to dismiss Hugh as dyscalculic: however, for an advantaged high achieving child he has startling gaps in understanding. These raise several questions, including the possibility of high test scores through performance in selected items. Hugh's case provides a range of explanatory models, from the medical, whereby glue ear and dyscalculia prevent learning, to a social model involving school and family practices, self – image and participation. From a post- modern viewpoint, all interpretations may be equally valid and the key question may be, which is most productive for Hugh? Alternatively, perhaps we need a more complex theoretical stance which acknowledges a role for both physical and social difficulties.

Tania

Tania, a very articulate 9 year old girl, enjoyed writing and achieved well in English. She was identified by her class teacher, SENCO and mother as having maths difficulties. The Dyscalculia Screener identified her as unlikely to have dyscalculia, possibly because she demonstrated strength in addition. Her mother hired a maths tutor who adopted a formal maths approach but she was not convinced that the approach suited Tania. She was able to successfully count forwards in ones using a 100 square. She was much less confident in counting backwards even starting from 20. She was successful in counting forwards in fives up to one hundred but when asked to count backwards responded, “No I can only count forwards in fives”. Even using the 100 square for support, she counted backwards very slowly in ones, following the board with regular eye movements. She had difficulty identifying a hidden number of objects, indicating insecure knowledge of number bonds to ten. She was able to perform simple written addition calculations but interpreted simple subtraction calculations as addition until reminded to check. Although she displayed strength in addition on the Dyscalculia Screener, she had difficulty in interpreting the subtraction sign.

Building on her success in counting forwards in fives she was asked to multiply numbers by five. She was inconsistent in her strategies. With 6 x 5, she counted 6 groups of 6, keeping a tally on her left hand, then stopped at 36 and said “37”. When asked how many groups she had counted she responded “4”. She knew few multiplication facts for 5, even though she could count forwards confidently in 5s to 100.

When asked to divide by 5 she put out a row of ten counters and split them into two equal groups with a line. When invited to record it in her own way she wrote quickly and confidently, “I know that five add five is ten so… ten divided by 5 is 5” .This suggested that she thought division was the inverse of addition. She also said that addition or subtraction might be the “opposite of multiplication”. For 15 divided by 5, she eventually successfully counted out a row of 15 counters and split them into two equal groups. When asked if it had to be two groups she responded confidently, “You cannot divide two groups because that makes 7 and 8 so you can divide it into threes instead and that makes five.” She seemed confused between the sharing and grouping aspects of division, or perhaps understood division as splitting into two equal groups.

Tania applied rules “mechanically and without confidence” (DfES 2001). She appeared to attempt to compensate for her maths difficulties by using verbal reasoning inappropriately. She did not have strong visual strategies and even chose to record her calculations with words and number names in preference to using symbols.

Tania would seem to be an example of a child for whom, like others identified with potential dyscalculia, lacked skills “that should have been mastered long before” (Kaufmann et al, cited by Gifford, 2006).

Bartholomew

Bartholomew, a middle class eight year old, was positively identified by the Dyscalculia Screener. He counted instead of subitising, even for two dots. He guessed 6 + 4 = 10 was wrong, but did not use fingers to check. He could count and subtracted 60-1, with difficulty. When asked how many fingers were on one hand, he counted them. He had poor recall of number facts, did not use fingers to calculate and did not understand place value. His school, for children with learning difficulties, diagnosed Aspergers, which might account for his commitment to counting dots and not using fingers, and his reluctance to learn new strategies.

Dyscalculia might have been misdiagnosed by the Screener, as other studies have found. Messenger et al (2007) found that some high achievers were identified as dyscalculic, while others were not, whom teachers thought more likely. Some children originally identified as dyscalculic were later no longer so identified, without any intervention. Similarly, Bartholomew’s school found that some children ‘recovered’ within a year or so. Voutsina and Ismail (2007) reported that the Screener ignored children’s understanding and individual strategies, so that children with less understanding scored better than those with good understanding whose responses were slow. The Dyscalculia Screener also identified children as dyscalculic who pressed the wrong keys but said the right answer. Voutsina and Ismail criticised the lack of clear criteria distinguishing children identified with dyscalculia from those without: for instance a slight difference in dot enumeration speed might be due to carelessness or boredom. Many children complained about the length of the test, raising the issue of parity of encouragement to complete it. From the data supplied with the test (Butterworth, 2003) it seems that the identification of dyscalculia is determined by percentile rather than distinctive characteristics of an impairment. Therefore caution needs to be exercised in interpreting the results of the Screener.

CONCLUSION

As a research team, we found difficulty in attempting to identify children for longitudinal case studies of ‘pure dyscalculia’. It is problematic, if not impossible, to isolate the factors which contribute to severe mathematics difficulties. What we have found with individual children are ‘startling contradictions, unsuspected strengths or weaknesses and fascinating complexities’ (Ginsburg, 1972). This suggests the need for theory which allows for greater complexity than medical or social models of learning difficulties as well as the need for longitudinal case studies to investigate mathematical learning trajectories.

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