I do not pretend to understand reading procedure - it is not my field - but as an orthoptist, I am amazed that such a method can be introduced and embarked upon without first eliminating the possibility of obstacles such as brain damage, congenital word blindness, refractive errors and abnormalities of binocular function, including convergence insufficiency.

I would like to thank Dr. T.D. Leckie for letting me present this case.

PRELIMINARY REVIEW OF 325 CONSECUTIVE CASES OF LEARNING DIFFICULTY

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Children with learning difficulties are sent for eye investigation when authorities suspect a visual impairment of some kind - motor, sensory or perceptual, or when a child who is not performing for some reason, such as mental retardation, brain damage or aphasia may need to be examined to see whether there is also a visual problem, which, if treated, might make the general outlook brighter.

This is a preliminary review of 325 such cases seen during the past 18 months.

The main problem was failure to **learn** at a rate comparable to other children of the same age, or failure to **achieve** to the level of their intelligence.

This was manifested by a problem of inco-ordination, generally; poor reading or lack of fluent reading, e.g. skipping words, losing the place, difficulty in progressing from one line to the next; untidy writing; poor spelling; reversals e.g. b and d; p and q; was and saw; etc., and more rarely inversions e.g. b and p; n and u; ' and sequencing, making spelling difficult. Most of the children were failing in reading and associated skills although many were good at maths. Some were behind in all phases of learning (51 cases).

The group of 325 included 255 males and 70 females - a ratio of 3.5:1, the mean age was 10.02 years - varying between 4½ years and 21 years of age. This is a biased sample of children with learning difficulties, as they were all suspected of having a component of visual defect in their problem at the time of referral. All were seen as private patients, except two groups, (1) 15 Primary School children, (2) 19 High School children, who had participated in two research projects during that time. No. 1 group was specially selected as having specific developmental dyslexia, age variation between 8 years and 12 years. This study has been accepted for publication in Cortex. No. 2 group (aged between 12 years and 15 years) was specially selected by their remedial teacher as probably having a visual difficulty but not necessarily having specific dyslexia or signs of reversal and confusion. Reversal is not generally a problem at high school age but sequencing and adequate form perception have still to be coped with. This study was undertaken for Mr. E. Gray, Director of Education for the Newcastle area.

REVIEW OF 325 CASES OF LEARNING DIFFICULTY

TABLE I

AGE	4½ years ..... 21 years.		Mean 10.02 years.	
SEX	Males... 255	Females ... 70	Total ... 325	Ratio M:F ... 3.5:1
SOCIO-ECONOMIC BACKGROUND				
	Low..... 22	Average 259	High 44	
INTELLIGENCE				
	Below Average 13	Average..... 232	Above Average... 80	
BEHAVIOUR				
	Aggressive 22	Normal..... 267	Hyperactive..... 36	
VISUAL ACUITY				
	Equal V.A..... 272	Unequal V.A.....53	6/6 or 6/5 ... 261	6/9 or <6/9..64
REFRACTION				
	Emmetropic..... 275	Myopic and/or	Hypermetropic and/or	
	Refractive Error.. 50	Astigmatic..... 11	Astigmatic..... 39	

As most of these patients were seen privately, the socio-economic background is average to high; similarly the intelligence quotient broadly speaking is also average to high, because people with this economic background would generally have higher motivation to seek orthoptic analysis. Only 22 children came from a below average socio-economic background. 44 came from a high background and the remaining 259 were from an average background.

The assessment of intelligence is not a job for the orthoptist and it is often difficult to get an accurate estimate of this in cases of learning difficulty sent for orthoptic analysis. Sometimes the parents will know (having been informed by a psychologist or hinted at by a teacher), occasionally the ophthalmologist or referring Dr. will know, or the psychologist will give an estimate on referral. Children with specific developmental dyslexia can be thought to have rather lower intelligence using some methods of testing than would be the case using another method where reading does not play such a prominent role.

I will consider the groups "average" and "above average" as a single group in this review. I single out the "below average" intelligent children as there is less chance of error in this small group (13) who appear to be well below average and many of them have evidence of brain damage (8). 3 had manifest squint with no binocular vision. Considered as a whole, the background of the total group was normal. Very few had history of neurological disorder (31), hearing defect (13), uncorrected refractive error or deprivation of educational opportunity. Some had emotional problems, a few were aggressive (22) others were hyperactive (36).

Refractive Errors. Most children were emmetropic (275) 11 had myopia and small astigmatism and 39 had hypermetropia with some astigmatism. Visual acuity was good, 6/6 or 6/5 in both eyes in 261 cases. 64 had 6/9 or less in one or both eyes. Unequal vision was present in 53 cases leaving 272 with equal or very nearly equal vision.

From these figures it is apparent that these children seem to be fairly normal young people from many angles except that they have a strange disability in learning to read and interpret symbols correctly.

TABLE II

ANALYSIS OF BINOCULAR VISION

Evidence of functional Single Binocular Vision.	Eso	Eso Group iv	Exo	Inter D.S.	Inter C.S.
322	30	236	52	3	1

No Binocular Vision.				
3	ADS 1	LDS 1	LCS 1	

Convergence rating. 0...4
322 Cases. Mean 1.8

0 — 6 cms, well maintained
1 — 6 cms, with effort to maintain
2 — 8 cms, with head retraction
3 — 10 cms .. 15 cms
4 — >15 cms

Stereoscopic Vision Rating. 0...4
322 Cases. Mean 1.8

0 — full
1 — good, but not full
2 — good, with stimulation
3 — fairly good
4 — poor – nil

S.V. Using Wirt – Titmus Test 9...0
282 Cases Mean 8

The Orthoptic Analysis took the usual form of orthoptic examination:- history; visual acuity; muscle movements; cover test; Maddox rod and wing: Titmus stereo-acuity test spots; visuscope check on fixation; accommodation and convergence ability; sighting eye (using a hollow cylinder to view a distant spot; preferred hand for writing; assessment of binocular vision - simultaneous perception, fusion fusional amplitude and stereopsis; and reference eye in central binocular vision (a new orthoptic test).

In this study I use the term "crossed correspondence" for a condition where the preferred hand is opposite to the reference eye in central binocular vision.

The test for reference eye in central binocular vision was developed in a previous study on Primary school children specially selected as having specific developmental dyslexia. In these cases the evidence of crossed correspondence was found to be a definite statistical significance. The triad esophoria, defective stereopsis and crossed correspondence was found to be highly significant for specific developmental dyslexia.

Previous tests to ascertain the dominant eye in binocular vision have been unsatisfactory. Recent workers in this field have been unable to make any discrimination of dominance in half their cases - even in the controls. (Bettman 1967 and Helveston 1970). These tests are based on suppression or alternation (Berner & Berner 1953). In either case true binocular vision has already failed at the point of decision.

Ogle (1962) notes that the phenomenon of directional difference of fused disparate images within Panum's area is a possible basis of tests for ocular dominance.

The new reference eye test is based on fixation disparity within Panum's area. A decision is made while true binocular vision holds in the central field, using a pair of fusion slides with slightly dissimilar indicators, e.g. house with 2 trees; house with a man and a woman.

Table II shows that most children had functional single binocular vision, only 3 squints had no binocular vision.

The evidence of esophoria (group iv) Mayou (1968) is interesting. This is a small esophoria for distance with an exophoria for near.

Convergence and stereopsis were rated (Table II) for convenience in applying statistical methods. The mean value of convergence ability is 1.8 which is between "effort to maintain" and "head retraction" at 6 cms.

Stereopsis as tested on slides with 8 stimulus objects (Xmas tree) gives a mean of 1.8 putting it near "stimulation needed to achieve almost correct answer." The Wirt-Titmus gives a mean of 8, i.e. 50 secs of arc. One should realise that these two tests for stereopsis can give strangely different results. Ogle (1962) states "that the magnitude of the stereoscopic depth perception must be carefully distinguished from the stereoscopic acuity or the precision of that depth.

TABLE III
ANALYSIS OF LATERALITY

Total No. of Cases 325	R. Handed 273	L. Handed 47	Ambidextrous 5
Triple combination: Eso, defective S.V. Crossed Correspondence 207	182	21	4

TABLE IIIa
Handedness & Sighting Eye

Rh:Rs 138	Lh:Ls 18	A:Rs 3
Rh:Ls 130	Lh:Rs 27	A:Ls 2
Rh:Es 5	Lh:Es 2	A:Es 0

TABLE IIIb
Handedness & Reference Eye

Rh:Rr 46	Lh:Lr 13	A:Rr 1
Rh:Lr 205	Lh:Rr 27	A:Lr 0
Rh:Er 19	Lh:Er 6	A:Er 4
Rh:nil r 3	Lh:nil r 1	A:nil r

R — Right
L — Left
A — Ambidextrous
E — Either
h — handed
s — sighting eye (Monocular test)
r — reference eye (Binocular test)

Table III shows the correlation of handedness with sighting eye and handedness with reference eye. This shows clearly the high incidence of crossed correspondence 232 (reference eye test) compared with the crossed dominance 157 in 325 cases.

Taking the combination of esophoria, defective stereopsis and crossed correspondence, which was proved highly significant in the earlier study of specific developmental dyslexia there are 207 instances among the 325 cases. This indicates that there is a high incidence of the visual components of specific dyslexia, contributing to the difficulties of the children in this group.

203 cases had a family history of left handedness and 85 had history of others with learning difficulties. There were 8 adopted children in the series and no family history was available about them.

33 children had full stereopsis and analysis of this group showed an interesting factor of fluctuating reference eye in 10 of them. Taking the entire group there were 28 who had fluctuating reference eye or "lack of dominance."

There were only 49 cases of amblyopia, which was only one or two lines on the Snellen chart.

In this review I have tried to analyse the ocular side of learning difficulty, in particular, that part concerned with binocular vision.

It is clear that in cases of learning difficulty, unless binocular vision is investigated in detail the ocular findings will be within the limits of normal eye function.

With information based on binocular vision including reference eye, it is much easier to understand why these children have trouble.

To date, I have been experimenting with treatment in an effort to set ocular functions in the path of the normal as far as possible.

Intermittent squint, refractive error (particularly in the desired reference eye) convergence deficiency can all be treated readily. But the treatment for crossed correspondence is still experimental and as yet I have no controlled data on which to base facts.

However, certain aspects of the treatment are becoming clear and general orthoptic principles still apply. If you wish to alter a reflex you must get in as early as possible before normal development has stabilised. I believe the upper age limit is around 12 years of age with some variation depending on motivation etc. Using the routine of total occlusion during lessons and homework with convergence exercises to support, I have not had trouble with patch amblyopia as has been suggested by overseas authorities (Helveston 1970). I have seen children's behaviour improve, reading become more accurate and fluent, writing become legible and flowing, overall coordination of the limbs occur and willingness to approach reading material which had been the source of many a family argument previously.

The basic need to catch up in learning will of course be still necessary and special remedial teaching will have to be undertaken.

The real value of the orthoptic test for reference eye in central binocular vision lies in its unique potential to differentiate the child at risk at an early stage so that the necessity for treatment of the fully developed syndrome with all its complicated overlays may never be necessary.

The point of the orthoptic treatment is to put the child in or near the position of a normally learning child in so far as visual function is concerned, so that he will be able to pursue his studies with more reward and in time should be able to work to his full potential.

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