

Throughout this year continual assessments will be made of the students' standards in all subjects. As well, term examinations will be given by the lecturers in each subject.

The Orthoptic School is preparing a submission for the Advanced Education Board for recognition of a three year course in Orthoptics to be conducted by the College. At the moment this submission is being closely examined by the school's External Advisory Committee comprised of ophthalmologists and orthoptists. If the submission is successful a three year course should be commenced in 1975. The syllabus being considered is the same as that of the Orthoptic Board of Australia with the addition of some behavioural studies. In recent years however, it has become increasingly clear that the student needs to study certain areas of Orthoptics in greater depth and to have a general background in both the behavioural and biological sciences. The need to develop a three year Orthoptics Course in this College has become apparent. More specifically the development of this course has become necessary due to the need to give the student a better understanding of ocular anatomy, ocular physiology and optics by providing a more thorough basis in general anatomy, physiology and physics; the need for the student to have a more comprehensive understanding of the behavioural sciences; the need to give each student time for elective study of special aspects of orthoptics; the need to fit the required number of clinical hours into the expanded academic programme; and the need for the course, which already extends over 94 weeks, to be accommodated within the organizational format of the New South Wales College of Paramedical Studies as a whole.

NEW BINOCULAR FACTORS IN READING DISABILITY

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ABSTRACT.

An orthoptic survey of a group of reading disabled high school pupils matched with an equal number of normal pupils is discussed. A new orthoptic test for reference eye in central binocular vision is introduced, which will be of value in differentiating the visual type of dyslexia.

Introduction

A study in 1971 on primary school children with reading disability revealed interesting new results in the analysis of binocular vision and laterality. Visual tests employed in the study included a new orthoptic test for reference eye in central binocular vision.

For many years, hand-eye dominance has been investigated, discussed and reviewed in relation to cases of learning disability (Walls 1951, Lederer 1961, Critchley 1970, Brod & Hamilton 1971, Gronwall and Sampson 1971). Various methods have been used to decide on the dominant eye, from the early sighting eye tests which were obviously monocular, to the controlling eye test used by Berner and Berner in 1953 and more recently by Bettman et al (1967), Norn et al (1969), Helveston et al (1970), and Hurtt (1971).

Reading normally involves the use of both eyes so that it is not surprising that investigations using monocular tests have yielded inconsistent results. Attempts to introduce a binocular element into the investigations by the use of controlling eye tests or tests based on retinal rivalry (Raynor-Smith 1970) similarly produced non-significant results. In retinal rivalry the two images are too dissimilar to allow normal fusion, and in the controlling eye test one image has been suppressed at the point of decision.

Helveston (1968) remarked that "of the 15 eye functions he listed, only binocular eye control behaviour and phorias were considered to be even possibly significant."

The significance of the newly discovered central overlap of binocular fields is

discussed in the Australian Orthoptic Journal (Dunlop, D.B., 1972). This paper elucidates the bilateral representation of central binocular vision in the retina, the lateral geniculate body, and the cortex, and shows a possible reason for reversals and confusion where normal consistent lateralised preference of neural functions is not present.

In 1962 Ogle noted that the phenomenon of directional difference of fused disparate images within Panum's area was a possible basis for tests of ocular dominance. It is on fixation disparity within Panum's area that the reference eye test, used in this survey, is based. It was felt worth while to conduct another study, this time with a group of high school children with reading disability, using the reference eye test as in the previous study.

Experimental Subjects

For the purpose of this study it was required that all experimental subjects should have a long history of reading difficulties with continuous reading retardation. They should have no uncorrected sensory defects and no history of prolonged absence from school, and should be of average or above average general ability. Fourteen boys and one girl were selected from the case studies of a Newcastle remedial teacher.

As a check for possible sensory defects all subjects underwent visual and audiometric testing. All had passed the School Medical tests for hearing and sight. Any obvious visual defect such as a manifest deviation or the necessity for corrective lenses was already ruled out. It is agreed that a primary visual defect is insufficient to create a reading problem (Naidoo 1970), (Robb 1970), (Goldberg & Schiffman, 1972) therefore such defects are not relevant to this study.

The assessed I.Q. as noted on the pupil record card could not be taken as a valid indication of the subject's general ability, since this had been measured by group tests requiring reading, which would have deflated the results. Accordingly all subjects were given an individual I.Q. test (ACER)* which did not involve reading. The mean I.Q. of the experimental group is 113, with a range from 91 to 130.

Control Subjects

All subjects were volunteers from local high schools. All underwent the same visual and audiometric testing for screening out sensory defects and were given the same individual I.Q. test as the experimental group. The mean I.Q. of the control group is 118, with a range from 96 to 129. The control subjects were individually matched with the experimental subjects on the basis of sex and grade, but it was not possible to match individually for I.Q. and age because of limitations of availability of subjects and testing time. Nevertheless the mean I.Q. of both groups is very similar, and above average (Table 1).

TABLE I
Mean Age, I.Q., and Reading Grades of Experimental and Control Subjects

	EXPERIMENTAL	CONTROL
Mean Chronological Age	14 : 1	13 : 6
Mean I.Q.	113	118
Mean Grade, Reading for Meaning	5 : 2	8 : 0
Mean Grade, Speed of Reading	4 : 5	7 : 7

By high school age it can readily be expected that all subjects of average or above average ability should be reading at grade level. For the purpose of this study, therefore any variation in I.Q. is not seen as a pertinent variable.

* Australian Council for Educational Research (Melbourne)

It can be noted from Table I that the mean age of the experimental group is seven months older than the control group, though the subjects were matched for grade. This can be accounted for by the fact that many of the experimental subjects had repeated a grade in their earlier schooling as a result of their learning difficulties.

Reading Assessment

Reading was assessed by the ACER Reading Tests Form C. Two subtests were used, the Reading for Meaning as a measure of reading comprehension, and Speed of Reading as a measure of reading fluency. In these tests the norms are measured in terms of grade level. A standard criterion of at least 2 years retardation in one or both subtests is accepted as indicative of present reading disability. The mean reading grade level for the two groups is set out in Table I.

While all subjects in the experimental group evidenced reading retardation on the Reading for Meaning subtest, this was not viewed as being the result of inability to comprehend, but rather as the result of slowness in the reading process. All subjects in the experimental group showed marked retardation on the Speed of Reading subtest, the measure of fluency. The mean chronological age of the experimental group is 14:1 years, and the mean reading grade level for fluency is 4.5, equivalent to an age level of 9:11 years and so indicating an average of more than 4 years retardation for the group.

The results of reading and I.Q. tests and group membership of the subjects were not made known to the researcher at the time of the orthoptic testing.

Orthoptic Assessment

The orthoptic examination followed the usual lines:- visual acuity, muscle balance, and level of binocular function, but with particular attention to convergence ability, stereopsis and the reference eye in central binocular vision (the new synoptophore test). In addition the sighting eye (a monocular test) and the preferred hand were also noted.

For the reference eye test a pair of fusion slides, macular size or smaller, with central indicators ("controls") such as the "House with two trees" or "Weather house with man and woman" slides (Clement Clarke F9 & 10; F69 & 70; F93 & 94) are used in the standard synoptophore. The slides are fused at the angle of fusion and disjunctive movements are carried out. The subject watches the centre of the picture carefully, but must be alert for any movement of either indicator ("control"). The eye seeing the steady indicator is the reference eye in central binocular vision. The movement of an indicator is more easily observed by the subject in diverging slowly than in converging, where accommodation can be confusing. Only answers taken before fusion breaks are valid. If suppression of an indicator occurs and no movement is observed, there is no significant binocular vision. That is, such a case would have insufficient central binocular function to act as a basis for the typical visual perceptual confusions found in ocular types of learning difficulty (dyslexia). It is possible that the suppressing eye can be the reference eye, in which case the subject observes the moving indicator before suppression occurs.

Orthoptic Examination Data

In this investigation unequal visual acuity is only of the order of $\frac{1}{2}$ to 1 line difference between the two eyes on the Snellen distance chart at the level of 6/5 -6/6.

Convergence deficiency has been noted in other studies (Guthrie and Bermingham 1971), and is evident here in an inability to maintain convergence to 6 or 8 cm. without undue effort. Difficulty in maintaining good convergence tends to leave the subject uncomfortable at normal reading distance after a time. Losing the place and the tendency to skip words are also problems with inadequate convergence.

TABLE II
 ORTHOPTIC EXAMINATION DATA SUMMARY
 Number of Subjects Demonstrating Ocular Conditions

OCULAR CONDITIONS	GROUPS	
	CONTROL: N=15	EXPERIMENTAL: N=1
Unequal Visual Acuity	2	2
Convergence Deficiency	4	10
Defective Stereopsis	4	13
Crossed Correspondence*	3	13
Crossed Dominance**	5	3
Esophoria	7	13
Exophoria	1	1
Orthophoria	7	1
Esophoria with Defective Stereopsis and Crossed Correspondence	0	9

* *Crossed Correspondence refers to preferred hand being opposite to reference eye in central binocular vision*

** *Crossed Dominance refers to preferred hand being opposite to sighting eye for monocular viewing.*

Children with specific learning difficulty often have problems with spatial relationships, yet stereo-acuity as tested with the Titmus rings is usually good, with 8 or 9 items correct. However, stereo-perceptions tests where many objects at varying distances are presented without clues to their distance often yield poorer results. Many of the experimental subjects were unable to discriminate between the relative distances of the eight stimulus objects in the Christmas tree test slides (Clement Clarke No. D53 and 54) until visual stimulation by rapid movement was given.

Crossed correspondence (reference eye opposite preferred hand) is found in 13 of the experimental subjects and in only 3 of the control subjects. Crossed dominance (monocular sighting eye opposite to preferred hand) occurs in 3 experimental and in 5 of the control subjects.

The presence of crossed correspondence has also been observed in a high percentage of the 325 unselected cases of learning difficulty seen in this area during the past few years (Dunlop, P. 1972)

Esophoria was frequently noted in the previous primary school study (Dunlop, Dunlop & Fenelon, 1973) and it occurs again in 13 of the present experimental subjects but only in 1 of the control group. It is interesting to note that the esophoria in most cases (12) is of the Group IV type (Mayou 1968) where there is a small esophoria for distance with an exophoria for near.

In the analysis of reading disability, single predictors such as convergence deficiency, esophoria, defective stereopsis and crossed correspondence are evident but can be unreliable on their own, as single indicators.

Taking the triple combination of esophoria, defective stereopsis and crossed correspondence, which was proved highly significant in an earlier study, (Dunlop, Dunlop & Fenelon 1973), no subject in the control group is singled out but 9 of the 15 (60%) of

the experimental group are identified.

Conclusion

In conclusion it would seem advisable to check binocular vision and in particular reference eye, even in the presence of normal findings in the usual ocular examination, in children who show a tendency to reading disability. This should be done in the early stages of reading difficulty as binocular reflexes can be altered more easily in younger children.

Summary

An experimental group of 15 retarded readers of high school age together with an equal number of normal children were studied with particular attention to the analysis of binocular vision and laterality. The mean I.Q. level, using intelligence tests not involving reading, was above average in both groups. A new orthoptic test is described which is binocular in concept, to ascertain the reference eye in central binocular vision. Certain orthoptic conditions were prominent in the experimental group although routine school medical testing had recorded normal ocular findings. A combination of esophoria, defective stereopsis and crossed correspondence (reference eye opposite to preferred hand) identified 9 (60%) of the retarded readers; it was found in no normally reading child.

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