THE VISUAL ABILITY AND EMPLOYMENT CAPABILITY OF THE PARTIALLY SIGHTED SCHOOL LEAVER : A CLINICAL STUDY

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Summary

The study was undertaken to investigate the visual ability and employment capability of partially sighted school leavers.

The concept of visual ability was discussed and aspects relating to the employment of the partially sighted were reviewed.

Visual ability investigations were carried out on a sample of 195 final year pupils attending five schools for the partially sighted in the three consecutive academic years 1976-79. The investigations covered various aspects: static distance and near visual acuity measured using both conventional and specially designed charts, the status of the peripheral and central fields, the integrity of the colour sense and a study of dynamic visual acuity. Ophthalmic, educational and biographical information for these youngsters was also extracted from their school records, and also from the records of a further 160 final year pupils. attending 8 other schools for the partially sighted.

A postal questionnaire was sent to the 355 youngsters approximately one year after the date of leaving school, requesting information on the employment record. A response rate of 85.6% was achieved.

Of the 304 leavers responding to the questionnaire, approximately 55% had sought employment and 45% had entered courses of higher or further education and training.

A measure of occupational success, based on job tenure, was derived for the youngsters who had sought employment. The visual ability data together with the data from the records was then related to this measure of occupational success, correlational analysis being used to ascertain the presence of any linear associations.

Small, but statistically significant correlations, were obtained between employment success and the sex of the youngster, academic qualifications, topics concerning the youngster's attitude to visual impairment and to the interaction with the normally sighted, the presence of an unemployed relative and one measure of distance visual acuity.

Recommendations were made concerning future areas of research.

Key words: employment partially sighted school leaver visual ability

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1 INTRODUCTION

Reference to the blind can be traced to the earliest recorded history and probably no other group in society has, from the outset, generated so much sentiment. Paradoxically, however, a scientific approach to the problems of the blind has occurred only in the last hundred years, and in particular, during the last few decades.

Contrary to lay opinion, only a small proportion of the blind have no perception of light. Indeed, it is estimated that between 75% and 89% of the blind population have some degree of usable residual vision (Goldish 1972; Goldstein 1962; Hellinger 1969; Kederis & Ashcroft 1970; Sorsby 1972).

The definition of blindness varies considerably from country to country. Indeed, a World Health Organisation (W.H.O.) report in 1966 listed 65 different definitions of the level of vision described as blindness (W.H.O. 1966).

Two categories of reduced vision are at present recognised in Great Britain: the blind and the partially sighted. These categories are defined in terms of the industrial or educational capability of the individual.

A blind person is defined in section 64 of the National Assistance Act (1948) as one who is

> " so blind as to be unable to perform
> any work for which eyesight is essential."

Partial sight is not defined in the 1948 Act, but at the time, the Ministry of Health advised that

"... a person who is not blind within the meaning of the Act of 1948, but who is nevertheless, substantially and permanently handicapped by congenitally defective vision or in whose case illness or injury has caused defective vision of a substantial and permanently handicapping character is within the scope of the welfare services ..."

The definitions currently applicable to visually handicapped children in England and Wales are contained in the Handicapped Pupils and Special Schools Regulations (1959)under the Education Act (1944). Children classified as blind are those

"... who have no sight or whose sight is or is likely to become so defective that they require education by methods not involving the use of sight."

In contrast, partially sighted children are regarded as those

"... who by reason of defective vision cannot follow the normal regime of ordinary schools without detriment to their sight or to their educational development, but can be educated by special methods involving the use of sight."

Registers of the blind and partially sighted are maintained by the Social Services Department of each local authority.

Children who are classified as educationally blind are usually educated in special schools for the blind. Braille is the main medium of recorded communication in these schools and emphasis is placed on the development of the skills which will enable the pupil to function in society as a blind person.

A large proportion of children with partial sight are educated in special schools for the partially sighted. In addition, a limited number are taught in special units and classes attached to ordinary schools. Both these groups are taught by sighted methods which are specially adapted to their particular needs and problems. A special school usually has a higher teacher-pupil ratio than in an ordinary school, possesses specialised equipment and provides a more secure atmosphere for its pupils.

Many partially sighted children do not attend special school or units, but are educated in ordinary schools alongside their normally sighted peers. Such education generally involves little or no alteration to the normal classroom regime.

A small number of children with partial sight are educated in special schools for the blind whilst others do not attend school at all, residing continuously at home or in long stay hospitals. In addition, youngsters with severe additional handicaps often attend other types of special schools rather than those for the partially sighted.

The responsibility for the educational placement of the child with reduced vision rests with the local education authority. Decisions concerning the appropriate mode of education are made only after assessing the overall needs of the individual child. The criteria taken into consideration include not only visual acuity, but also other factors such as ophthalmic and medical history, intelligence, progress in normal school and family background.

The current figures for England and Wales published by the Department of Education and Science (D.E.S.) in 1974 list 18 all-age special schools for the partially sighted. In addition, there are two special schools for both the blind and partially sighted and one special school for the partially sighted which caters for pupils up to the age of eleven years. Partially sighted children are also admitted by ten of the special schools for the delicate and the physically handicapped. The exact number of partially sighted children receiving education in England and Wales is unknown. An approximation, however, can be gained from the statistics published by the Department of Health and Social Security (D.H.S.S.) and by the Department of Education and Science.

The figures from the D.H.S.S. for England (D.H.S.S. 1978) show that for the twelve months ending 31st March 1977, there were 2,455 children, aged between five and fifteen years, registered as partially sighted. One thousand and seventy-four of these children (43.7%) were being educated in special schools for the partially sighted, 354 (14.4%) in other types of special school, and 751 (30.6%) in ordinary schools.

The figures from the D.E.S. for England and Wales (D.E.S. 1979) show that in January 1977 between 2,205 and 2,329 partially sighted children, aged three to nineteen years, were attending special schools and classes. The figures also show that 1,599 children were being educated in special schools for the partially sighted.

It is clear that neither set of figures is comprehensive: the former deal only with registered children, while the latter are concerned solely with those in special schools and classes. The figures, in any case, clearly overlap.

In marked contrast to the educational facilities generally provided for the partially sighted, there is little in the way of any special provision for those seeking employment or job training. Indeed, such school leavers become the responsibility of a careers service catering for the employment needs of the normally sighted young adult.

It is rather surprising that a society which provides a realistic educational system for its partially sighted children, should effectively ignore the needs of those same youngsters once they seek employment. Indeed, their problems at this time are exacerbated by the fact that, unlike the blind, they are expected to compete for employment alongside the normally sighted. As a result, a high level of job failure and unemployment is likely to occur in the years immediately after leaving school. The lack of a specialist careers service is all the more disturbing when one considers that, as Tuckey, Parfitt & Tuckey (1973) estimate, the cost of special education is at least twice that of ordinary education.

In contrast, the blind school leaver can seek the aid of specialist employment facilities which include vocational assessment and training centres and officers particularly trained in the occupational needs of the blind.

A school leaver with partial sight may register as disabled and can, in this way, benefit from the assistance of an officer experienced in dealing with the rehabilitation of the handicapped in general. The youngster may also attend a period of occupational assessment at an Industrial Rehabilitation Unit. In addition, some partially sighted adolescents are accepted for assessment, training or further education by blind methods and some are admitted to courses run by specialist colleges catering for the handicapped or the disabled. Such facilities, however, are not designed specifically for the partially sighted and therefore seldom meet their needs.

The problems of employment are not simply related to job opportunities and openings, but involve the visual and psychological consequence of partial sight which in themselves often lead to job failure. Such factors are unfortunately poorly understood.

The origins of this project can be traced back to the late 1960's. Mr B. Jones, then Headmaster of the West of England School for the Partially Sighted, together with Mr G.Cantrell, Consultant Ophthalmologist, discussed the problems facing the partially sighted school leaver with Dr M. Wolffe of the Department of Ophthalmic Optics, University of Aston in Birmingham.

Jones and Cantrell had, for many years, observed a wide variation in employment capability amongst partially sighted leavers. They felt that the methods of vocational assessment and placement were unsatisfactory. They had noted that some leavers were unsuccessfully employed whilst others, with identical eye conditions and seemingly the same levels of vision, were satisfactorily engaged in work of a visually-demanding nature.

Jones and Cantrell considered that the differences in employment capability might be attributed to the apparent variation in the ability of the individual to use residual vision. Furthermore, they suggested that the development of a method which assessed the so-called "visual ability" - the ability to make effective use of residual vision - would be a valuable contribution to the vocational assessment of the partially sighted.

In an attempt to overcome some of the problems facing the partially sighted school leaver, a project entitled "The Employment and Visual Ability of Partially Sighted School Leavers and Young Adults" was eventually undertaken at the University of Aston in Birmingham (Green 1976). As a consequence of this work, the present study was started in October 1976. This study, funded by the Department of Health and Social Security, is a continuation of Green's work.

2. HISTORICAL BACKGROUND

A general realisation of the problems associated with and experienced by the partially sighted has only emerged in the last three decades. Prior to this period, their educational and vocational development was restricted initially by the attitudes of society in general and later by prevailing medical opinion.

Records of the early civilisations show that the handicapped were set apart from society and were either put to death or held in esteem. With the advent of the Jewish and later the Christian religions, the attitude towards the handicapped changed. The first hospices to admit the blind were established under the auspices of the Church at Caesarea-in-Cappodicia and in Syria during the fourth and fifth centuries. Later, during the Middle Ages, several hospices were founded exclusively for the blind. These included, for example, the Hospice Nationale des Quinze-Vingts, Paris, founded during the latter half of the thirteenth century, reportedly for individuals blinded in the Crusades. The first English hospice, Elsing Spittle, opened in 1329.

A turning point in the education of the blind occurred in 1784 when Valentin-Haüy opened the first formal school for the blind, L'Institution Nationale des Jeunes Aveugles, in Paris. The establishment of other institutions soon followed. In 1791, Henry Dannett founded The School for the Indigent Blind in Liverpool. The aim of the school was instruction in "Music and the Mechanical Arts" such that the blind "be rendered comfortable in themselves, and useful to their country". After two years, the school changed its name to the Asylum for the Indigent Blind and again later to the School of Industry for the Blind. Children and adults of both sexes were admitted, and, since the income of the school was derived from the proceeds of its workshops, all the pupils were expected to undertake work. By the end of the nineteenth century a further three similar institutions had been established by various philanthropists. The ensuing schools, founded some thirty years later in York and London, followed a more formal educational approach in preference to the strictly industrial orientated curriculum. The latter school was funded by the London Society for Teaching the Blind to Read which later established further schools, for example, in Exeter and Nottingham. The schools founded in the following decade also concentrated on providing more formal education. Such schools included the first for the handicapped to be opened by a religious organisation, the Catholic Blind Asylum founded in Liverpool by the Sisters of Charity of St. Vincent de Paul in 1841, and the General Institution for the Blind established in Birmingham in 1847 (Davey 1954; Taylor & Taylor 1959; Eaga 1962; Farrell 1962; Pritchard 1963; Anon 1965; Lowenfeld 1974).

In 1866, the College for the Blind Sons of Gentlemen was opened at Worcester and was the first school for the blind to incorporate teaching on a secondary school level. Six years later, the Royal Normal College and Academy of Music was opened at Norwood to provide general secondary education leading to specialization in music or pianoforte tuning.

Concomitant with the trend towards a more formal educational approach was the development of techniques which enabled the blind to read. In 1829, Braille had introduced a system of embossed dots which was later to bear his name and to become the main method of reading and writing for many blind individuals. This system, however, did not gain immediate acceptance since it was felt by many that any such method should be based upon the more familiar Roman alphabet. Indeed, several different systems were developed and used in one school or another. These systems were based either on Roman characters, for example, the Alston and Moon types or on the stenographic approach such as the Lucas type. As a result of the work of Armitage and others, carried out under the auspices of the Indigent Blind Visiting Society, the Braille system was recommended for use among blind children and the Moon system for the old and less intelligent. The consequent adoption of Braille by the various schools in the latter half of the nineteenth century is considered to have been a major advance in the education of the blind.

The Education Act of 1870 and the corresponding Education (Scotland) Act of 1872 established school boards to provide education for all children from the ages of 5 to 14. The Act, however, did not specifically mention any particular disadvantaged groups. Nevertheless, in 1868, a blind child was being educated in Scotland alongside a class of sighted youngsters and by 1874, 50 Scottish children were being educated by such methods. Blind youngsters were also admitted to ordinary schools by the London School Board in 1873 and two years later the Board appointed a blind teacher to educate these youngsters. In 1878, the Board decided to instigate part-time special classes for its blind pupils. Following these initial steps, special classes for the blind were established by the Sunderland and Bradford School Boards in 1882 and 1885 respectively and the Cardiff Board appointed a blind teacher to educate the blind alongside the normally sighted.

In 1874, the Charity Organisation Society set up a Committee to consider the lack of specific mention of provisions for blind children in the 1870 Education Act. Following the report of this Committee in 1876 and the recommendations of other bodies such as the Conference on the Education of the Blind at York in 1883, a Royal Commission was set up in 1885 to report on provision for the education of the blind, the opportunities for their employment and the educational changes needed to increase their qualifications for employment. The Commission's terms of service were later extended to include the deaf. After four years, the Commission issued its report. It recommended in effect that the benefits of the 1870 Education Act should be available for blind children. It advocated that the blind should receive compulsory education from the ages of 5 to 16. The Commission suggested that the pupils should undertake elementary education up to the age of 12 and should then receive, depending upon ability, either technical or academic instruction. It proposed that elementary education should be provided by the school boards in their own schools alongside the normally seeing. The secondary education was to be undertaken at a "high class college" and technical instruction at existing approved institutions or at those to be established by the school authorities. The tone of the report, however, left no doubt that the recommendations were made in the interests of the state rather than in the interests of the child.

In 1890, a Bill incorporating many of the Committee's recommendations was laid before Parliament. After much debate over the financial provisions, the Elementary Education (Blind and Deaf Children) Act was finally passed in 1893. The Act placed the responsibility of educating and maintaining blind children upon the school authorities. Compulsory education was to be undertaken between 5 and 16 years. Such children, thus for the first time, were to be educated as of right rather than as a result of charitable enterprises.

The Education Act of 1902 replaced the school boards by the larger local education authorities which also became responsible not only for the education of the blind but also for "education other than elementary". This latter phrase was interpreted to include day technical classes for the blind over the age of 16 (Davey 1954; Eaga 1962; Pritchard 1963; Anon.1965).

The educational provisions which had developed over the years had failed to take into account the partially sighted. Some remained in ordinary schools whilst many were taught exclusively by methods applicable to the blind. Indeed, it had been recognized as early as 1802, by Franz Von Galiein in Austria, that partially seeing children should not be educated alongside blind children. The development of special education largely arose from the work of two men, James Kerr, Medical Officer to the London School Board and N.Bishop Harman, Ophthalmologist to the London County Council. Both men believed that a different form of special education was necessary for myopic children. In 1905, Kerr raised this issue in a report to the London County Council and advocated that special classes should be established for youngsters with high myopia. Two years later, speaking at the Second International Congress of School Hygiene in London, Harman outlined the results of a survey of the children attending the schools for the blind maintained by the London County Council. He reported that 6% of the pupils were high myopes and consequently questioned the value of blind education for such youngsters.

As a result of these opinions, the London County Council arranged for myopic children attending the schools for the blind maintained by the Council to be taught by sighted methods. A similar approach was also adopted by the Nottingham Education Committee.

In 1908, the first special class for children with residual vision was opened in Camberwell, South London. This class contained a large proprotion of myopic youngsters and, as a result, became known as the myope class. In 1910, Harman described this pioneering work in an article published in the British Medical Journal. One year later, in 1911, the work of Harman and Kerr received Government sanction from the Board of Education and, indeed, by 1913 myope classes had been established by eight local education authorities. By the early 1930's there were 37 special classes in London, alone, catering for the needs of 850 children (Harman 1933). Other figures for this period show that, at 31st December 1930, 5,144 children had been ascertained as being partially blind. Of these, 1,986 were attending ordinary elementary schools, 2,771 were being educated in schools and classes for the blind and partially blind, 52 at other institutions and 335 were categorized as being neither at school or institution.

Scholarship in the myope classes was regulated by prevailing ophthalmological opinion concerning the detrimental effect of reading on high myopia. Consequently, children with high myopia were permitted to read and write only using large print held at an arm's length and this policy was also applied to youngsters with other disorders. Emphasis was placed both on the use of natural lighting and on the provision of adequate rest periods. Special desks were used which incorporated a blackboard on one side and a work surface on the other. (Harman 1910; 1914; 1933; Brown 1921; Whitfield 1932; Anon. 1934).

In 1931, the Board of Education set up a Committee of Enquiry under Dr. R.H.Crowley to "inquire into and report upon the medical, educational and social aspects of the problems affecting partially blind children". The findings were published in 1934. The Committee deprocated use of the term "partially blind", felt that the title "myope class" was too restrictive whilst that of the American "sight-saving class" was a misnomer, and advocated the term partially sighted. They considered in detail the question of myopia and concluded that children exhibiting myopic degeneration, and/or a corrected acuity of 6/24 or worse should be educated at a special school. The Committee also recommended that, in the absence of fundus changes, the mode of education should be determined by the rate of any increase in myopia. It considered that children exhibiting an increase in myopia of more than one dioptre per year or those showing a sudden increase of more than two dioptres after a period of apparent arrest, should also be educated in special schools for the partially sighted. They pointed out, however, that other factors such as the age of the child and the presence of a family history of degenerative myopia, must also be taken into consideration. In discussing children with disorders other than myopia, the Committee recommended that distance acuity of 6/24 or worse should also be the criteria for admission to a special school for the partially sighted. The Committee also felt that partially sighted children should not attend schools for the blind and advocated that education should be undertaken in special schools attached to, and forming an integral part of, the ordinary school It also proposed a reorganisation of residential schools for the blind in order to establish boarding schools for those partially sighted youngsters living in areas where the creation of day classes would be impracticable. The Report further advocated a lessening of restrictions concerning the use of near vision by high myopes and a complete relinquishment of these standards for those with other disorders. The Committee also dealt in detail with the question of employment for partially sighted youngsters. It was against the principle of specific vocational training adopted in the case of the blind and felt that the general education should be of a standard such as to equip the partially sighted youngster to compete on equal terms with the normally sighted.

The Education Act of 1944, made specific reference to the education of the handicapped. This was a major breakthrough in that previous educational legislation had always dealt separately with the handicapped. The Act made local education authorities responsible for the education of the disabled. In cases of 'serious' disability, education was to be in special schools catering for the particular impairment. If this arrangement was not possible, or if the disability was not "serious" the authority was to provide education either in its maintained or in its assisted schools. In addition, the Act made the local education authority responsible for the ascertainment of all children requiring special education. It also empowered the Minister to draw up regulations defining the categories of disabled pupils and the appropriate modes of education. Indeed, in 1945, under the Handicapped Pupils and Special Schools Regulations, the partially sighted became recognized as a separate category of handicapped pupils. As a further consequence of the Act, in the period 1945-47 four residential schools for the blind and and partially sighted became solely responsible for the partially sighted. By 1960, only two schools catering for both the blind and the partially sighted remained.

Gradually, the ophthalmological restrictions concerning the use of residual vision were relaxed and by the 1950's, the school curriculum took on the form it bears today (Whelton 1935; Anderson 1937; Tetley 1938; Hardcastle 1944; Moffatt 1953; Weavers 1953; Anon 1954; Jackson 1969; Harcourt 1973). In 1968, however, a Committee of Enquiry was appointed to inquire into, and make recommendations about, the organisation of educational services for the blind and partially sighted. The Committee, under the chairmanship of Professor M. D. Vernon, reported in 1972 and made many recommendations. These included the planning of educational services, medical services both for the pre-school child and for those at school, the organisation of schools, school curriculum and teaching aids, further and higher education and vocational guidance, the training of teachers and other staff and future research. In particular, it suggested that blind and partially sighted youngsters should, wherever possible, live at home and attend day schools. In cases where this would not be possible, the Committee advocated that such children should board on a weekly basis. The Report also recommended, in contrast to previous opinions, that the blind and partially sighted should be educated in the same schools. It also called for the establishment of vocational assessment centres, the format of which would depend upon the outcome of research. In this context, the Report advocated study of the employment opportunities open to the partially sighted and development of tests to predict vocational/occupational success.

In 1978, a Committee of Enquiry, under the Chairmanship of Mrs H. M. Warnock, reported on the education of handicapped children and young people.

The terms of reference for the Committee covered the educational provisions available to the handicapped and made specific reference to the preparations for entry into employment.

The Report, in particular, discussed the trend towards educational integration of the handicapped in ordinary schools. It maintained that the policy of integration should, in general, apply to both blind and partially sighted children and that the educational needs of the two groups should be considered separately. The Committee also recognised that the provision of educational training and employment facilities during the transition from school to adult life was a complex matter.

Considerable progress has been made in the last few decades towards integrating the partially sighted into society. Nevertheless, many problems still remain unresolved.

3. THE CONCEPT OF VISUAL ABILITY

3.1 Introduction

It has been recognised for some time that visually handicapped individuals exhibit a wide variation in ability to function with residual sight. This sighted capability is being increasingly termed visual ability (Green & Wolffe 1973; Scholl & Schnur 1975; Greenhalgh 1976; Taylor 1981). Other terms such as visual efficiency (Graham 1959; Bier 1960; Goldstein 1962; Hoover 1963; and Barraga 1964) and visual disability (Colenbrander 1976; 1977; Spivey & Colenbrander 1976) have also been used, but it can be argued that these do not stress the positive aspects of such vision.

Although interest in visual ability gained momentum during the Second World War when many visually handicapped persons were successfully employed in industry (Graham 1959), very little is still understood about the use that can be made of residual vision. The lack of progress over the years stems from the almost total absence of research in this area. Indeed, it is only recently that attempts have been made to place the theory of visual ability on a sound academic plane. Few contributions to the subject appear in the literature and many of these, being founded on individual experience or empirical judgement, lack a firm scientific base. The present understanding of visual ability originates to a large extent from the work of Fonda (1961); Hoover (1963); Colenbrander (1976; 1977); and Spivey & Colenbrander (1976).

One of the problems facing those working in the area of low vision is the absence of quantitative methods for assessing visual ability. The need for assessment techniques is undeniable, but with the theory of visual ability in its infancy, progress towards this end is extremely slow. Indeed, the enormity of the problem can be put into perspective when one considers that the ability to use vision has not been determined for the normal visual system. Low vision presents the additional complication of a defective visual system with its associated sequelae.

3.2 Previous studies

It is generally agreed that distance visual acuity alone does not provide a reliable measure of the use that can be made of residual vision (Barraga 1966; 1976; Bier 1960; Cullinan 1978a; 1978b; Faye 1970; 1976; Genenskey 1976; Hellinger 1969; Jones 1962; Lederer 1978; Skydsgaard 1972; Zimmerman 1965). This apparent consensus over visual acuity, however, lacks scientific validation. Various aspects of performance with residual vision have, nevertheless, been investigated by Gray & Todd (1967), Carroll & Hibbert (1973) Haase & Bryant (1974) and Berla, Rankin & Willis (1980).

Gray & Todd (1967) carried out a comprehensive study for the Ministry of Health in London. This work investigated the mobility and reading capabilities of the registered blind. A cross section of the registered blind in England and Wales were interviewed by Government Social Survey interviewers. The interview elicited performance in mobility and mode of reading.

The sample contacted consisted of approximately 1 in 20 of the registered blind aged between 16 and 65 years and 1 in 60 of those aged 65 to 79 years. One thousand and forty-four of the individuals under 65 years of age and 420 of the individuals aged between 65 and 79 were interviewed. This represented 90% and 83% of the original sample respectively.

Performance in mobility was determined by collecting data concerning the journeys made "beyond the house and garden" in the week preceding the interview. The mode of reading was ascertained by questioning and, in some cases, by the administration of a print-reading test.

Residual vision for distance usage was divided into 5 categories dependent upon the individual's visual capability: cannot see windows; can see windows but no more; can see more but cannot see car; can see car but cannot see cyclist; can see cyclist.

Gray & Todd concluded that the level of residual vision was one of the "largest contributing factors" in the degree of independent mobility. They also found that there were basic differences in mobility patterns for varying amounts of residual vision.

Carroll & Hibbert (1973) investigated the visual perceptual ability of a class of partially sighted children. The sample consisted of 13 children; 6 of infant school age and 7 of junior school age. The median binocular distance visual acuity was 6/24.

The children were assessed with the Williams Intelligence Test for Children with Defective Vision; the Frostig Developmental Test of Visual Perception; the Bristol Social Adjustment Guides and the Burt (Re-arranged) Word Reading Test. The older children were also examined with the Staffordshire Arithmetic Test.

Carroll & Hibbert found a correlation of $r = 0.83$ between perceptual quotient (P.Q.) and intelligence quotient (I.Q.). This correlation was highly significant ($P < 0.001$). There was no correlation between P.Q. and distance visual acuity ($\tau = 0$). A slight, but statistically non significant correlation, was present between perceptual ability and near visual acuity. (The type of correlation coefficient is not stated but the value is given as 0.25).

Intelligence quotient was found to be correlated with distance visual acuity ($\tau = 0.11$). The value, however, was not statistically significant. I.Q. also correlated with near visual acuity ($\tau = 0.35$); this value being significant at the 5% level.

Carroll & Hibbert also analysed their data using the Kendall Partial Rank Correlation technique. Little difference was found in the correlation between perceptual ability and intelligence quotient. The resultant correlation coefficient between P.Q. and near visual acuity approximated to zero (-0.061). In addition, the correlation between I.Q. and near visual acuity was reduced to 0.25.

Carroll & Hibbert in drawing attention to the small sample size tentatively concluded that performance on the perceptual test was directly dependent upon intelligence and had little to do with visual acuity.

In 1974, Haase & Bryant described the development of a scale which was administered by interview and was designed to quantify functional distance visual loss. The scale consisted of 5 questions, the first 4 of which were ordered in the form of a Guttman Scale, i.e. following the first negative answer, all subsequent correct answers should be in the negative. The scale is shown in Table 3.1.

(1) (When wearing glasses) can you *see* well enough to recognize a friend if you get close to his face ?

(2) (When wearing glasses) can you *see* well enough to recognize a friend who is an arm's length away?

(3) (When wearing glasses) can you *see* well enough to recognize a friend across a room ?

(4) (When wearing glasses) can you *see* well enough to recognize a friend across a street ?

(5) Do you have any problems seeing distant objects ?

Table 3.1 The distance scale used by Haase & Bryant (1974) to measure functional distance vision loss.

Haase & Bryant administered the scale to 1661 low vision patients, aged 6 years and over, who attended the general receiving wards of 6 eye clinics in North America over a 4-6 week period. An eye examination was administered to each interviewee by ophthalmologists and clinic technicians immediately following the interview. The sampling was carried out such that the sample was approximately the same for each clinic and for each of 4 visual acuity categories (better than 20/50; 20/50 to better than 20/100; 20/100 to better than 20/200; and 20/200 or worse).

Haase & Bryant concluded that the scale exhibited both face validity and construct validity. The content validity was measured by a Pearson phi coefficient which assessed the degree of association between the scale measurement and the distance visual acuity. The value of phi (+0.36) was, however, relatively weak.

In 1980, Berla, Rankin & Willis described a test for evaluating visual ability. This test, the Diagnostic Assessment Procedure (D.A.P.) consisted of 40 specific visual tasks to be undertaken by the visually handicapped individual. The tasks were divided into eight categories and ranged in complexity from the detection of a light to the writing of letters and the reading of simple words. The authors claimed that the test possessed good content validity.

The test was administered to 112 legally blind youngsters by 12 teachers specifically instructed in the procedure. A re-test assessment was also carried out on the youngsters after an interval of 2-3 weeks. The youngsters, 60 males and 52 females, were aged between 5 and 20 years and were attending various schools in North America. The distance visual acuity in the better eye ranged from

20/200 to perception of light, with the majority of the sample possessing an acuity between 20/200 and 18/200.

Analysis of the results from the youngsters showed that the test exhibited good test - retest reliability (r = 0.96) good internal consistancy (KR20 = 0.94) but showed a lack of construct validity.

Two interesting contributions to the literature on visual ability are those of Stone (1965) and Cameron (1979a; 1979b). These papers are notable in that both authors are visually handicapped.

Stone discussed some of her personal difficulties in mobility. She considered that many of her problems had been overcome by adaptation to her environment and by trial and error. Cameron put forward a most critical analysis of his experiences as a tyrosinase-negative oculocutaneous albino. His distance visual acuities were given as 6/60+ right and left. He considered that his life style had been restricted by others on the basis of anticipated performance. Furthermore, Cameron regarded his own ability to perform normal activities as unexceptional and questioned the reliance on Snellen acuity as an indicator of disability. He additionally illustrated his argument with an informative discussion of his visual capabilities.

3.3 Theoretical Aspects

Visual ability is now thought to be a complex function involving many factors, some visual and disease orientated and others psychological and sociological in origin. Indeed, Graham (1959) illustrated this point when he drew attention to the fact that the term psycho-visual efficiency had been used in 1952 (Pine Brook Report 1952) to :

> ".....describe motivational factors as well as medical factors that make for efficient use of residual vision....."

The complexity of visual ability was also recognised by Hoover (1963) when he defined it as :

> ".....a complex of measurable visual characteristics which, when combined with other sensory and physical characteristics, provide an opportunity to utilize sight ......"

He stated that opportunity implies the need for motivation or incentive and considered sensory and physical characteristics to include :

> ".....the psychological, intellectual and all sensory modalities in addition to sight, as well as the motor skills and anatomical variations ......"

This opinion was supported by Barraga when she stated in 1974 that :

> ".....the attitude, personality, mental capacity, physical stamina and motivation of individuals are suspected to have a close relationship to visual performance..."

Similar views have also been expressed by Goldstein (1968) and Colenbrander (1977). In addition, Barraga, Collins & Hollis (1977) go so far as to state that :

> "Because functioning and efficiency are contingent on physiological, psychological, intellectual, and environmental factors, they are likely to be unique to each person. Hence they cannot be measured or predicted clinically with any accuracy by medical, psychological, or educational personnel..."

In view of the uncertain nature of visual ability, a provisional schema has been devised (Fig.3.1). This diagram is based on, and modified from, the original work of Colenbrander (1977) which defined the relationship between visual disorder, visual impairment, visual

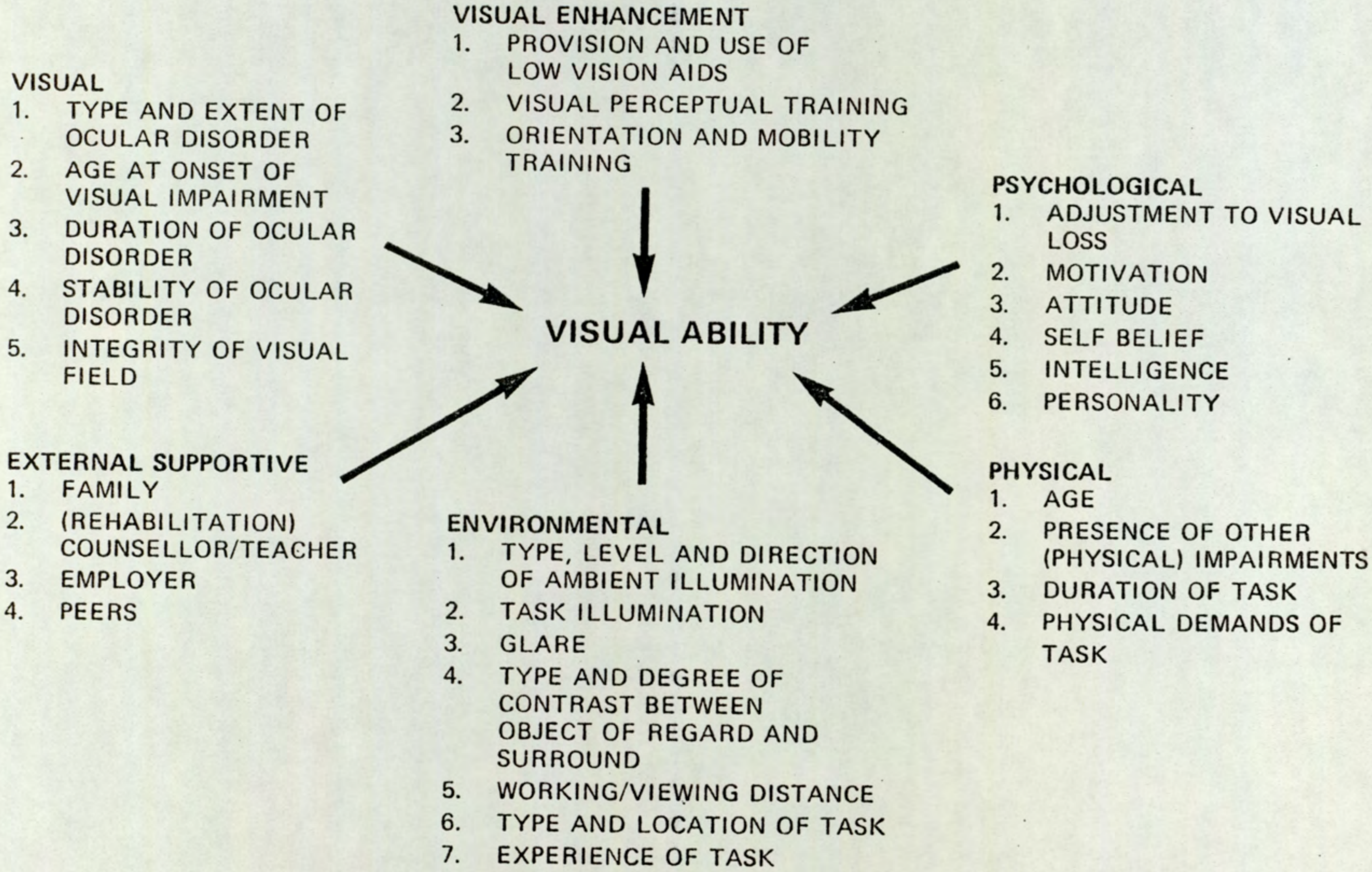


Fig. 3.1 Schematic representation of some likely components of visual ability.

disability and visual handicap.

A visual disorder is a deviation from the normal structure of the visual system and may result from disease, injury or congenital anomaly occurring anywhere along the visual pathway. It can lead to a visual impairment which is a limitation of one or more of the basic functions of the visual system. These basic functions can be measured, for example, in terms of visual acuity, visual fields, binocular vision, colour vision and dark adaptation. A visual impairment can cause visual disability if the visual impairment is sufficient to impede the peformance of the individual in a visual task. Visual disability can lead to visual handicap which in turn represents the extent to which the individual is able to overcome visual impairment or disability and manage the personal, economic, social and environmental demands of society.

As a measure of what can be achieved, the term visual ability would seem to be more appropriate than visual disability since it emphasises the positive nature of performance with residual sight.

Visual ability is not only dependent upon the degree of visual impairment, but also upon many other factors. These can be divided for convenience, into 6 main categories : visual, visual enhancement, psychological, physical, environmental, and external supportive factors. That other factors play a part in determining visual ability is almost certain. The complexity of visual ability is such that many of these categories and subcategories both overlap and interrelate with each other. The extent to which each individual component influences visual ability is unknown as is the extent of the interaction between components. This interaction may be such that, as Barraga (1974) recognised, the components may well be seldom identifiable as specific variables.

Visual Factors

The nature and extent of the ocular disorder is fundamental to the concept of visual ability. Indeed, it influences the majority of the components of visual ability.

The importance of the ocular disorder in determining the use that can be made of residual vision has been noted by a number of workers (Fonda 1961; Silver 1965; Hoover 1970; Barraga 1974; 1976; Colenbrander 1977). Nevertheless, the paucity of the literature on this topic suggests that the significance of the visual disorder is not widely appreciated. Low vision may occur as a result of a blurred retinal image, media disturbances, and retinal or neural damage (Michaels 1975). Such disorders can give rise to many different levels of visual perception. Moreover, the visual perception resulting from any one particular ocular disorder will be dependent upon the severity of that disorder at any specific time. Indeed, as Hoover (1970) suggests, it may be surmised that different levels of visual perception require the exercise of visual ability in different forms.

The degree and type of field loss is thought to influence the use that can be made of residual vision, loss of peripheral vision impairing mobility and central field defects inhibiting performance on near visual tasks (Skydsgaard 1975; Faye 1976; Mehr & Fried 1975; Bailey 1978).

The age of the individual at the onset of visual impairment is also considered to be an important factor in the use of residual vision (Fonda 1961; Silver 1965; Barraga 1976). Fonda (1961) considers that in those cases where onset occurs before the age of 5 years, individuals never know the advantages of normal vision and so find it easier to adjust to their impairment. Indeed, Silver (1965) believes that for those with residual sight emanating from an early age, the capabilities and training possibilities may be endless.

Visual ability may well be influenced by the degree of stability of the ocular disorder. Progressive conditions such as diabetic retinopathy are thought to adversely affect the use that can be made of residual vision (Fonda 1961). In contrast, it is felt that individuals with non-progressive diseases should be encouraged to make maximum use of their residual sight (Silver 1965).

Visual Enhancement Factors

It has been recognised for some years that performance with residual vision can be enhanced by the provision and utilization of low vision aids (Bettica 1954; Fonda 1956).

Their value in general, comprehensively summarised by Borish (1970), has been described by many authors (Bier 1960; Faye & Hood 1975; Faye 1970; 1976; Fonda 1970; Mehr & Freid 1975).

Specially designed training programmes, however, can also raise performance levels. The work of Barraga, which is based upon the developmental nature of visual perception, has clearly shown that a formal training procedure can enhance the visual ability of visually handicapped children (Barraga 1964a; 1964b; 1965; Moore 1972).

Barraga (1964a) investigated the effect of a period of intensive visual training on children previously educated by non visual methods. The doctrine of the initial training periods was to replace tactile recognition of tangible objects with that of visual recognition. Succeeding sessions progressed from the teaching of recognition of outlines and then inner details, to the observation of likenesses and differences, and the eventual recognition of letters and words. She used three groups of visually handicapped children in her study. Two of the groups each consisted of 10 children aged between 6 and 13 years. These children, previously educated as blind, had corrected distance visual acuities of 6/12 or less in the better eye, Interim-Hayes-Binet intelligence quotients of not less than 80, an ocular disorder from birth, and no other known impairment likely to impede learning. One of these groups acted as the experimental group while the other was used as the control group. The children in these two groups were additionally matched with respect to pretest scores on Barraga's Visual Discrimination Test. This test, especially devised for the experiment, had been adapted from reading readiness materials. The test purported to measure the ability to discriminate and recognise geometric forms, objects, words and letters.

A third group of 10 visually handicapped children, previously educated by sighted methods, were used as a comparison group. These children had been selected on the same criteria as those in the other groups. The distance visual acuities of these children, however, ranged from object perception to 20/200.

The children in the experimental group received a daily 45 minute lesson for 8 weeks. The children were taught in pairs. The teaching programme, devised by Barraga herself, strove to teach each child to "learn to see". It was based upon "offering discriminating clues ... associated with previously experienced stimuli". The lessons were devised and individually structured to encourage the development of discrimination and recognition of visual stimuli.

After the teaching period had been completed, children in all three groups were again tested on the Visual Discrimination Test.

Statistical analysis was carried out between the initial and final scores on the Visual Discrimination Test. The mean final score of the children in the experimental group was statistically significantly higher than the mean initial score ($p < 0.005$). The mean increase in the score of the children in the experimental group was also greater than the corresponding increases of the children in the control group and the children in the comparison group. These differences were also statistically significant ($p < 0.05$).

Barraga's results thus confirmed the hypothesis that the visual ability of children with low degrees of residual vision could be enhanced by a controlled training programme.

The experimental group was also tested on the Visual Discrimination Test after an interval of 5 months (Barraga 1964b) and after 1 year (Barraga 1965). The scores indicated that there had been very little regression of performance.

An ophthalmological assessment of the pre-training and post-training near visual acuities was also undertaken during the study. The differences between the pre-training and post-training acuities of the children in the experimental group were not statistically significant. Nevertheless, an increased near acuity was recorded from seven subjects. Additionally, no significant differences were found between the post training acuities of the experimental group and those of the control and the comparison groups. Six subjects in the experimental group, however, did have post training acuities greater than those of their matched controls.

Similar studies to that of Barraga (1964a) have since been conducted by Ashcroft, Halliday and Barraga (1965), Holmes (1967), and Tobin (1972). Ashcroft et al (1965) used an experimental group of 24 children and a control group of 17 children. The children, aged between 6 and 13 years, were selected on the same criteria as those in Barraga's study. Slight modifications were, however, made to the sampling procedure. The lower limit of I.Q. was reduced to 70, while the upper limit of distance visual acuity was raised to 8/200.

The training programme of Ashcroft et al differed from that of Barraga (1964a) in that commercially available training materials were used by 4 teachers. (In her study, Barraga had made the teaching materials herself and had administered the training programme entirely on her own).

The post training scores of the children in the experimental group on Barraga's Visual Discrimination Test were significantly higher than the pretraining scores. Halliday (1966), in describing the work of Ashcroft et al, does not state the level of statistical significance nor does she mention how the scores of the children in the experimental group compared with those of the children in the control group. Furthermore, no mention is made of the effect of the training on the recorded distance and near visual acuities.

Halliday (1966), however, concludes that the results of the study by Ashcroft et al confirmed the original findings of Barraga (1964). The study also proved that similar results to that of Barraga could be obtained by different persons using the same experimental teaching approach.

In 1970 Barraga introduced her Visual Efficiency Scale. This was essentially a revision of the Visual Discrimination Test. The scale was subsequently validated on 104 normally seeing pre-school children by Harley, Spollen & Long (1973) and by Harley & Spollen (1973) on a group of 78 visually handicapped children aged between $6\frac{1}{2}$ and 14 years.

In 1972, Tobin used Barraga's Visual Efficiency Scale and teaching materials on 5 children registered as blind. The study differed from previous investigations in that the pretesting with the Visual Efficiency Scale served as a diagnostic tool to identify specific areas of perceptual dis function. The children were then given lessons solely in the area that had been identified as deficient. The children, aged between 7 and 10 years all attended a residential school for the blind. Selection was made on the basis of absence of additional sensory handicaps sufficiently gross to interfere with mobility and communication, distance visual acuity in the better eye of greater than perception of light and an evaluation that perceptual training might be of benefit. Distance visual acuities were between counting fingers at 4 feet and 6/36, although whether this is with or without spectacle correction is not clear from the report. I.Q.'s ranged from 86 to 120, but unfortunately the intelligence test is not stated.

The children were tested on four sections of Barraga's Visual Efficiency Scale. Teaching was given in areas where a score was achieved of less than 75%. Individual daily lessons were given over a 5 week period. Post training scores were statistically significantly higher than the pretraining scores ($P < 0.01$). The per-centage gain in score varied from 20% to 81% with a mean of 52%. In four of the children, the overall gain was largely due to increased scores on the sections related to the training.

The expertise possessed by the individual in orientation and mobility skills is likely to contribute to the degree of visual ability that can be achieved. Orientation and mobility teaching programmes for individuals with residual vision provide instruction in the interpretation and use of visual and non visual cues, with the aim of developing an ability to recognise, understand and utilize the environment (Richterman 1966; Hughes 1967; Apple & May 1970; Dugmore 1973; Allen 1977; Verlander 1978).

Psychological Factors

Motivation is considered by a number of workers to be an important factor in determining the use that can be made of residual vision (Fonda 1961; Hoover 1963; Stone 1965; Richterman 1966; Goldish & Marx 1973; Scholl & Schnur 1975).

Barraga (1976) in discussing the problems of individuals whose vision had deteriorated in adulthood or old age, maintained that the motivation to continue to function independently is one of the primary factors related to the efficient use of residual vision. The degree of motivation, in particular, is likely to depend upon the response to loss of vision which, in turn, is considered normally to follow several distinct phases: shock, depression and readjustment (Fitzgerald 1971; Mehr & Mehr 1970; Perlman, Adams & Sloan 1977; Emerson 1981). Similarly, intelligence is thought to be an essential counterpart of motivation in determining the degree and rate of visual achievement, and is therefore closely related to the efficient use of residual vision (Fonda 1961; Richterman 1966; Barraga 1974; 1976; Marshall 1978 b). It is also suggested that motivation is a factor influencing the degree of visual ability in visually impaired children (Barraga 1974; Marshall 1978 b; 1979).

The role of intelligence is highlighted by an interesting study carried out by Williams (1968). She investigated an hypothesis, widely discussed amongst teachers of the blind, that children blinded from retinoblastoma are generally of above average intelligence.

Williams' sample comprised 50 children afflicted with retinoblastoma and 74 children blind from other causes. This latter group represented a random 10% sample of other blind children in England and Wales. Both groups of children, aged between 5 years 6 months and 15 years

5 months, were selected from each of the schools for the blind in England and Wales. Children from the Sunshine Nursery Schools and the special schools for blind with additional handicaps were not included in the sample. The group blinded from retinoblastoma comprised 27 boys and 23 girls. The non-retinoblastoma group consisted of 37 boys and 37 girls.

Only 5 individuals with retinoblastoma had residual vision: visual acuities ranged from 1/18 to 6/24. Forty-five children in the non-retinoblastoma group were either totally blind or had perception of light only. The visual acuities of the remaining 29 children ranged from counting fingers to 6/60. The onset of blindness in the retinoblastoma group had been recorded as under three years of age in all but three of the cases. Visual impairment was present at birth in all but 5 of the non-retinoblastoma group.

In addition, 60 normally sighted children (30 boys; 30 girls) selected from 4 ordinary schools were used as a control group.

Each child in the three groups was given the Williams Intelligence Test Scale. This had been previously developed by Williams in 1956 for measuring the intelligence of children with a visual handicap. Williams found the mean I.Q. of the retinoblastoma group to be 119.72 (standard deviation 9.76) and that of the non-retinoblastoma group to be 102.81 (standard deviation 15.96). The mean I.Q. of the sighted control group was 102.67 (standard deviation 12.01). Statistical analysis showed that the difference between the mean of the retinoblastoma group and that of the non-retinoblastoma group was highly significant ($P < 0.001$). The difference between the means of the retinoblastoma group and the sighted group was also highly significant ($P < 0.001$). There was no significant difference in the means of the sighted group and the non retinoblastoma group.

Other psychological factors have also been shown to be of importance. Barraga (1974) and Fonda (1961) have drawn attention to the fact that personality can compensate for visual loss. Similarly, the attitude of the visually impaired individual is thought to influence the degree of visual ability that can be achieved (Barraga 1974). Commenting on individuals with acquired visual impairment occurring in adulthood or old age, Hoffman (1955) Barraga (1976) and Goldish & Marx (1973) consider that a person believing in the capacity to retain some visual ability and to use some vision for personal care and continued independence will maintain an interest in using sight. Barraga (1969) has also contended that the ability to respond to visual impressions leads to a sense of satisfaction. She has pointed out that this satisfaction then becomes a reinforcing element which leads persons with low vision to seek further experiences of a similar nature. This in turn encourages the best possible development of residual vision.

External Supportive Factors

Visual ability may be influenced by the degree of guidance and support received by the individual (Fonda 1961; Kell 1978; Marshall 1979). This may arise from a number of sources such as the family and the rehabilitation counsellor. The contribution from the home environment is likely to depend upon the psychological status of the family unit and the family attitude (Richterman 1966; Lowenfeld 1974). Help in terms of rehabilitation is an important factor in the development of visual ability in individuals who become visually handicapped in adulthood or old age (Barraga 1976).

Physical Factors

Increasing age may adversely affect the use that can be made of residual vision. Older patients in general, fatigue more easily, are less strongly motivated than younger individuals and are usually affected with other infirmities (Fonda 1961). The presence of additional physical impairments may also affect the use of residual vision, particularly if the low vision is part of an overall syndrome such as rubella. The length of time that an individual can sustain a particuar visual task is considered to be an important component of visual ability (Hoover 1962; Scholl & Schnur 1975). The physical demands of the task may also affect the level of visual ability that can be achieved.

Environmental Factors

It is thought that certain environmental factors influence visual ability. The type, level and direction of ambient illumination as well as the level of the task illumination are known to affect the use that can be made of residual vision (Barraga 1974; Barraga et al 1977; Faye 1976; Fonda 1970; Pelling 1980). Other factors which can influence the level of visual ability are the amount of glare and the type and degree of contrast between the object of regard and its surround (Barraga 1974, Barraga et al 1977; Faye 1976; Richterman 1966; Sicurella 1977; Pelling 1980; Zimmerman 1965). Relatively little research, however, has been undertaken into the relationship between illumination and visual performance among the visually handicapped. (Gazely 1978; Lehon 1980). Nevertheless, it is clear that the relationship between residual vision and the level of illumination required to carry out set tasks is very complex. Fonda (1970) for example, believes that the required level of illumination depends largely on the type of ocular disorder present and should be determined on an individual basis. Indeed, he maintains that lighting requirements often vary in individuals with identical disorders. Fonda contends that individuals with such conditions as achromatopsia, albinism, aniridia, posterior subcapsular cataract, central corneal opacities, and some cases of advanced macular degeneration often function better in minimum illumination. He considers that conditions giving rise to optimum performance under high levels of illumination are coloboma of the retina and choroid eye diseases associated with pinpoint pupils, glaucoma, healed chorio-retinitis, hereditary pigmentary degeneration of the retina, optic atrophy, pathological myopia, surgical aphakia and most cases of macular degeneration.

The distance at which the task can be carried out is likely to affect the level of visual ability since it is recognised that the standard of vision in many low vision individuals varies with viewing distance (Skydsgaard 1975; Lie 1977; Lederer 1978). Skydsgaard (1975) for example, considers that disorders such as peripheral opacities of the cornea or lens, irregular astigmatism, keratoconus, myopia, and nystagmus can give rise to higher levels of vision at near than at distance. Enhanced near vision in cases of congenital idiopathic nystagmus and albinism is particularly marked and arises from a blocking of the nystagmus by the associated convergence (Gay, Newman, Keltner & Stroud 1974; Gould & Silver 1974). Reduced near vision, compared to distance, can occur in individuals with central or inferior nasal opacities of the cornea or lens, central scotomata, or where field defects encroach close to fixation (Skydsgaard 1975).

A closely related factor is the degree of magnification which can be achieved by reducing the distance between the observer and the object of regard.

The level of visual ability required to successfully undertake a particular visual task will depend upon the nature of that task. Colenbrander (1977) for example, draws attention to the distinction between critical tasks such as reading and more gross tasks such as mobility.

Experience of the task is also considered to influence the level of visual ability that can be achieved (Scholl & Schnur 1975).

3.4 Current Methods of Assessment

A number of American workers, recognising not only the inadequacy of the existing arbitrary criteria for legislative definitions of blindness but also the absence of a quantitative method of assessing visual ability, have introduced various functional classifications of low vision (Fonda 1961; 1970; Genensky 1971; Faye 1976; Colenbrander 1976b; 1977). These qualitative definitions attempt to categorize individuals in terms of their level of functioning with residual vision, i.e. their level of visual ability.

Fonda (1961; 1970) introduced a classification to facilitate appropriate educational or occupational placement of the visually handicapped. It is based upon distance visual acuity and divided into four groups.

Individuals in Fonda's Group I have visual acuities from light perception to 1/120. Fonda suggested that these patients, whenever possible, should be taught to use Braille.

The visual acuities of those in Group II ranged from 2/200 to 4/200. Fonda stated that these individuals should be encouraged "to the highest possible degree" to read print and should be encouraged to travel independently, subject to the visual fields being adequate for such purposes.

Individuals in Groups III and IV, with visual acuities from 5/200 to 20/300 and 20/250 to 20/70 respectively, should be taught to use their eyes.

In 1971 Genensky put forward a "functional classification system of the visually impaired". This classification divided into four groups, was based upon the levels of residual vision which permitted mobility and/or the visual capability of reading and writing.

Individuals placed in Group I are designated as *Functionally Blind* or *Nonfunctionally Sighted*. These individuals are unable to read or write either with or without low vision aids. They are also unable to "manoeuvre in an unfamiliar environment" without the aid of a guide dog, cane, or guidance from a person with mobility.

The individuals in Group II, described as the *Functionally Sighted*, are capable not only of reading and writing but also of safe and unaided mobility.

Group III individuals, the *Functionally Sighted with Aided Mobility*, are capable of reading and writing, but required assistance with mobility.

Similarly those in Group IV, the *Functionally Sighted with Neither Sighted Literacy nor Sighted Illiteracy*, are unable to see to read or write, but are capable of safe and unaided mobility.

Genensky additionally described individuals in the latter two groups as being quasi-functionally sighted.

A clinical classification of the low vision patient has been proposed by Faye (1976). This is divided into five groups and is based upon the degree of functional impairment, response to low vision aids and need for special training and education.

Patients in her Group I category are the *least impaired* The level of vision is such that it does not affect the ability to function.

The patients designated as Group II have *moderate functional impairment*. Visual acuity is moderately reduced and visual field loss is insignificant. Near vision, corrected by reading additions or low vision aids is adequate for most reading.

Patients in Group III have *moderately impaired function* They exhibit reduced central vision, moderate field loss, and/or an inability to cope physically or psychologically with the impaired vision. Reading is difficult, aids are most often used for short-term special needs, and Faye states that these individuals may require selected rehabilitation training. The patients in Group IV possess *poor functional vision*. In addition to poor central vision, marked field loss and poor medical prognosis, they have psychological and physical problems with adaptation to their impairment. These latter difficulties are such that rehabilitation training is necessary. Low vision aids are of limited use to these patients.

Faye's Group V patients are the most *impaired visually*. Visual acuity is very poor, and the field loss might be a major contributing factor to the incapacity. In addition, the medical prognosis is poor. These patients utilise visual cues for mobility; they make minimum use of low vision aids and are unable to read continuous text. Such patients require rehabilitation which involves training particularly in mobility and daily living skills, in addition to being retrained for employment.

Colenbrander (1976 ; 1977) also has a classification of visual disability. Divided into 7 groups, the first group are those with *no disability*. Individuals in the second group are considered to have a *slight visual disability*. These individuals are capable of performing visual tasks without special aids. Those in the third group, with *moderate visual disability*, can reach near normal performance with special aids such as magnifiers and reading additions over 4.0 dioptres. The fourth group involves individuals described as having a *severe visual disability*. Using aids, these individuals are only able to carry out visual tasks at a reduced level of performance eg with diminished reading speed and reading endurance. Those in the fifth group, *profound visual disability*, are unable to perform most detailed visual tasks such as reading. In addition, they experience difficulty with gross visual tasks such as mobility. These individuals become increasingly reliant upon their other senses. Individuals in the sixth group, rely mainly on the other senses. Those in the last group, *total visual disability* have no vision and rely entirely on their other senses.

The concept of "visual efficiency" has occasionally been used to assess visual ability (Spaeth, Fralick & Hughes 1955; Cebon 1969; Colenbrander 1975). The historical development of "visual efficiency" has been reviewed by Ryan (1962). This concept originated from the legal requirement, in cases of compensation, to quantify the degree of visual impairment resulting from industrial or other accidents. Various schemas have been put forward which have assessed the relative importance of central vision, peripheral vision and ocular motility. Drasdo (1976), in discussing the American Medical Association schema, (Spaeth, Fralick & Hughes 1955), considers that "although the method is empirical rather than scientific in origin, it has much to commend it in practice". Spivey & Colenbrander (1976) however, consider that it "represents a complex measure of impairment but is not a measure of visual ability".

The attempts to define and rationalise the concepts of visual ability stem from the need to improve methods of assessment. The fact that those having residual vision are trained to think in terms of functioning as sighted individuals rather than as partially blind underlines the importance of arriving at a clearer understanding of this subject.

4 OCCUPATIONAL ASPECTS

4.1 Introduction

At present, very little is known about the employment capabilities of partially sighted young people. Indeed, only during the last two decades has any significant interest been shown in their employment potential.

This neglect stems from the early ophthalmological approach to partial sight in which the use of residual vision was positively discouraged. It was believed that the best way to preserve such vision was to limit its use. This medical constraint largely restricted the partially sighted to the traditional occupations of the blind. The limitations on the use of residual sight were lifted in the early post Second World War years and, for the first time, the partially sighted were encouraged to undertake sighted employment.

The employment potential of the partially sighted school leaver has been the subject of relatively few studies. Consequently many questions remain unanswered. In particular, little is known about the factors which determine success in employment.

The literature on the occupational aspects of partially sighted young people can be broadly categorized into generalised discussion papers and reports of follow-up studies of former pupils and patients.

4.2 General discussion

Partially sighted school leavers are now regarded as young people with potential and choice (Grunwell 1974; Kell 1974). Gilleard

(1976) and Butler (1979) similarly believe that emphasis should be placed on their strengths rather than their weaknesses. Indeed, Kell (1974) considers that, unless circumstances indicate the contrary, partially sighted school leavers should be encouraged to "aim for the highest level within their capabilities". Greenhalgh and Gill (1978) similarly have drawn attention to the fact that more and more people with residual vision are being encouraged to choose their jobs in the same way as the normally sighted.

Nevertheless,many difficulties are experienced not only by those concerned with the occupational placement of the partially sighted but also by the partially sighted themselves.

In 1961,Sorsby stated that the employment opportunities open to the partially sighted were "not adequate on either individual or social grounds". Marshall(1978b) headmaster of a school for the partially sighted, acknowledged that the placement process is long and often tedious. He, nevertheless, considered that it is possible to place partially sighted school leavers in successful careers "commensurate with ability, intellect and attainment". Employment prospects for the adventitiously visually impaired, however, are considered to be far more limited (Greenhalgh and Gill 1978).

Drake (1960) considered that education at partially sighted school did not "in any degree" fit the youngster for future employment. Similarly Barclay (1963) maintained that partially sighted youngsters often left special schools or classes without qualifications and were consequently limited in their choice of occupation. The opposite view was held by Gilleard (1976) who suggested that partially sighted youngsters from special schools are probably the best equipped to cope with employment. He did, however, point out that job opportunities for the handicapped could be improved by further education or training. The successful transition from the sheltered environment of a special school to the demands of a sighted society is, nevertheless, difficult to make (Wilkes 1961; Cunliffe 1968; Gilleard 1976).

Cunliffe (1968; 1973; 1976) noted that some partially sighted youngsters have sufficient residual vision to read and write, but do not have enough sight to operate industrial machinery at the normal distance of an arm's length. He pointed out that such an individual would be within the educational definition of partial sight, but, on leaving school, might come under the industrial definition of blindness. Cunliffe felt that this situation had been exacerbated by the increasing use of low vision aids in schools which had enabled more and more youngsters to forgo an education by blind methods. He further believed that such youngsters should be re-educated to undertake employment by methods applicable to the blind.

Kell (1974) Gilleard (1976) and Greenhalgh & Gill (1978) considered that potential difficulties and practical problems in certain occupations could be overcome by attention to factors such as improved lighting, use of low vision aids, speech machines and mobility devices. Marshall(1978b) maintained that youngsters should be trained to ensure that special demands on potential employers are unnecessary.

In 1974 Wolffe, discussed the role of residual vision in job capability. He pointed out that one of the problems in determining employment capability lay in relating levels of residual vision to occupational potential. He considered that measuring residual vision in terms of visual acuity was often of little value as job requirements were rarely graded in this manner. In addition, Wolffe felt that the ability of partially sighted children to carry out tasks far exceeded that indicated by their visual acuity. These opinions were also put forward by Green and Wolffe (1973). Wolffe called for the development of a series of predictive tests of employment capability to aid those involved with vocational placement of the partially sighted. Indeed, the use of psychological tests to predict the vocational potential of visually handicapped persons has been discussed by Wilson (1971).

Herkes (1978) and Butler (1979) advocated research to determine additional trades and professions suitable for those with partial sight. Similarly, Sorsby (1961) suggested the introduction of a list of occupations for the partially sighted. The list was to be kept under constant review, and was to indicate job openings rather than job restrictions. In addition, Clayton (1973) proposed the redesign of jobs to match the capabilities of the visually handicapped.

Cunliffe (1976) noted that visually handicapped youngsters, being unaware of their personal limitation, frequently make errors in the self assessment of prospective occupations. Such unrealistic choices were most likely to be made by the less intelligent and by those who have been over protected in the school years. In contrast, Marshall (1978b) considered it rare to dissuade a pupil from a choice of career. In addition, Davidson (1975) after administering various occupational psychology scales to both legally blind and sighted adolescents, concluded that visually impaired youngsters may not be as vocationally immature as is generally believed. Cunliffe (1968; 1976) stated that failure in an unrealistic occupation not only results in a lost opportunity for the individual, but might produce an employer with an unfavourable attitude to future applicants with a handicap.

Herkes (1978) and Butler (1979) drew attention to the fact that individuals applying for jobs can be discriminated against on the grounds of their partial sight. In contrast, Cunliffe (1976) suggested that a visually handicapped individual can often attract the goodwill of fellow employees and so improve the working relationship on the shop floor. Indeed, Cunliffe stated that many young people are retained in employment more for their social worth than for their economic worth.

Handicapped youngsters have an overwhelming desire to work (Gilleard 1976), but are frequently employed well below their intellectual capabilities, in jobs of low status. Consequently they experience frustration at the poor prospect of promotion (Drake 1960 ; Herkes 1978 ; Butler 1979). Drake (1960) drew attention to the fact that successive failures in employment, due to inadequate sight, can often undermine the self confidence of the individual to such an extent that specialist training and guidance becomes necessary.

The attitudes of the youngster towards personal disability, job prospects, employer and fellow employees are considered by Gilleard (1976) to have a considerable bearing on the future success in employment.

Courses which provide a practical experience of the working environment are of immense value to the partially sighted youngster (Cunliffe 1976 ; Gilleard 1976). Nevertheless, the adequacy of the provisions for the vocational guidance of the partially sighted has been questioned on a number of occasions (Drake 1960 ; Herkes 1968 ; Cunliffe 1973). Indeed, Drake (1960) considered that the needs of the partially sighted are served neither by the vocational training and placement services available to the sighted nor by those provided for the blind. He advocated the introduction of a centre to cater for the occupational problems of school leavers and adults with partial sight. Similarly, Gilleard (1976) felt that the school leaver with partial sight would benefit from the introduction of a "half way stage" between school and employment.

4.3 Follow-up studies of partially sighted school leavers

The progress of the visually handicapped school leaver in the immediate post school years has been the subject of a number of studies (Marshall 1978b; Kell 1974; Clayton 1973; Tuckey, Parfitt and Tuckey 1973; Wilkes 1961; Ministry of Labour 1960).

In 1978, Marshall briefly reported the results of a ten year survey of the careers pursued by former pupils of Exhall Grange School. Listing 98 different types of employment undertaken by his former pupils, Marshall grouped the occupations into eight categories: Civil Service, engineering, teaching, catering, social-type work, out-door-type work, general and clerical. A full list of these occupations is given in Table 4.1.

A Working Party Report (1974) on the partially sighted school leaver, under the chairmanship of Kell made vague reference to a study of school leavers from Exhall Grange School, Coventry and the six schools for the partially sighted in London and the Home Counties. The sample comprised 285 leavers from the three academic years 1970-73. The leavers were found to have entered 30 different

Overleaf ... Table 4.1. Careers entered by former pupils of Exhall Grange School. (After Marshall 1978b).

A Civil Service

1. Clerical officers
2. Typists
3. Tax officer, Higher Grade, B.A. Degree
4. Executive Officer
5. Assistant Statistician, M.Sc.-Statistics

B Engineering etc

1. Standards Engineer - B.Sc.Economics
2. Electrical Engineer - B.Sc.Physics
3. Estimating Engineer - Chartered
4. Heavy Vehicle Repairer
5. Electronics-Student Apprentice
6. Assistant Sales Engineers
7. Assemblers and Borers
8. Capstain Operators
9. Semi-skilled machine operator
10. Piano Repairing/Tuning
11. Progress Clerks - O.N.D.Technical
12. Company Director
13. Centre Lathe Turners

C. Teaching

1. Sociology M.Sc.
2. English B.A.
3. Geography B.A.
4. Geology B.Sc.
5. Lecturer in Tech.Coll.-B.A.
6. General Teaching (some B.Ed.some Cert.Ed.)

D. Catering

1. Cooks (City and Guilds)
2. Waitresses
3. Shelf-filler (Supermarket)
4. Hotel Managers
5. Trainee Hotel Managers
6. Stock Co-ordinator
7. Food Technologist (City and Guilds)
8. Wholesale Fruit and Vegetable Salesman
9. Provisions - Shop Assistants
10. Check-out Cashiers - Supermarket

E. Social Type Work

1. Nurses (S.R.N., C.M.B.)
2. Physiotherapists
   Physiotherapists (Student)
3. Trainee Hairdressers
4. Employment Officer - R.N.I.B.
5. Technical Officers for the Blind
6. Day Centre Manager
7. Domestic Help
8. Ward Orderly
9. Psychologist (developmental) - M.Sc.
10. Pop Singers (professional)
11. Pop Drummer (professional)
12. House Parent Trainees
13. Social Work Adviser

F Outdoor-type Work

1. Farmers
2. Stable Hands
3. Charge-hand Grooms
4. Gardeners (Diploma)
5. Under-foreman Gardener (trained)
6. Horticulture - Parks & Gardens (skilled & trained)
7. Garden Centre Manager
8. Milk Depot Loader

G General

1. Packer (Factory)
2. Warehouseman
3. Brewery Co. Buyer (fitting out "pubs")
4. Storeman
5. Trainee Shop Managers
6. Travel Agency Clerk
7. General work in printing works
8. Assembly line Workers
9. Hospital Kitchen Porters
10. Care Salesman
11. Salesmen (shops)
12. Sagger Repairer
13. Car Factory Worker
14. Furniture Porter
15. Apprentice Carpenter
16. Hide and Skin Factory Worker
17. Laundry Workers
18. General Labourers
19. Pharmach (Shop) Assistants
20. Store-woman
21. Shopkeepers
22. Soap Factory Worker
23. Trainee Hospital Technician

H Clerical etc. (see also A)

1. Receptionist/Telephonist
2. Clerks
3. Copy Typists
4. Audio Typists
5. Senior Hospital Admin. Assistant
6. Telephonists
7. Comptometer Operators
8. Fatstock Marketing
9. Reconciliation Clerk
10. Admin. Officer (Polytechnic)
11. Trade Union Research Officer - B.A.
12. Admin. Assistant - Local Government
13. Computer Programmers
14. Solicitors
15. Admin. Trainee - Electricity Board
16. Management Science - Ph.D.
17. Town and Country Planning
18. Chief Clerk - Local Government
19. Clerk/Typist
20. Building Society Clerk

J Further Education

At Universities, Colleges of Education and Colleges of Further Education.

occupations and 5 categories of further education. The proportion of leavers in employment was not given, but more than a third were reported to have undertaken some form of further education.

The Kell Report also made passing reference to a similar study by Kettle in 1965. Kettle's study was carried out nationally and covered the three academic years 1963-65. Kettle found that 77% of his sample could be categorised into five different occupational groups. Out of the total sample, 26.5% were employed in assembly, packing, or factory work, 18% in telephony, typing or office work, 20% as shop assistants in the retail trade, 6.5% in catering or hotel work and 6% in traditional crafts. Kell's report does not give the number of leavers in Kettle's sample, nor does it state the percentage of leavers unemployed or in further education.

The Kell Report listed the percentages of school leavers from its own survey grouped according to Kettle's classification. It is not clear whether the two studies refer to the initial or subsequent occupations of each leaver. The comparative range of occupations accounted for less than 50% of the leavers. Thirteen per cent were employed in factories, 10% in office work, 24% in catering and hotels, and less than 2% in traditional crafts.

Data from school leavers from 5 of the 7 schools was summarised by Kell in two tables (Tables 4.2 and 4.3).

It is interesting to note that the total number of leavers in the various employment categories from the Inner London Education Authority (I.L.E.A.) Schools decreased from 1971 to 1973. Since the total number of leavers from the schools is not stated, the decrease could indicate either the growing problem of unemployment or simply a smaller number of leavers.

Job Function	1971	1972	1973
Packing	1	1	1
Shop assistants	8	6	2
Working with children	-	1	1
Messenger	1	-	1
Telephonist	-		1
General office	10	6	4
Unclassified	-	1	1
College of Further Education	15	18	10
Blind Assessment Training	3	2	1
Other Training	-	1	1
Carpenter	2	1	2
Plasterer	1	-	1
Gardener	-	-	2
General Factory Work	-	3	-
Barrister's Clerk	-	1	-
Income Tax Office	-	1	-
Receptionist	-	1	-
Remploy	1	-	-
Hairdressers	3	-	-
Baker	1	-	-
Sixth Form	1	-	-
Total	47	43	28

Table 4.2 Job function undertaken by leavers from 4 schools for the partially sighted in the Inner London Education Authority (After Kell et al 1974).

Job Function	1971	1972	1973
Catering and Hotels			1
General Office			1
General Handcraft			1
Baker			1
Other Training			2
Packing		1	
Shop Assistant	1		
Blind Assessment Training	2		

Table 4.3 Job function undertaken by leavers from Joseph Clarke School (after Kell et al 1974).

In view of the fact that the sample studied by the working party was largely selected from London area day schools, the findings are unlikely to be representative of the national trend.

Clayton (1973) briefly reported the results of a follow-up study, by postal questionnaire, of 343 former pupils of Maryland School for the Blind. Of the 44% who had completed and returned the questionnaire, approximately one third were undertaking gainful employment, one third were unemployed and one third were in full time education.

Tuckey, Parfitt and Tuckey (1973) carried out an extensive study of the handicapped special school leaver. The post school status of individuals with various types of handicap was determined approximately 18 months after leaving school. The occupational or educational status of each leaver was then related to an assessment provided by the teachers and careers officers prior to leaving school.

Of the 888 special schools originally contacted, 619 took part in the study. These schools provided information on 7,094 adolescents who were expected to leave during the 1968/69 academic year. A sample of 1,700 individuals was selected from this return. The sample was chosen to include adequate numbers within each handicap and also to contain a higher proportion of severely and multiple-handicapped individuals. A questionnaire requesting detailed information on each child in the sample was sent to the appropriate schools. The questionnaire sought information such as the type and severity of handicap, intelligence, attainments and attitudes, and the head teacher's opinion on the suitability for further education, training or employment. A similar, but shorter, questionnaire was also sent to the appropriate careers officers. The final sample comprised 1,373 children. The follow-up study took place at the beginning of 1971. Careers officers were asked to interview the school leaver, the parents and where appropriate the employer. Interviews were conducted with 788 (58%) of the leavers.

Of the 7,094 handicapped leavers only 89 were partially sighted Fortunately all formed part of the final sample and, subsequently, a total of 54 were interviewed in the follow up.

Thirty-eight of the 54 partially sighted leavers had experienced "open" employment and one leaver "sheltered" employment in the period since leaving school. Indeed almost one third of these individuals were still employed in their first job after one year. Nevertheless, 23% had been unemployed for a period of at least six months.

Five youngsters with partial sight were considered to be employed in occupations well below their capability. In addition, it was estimated that the majority had been employed at some stage in work which was both relatively unskilled and poorly paid. No individual was found to be in employment leading to a professional qualification and only one boy had commenced an apprenticeship on leaving school. The average number of employments since leaving school was 2.4 per person.

Prior to leaving school, six partially sighted leavers had been considered to be either suitable for sheltered employment or unemployable. Three of the six leavers were unemployed at the time of the interview, two were employed in a warehouse and at a skilled laboratory job respectively, and one was in sheltered employment.

Fifty-seven per cent of the partially sighted (approximately 30 individuals) had received some form of further education or training. Of these, 24% had attended schools or colleges of further education, 13% specialised residual courses and 15% industrial rehabilitation units or assessment centres. Five per cent were categorised as having received "other" types of education or training. Tuckey et al found a marked discrepancy between those individuals considered suitable for further education and/or training, and those who had actually received such courses. Only 47% of the partially sighted considered suitable for further education and training and 44% thought suitable for training only had, in fact, undertaken such education.

Wilkes (1961) interviewed a group of partially sighted adolescents to determine their opinions and experiences after leaving school.

Her sample comprised 32 subjects (20 males; 12 females) aged between 16 and 21 years. At the time of the interview, all individuals had left school at least one year previously. Three of the subjects had attended an ordinary school and three others had been transferred from a special school to an ordinary school. The remaining individuals had all been educated in a special day school for the partially sighted. Eleven individuals had retinal disorders, eight had myopic degeneration, six had congenital cataracts and five had nystagmus.

The remaining two individuals had corneal ulcers and ophthalmia neonatorum respectively.

Wilkes found that although many of the former pupils had enjoyed their schooling, they were reluctant to admit that they had attended a special school. The subjects felt that they had been treated differently from other children. They also sensed that the public associated special schooling with mental backwardness. Wilkes considered that the outstanding difficulty was learning how to fit into a sighted world. The adjustment necessary after leaving school was found to present particular problems for those who had attended special schools. Some subjects, in an attempt to adjust, had minimised their difficulties. It was felt that the public had no conception of the particular difficulties associated with a reduced field or low acuity. In particular, it was noted that fellow employees failed to comprehend why an apparently normal workmate needed preferential treatment.

Wilkes found that the first employment tended to be transient, particularly when the work was of an unskilled nature. At the time of the interview, however, most of the subjects claimed to be settled in their work and 75% were satisfied with their jobs. Most of the employment tended to be in shops, warehouses, garages, building sites and factories. The reasons for changing jobs were found to be varied. Wilkes concluded that employment prospects were dependent on chance factors such as attitudes of employers. She pointed out that

> " ..... with luck, a good employer, and support from his family, a partially sighted child can do very well, but there is little help to those who are not so fortunate."

Wilkes called for a study of the social and personal needs of the partially sighted adolescent and for the instigation of an after-care service to coordinate the various social, educational and medical services available to the young person.

In 1958, the British Council for the Rehabilitation of the Disabled set up a working party to enquire into the needs of physically and mentally handicapped school leavers. During this enquiry, doubts were expressed as to whether handicapped school leavers were being given the opportunity to gain employment commensurate with their intelligence and abilities. As a result, the then Ministry of Labour offered to follow-up a sample of handicapped school leavers to determine the proportion "making a reasonably satisfactory start in employment."

The subsequent investigation involved school leavers from the academic year 1954/55. This period was chosen for two reasons. It allowed a reasonable period of time for the leavers to have settled in employment and, additionally, it was a time of "good employment opportunities".

The survey concentrated on 83 areas. These were selected to include urban and rural areas and to allow for the diversity of industry. In addition, emphasis was placed on the inclusion of areas with less than the average number of available jobs. The sample consisted of all the handicapped school leavers reported by the school health service in the selected areas. A number of other handicapped individuals of similar age were also included, such as the ineducable, but employable, and those in whom impairment occurred after leaving school. The sample comprised 3,059 individuals

The records of 2,869 indivuals were examined by the Youth Employment Officers. Reports were prepared from the records of each leaver. The Youth Employment Officers considered, from inspection of the records, that five-sixths of the individuals had made "a reasonably satisfactory start in employment." The cases of the remaining one-sixth were referred for a further opinion by the Disablement Resettlement Officers (D.R.O.'s). The D.R.O.'s perused the additional information contained in the Employment Exchange records and, where necessary, carried out personal interviews. As a result, they considered that half of the referred individuals had also made a "satisfactory start".

Of the total sample, a "reasonably satisfactory start in employment" had been achieved by 2744 (96%) individuals. Four per cent of these leavers had attended grammar schools and 25% special schools. The remainder had been educated mainly in secondary modern schools. The successful individuals were placed in ten employment categories.

Seven per cent (202 individuals) of those considered to have made a "reasonably satisfactory start" in employment were partially sighted. The number of partially sighted individuals in each employment category is given in Table 4.4.

One hundred and twenty four individuals (4%) were considered to have made an unsatisfactory start in employment. Personal interviews were carried out and detailed reports prepared on all these individuals. As a result, it was found that approximately 60 youngsters were unemployed, registered for employment and regarded as suitable for ordinary work. The number of those with partial sight was not given. The distribution of handicaps amongst the unemployed was, however, similar to that amongst the satisfactorily employed. This would seem to suggest that 7% of the unemployed (ie 4 or 5 individuals) were partially sighted.

Of the remaining 64 individuals, one quarter were employed in occupations considered as unsuitable, almost a half were thought to be suitable for sheltered employment and over one quarter were considered to be incapable of "wage earning employment". The proportion of partially sighted individuals in these categories is not given.

A study of visually handicapped individuals in further and higher education was reported by Butler (1979). The survey was carried out during the years 1969-78 and covered 485 students with levels of

		%
Apprenticeships	37	18.3
Work leading to professional status	3	1.5
Clerical and office work	11	5.4
Factory work, other than apprenticeships, which is regular and stable	44	21.8
Factory work, other than apprenticeships, which is temporary or probably temporary	-	-
Distribution - regular and stable	37	18.3
Distribution - temporary or probably temporary	1	0.50
Other employment - regular or stable	62	30.7
Other employment - temporary or probably temporary	4	2.0
Sheltered workshop, e.g. Remploy	3	1.5
Total	202	100%

Table 4.4 Employment classification of 202 partially sighted school leavers followed up by the Ministry of Labour in 1960.

vision ranging from total blindness to partial sight. Butler found that 45% of the sample had undertaken courses at university, 12% at polytechnics, 11% at colleges of education and 32% at technical and other colleges. These figures, however, overlap due to the fact that many students had attended more than one type of educational establishment during the nine years of the survey. The occupations on leaving further or higher education were recorded for 104 of the partially sighted individuals. Twenty five per cent had entered the teaching profession and 22% had become social workers. Of the remaining 55 individuals, 46 were employed in 25 job categories and nine were unemployed. Butler noted, however, that very few students had entered professional employment in the industrial sector.

Two surveys of the employment situation in America were carried out by Dickey and Viecili (1972) and Clayton (1973).

Dickey and Viecili (1972) utilized a postal questionnaire to investigate the occupation and visual acuity of visually handicapped individuals placed in employment by counsellors for the blind who had undertaken the University of Southern Illinois Job Development and Placement Course. Completed questionnaires were returned by 77 of the 225 counsellors. Analysis revealed that these counsellors had placed 1733 clients in employment. The proportion and visual acuity of individuals in each employment category are shown in Fig.

Clayton (1973) surveyed 1981 employers in Maryland by postal questionnaire to determine the number of visually handicapped individuals in employment. Completed questionnaires were received from 23% (460 employers) of the sample. Analysis of these questionnaires showed that 57 visually handicapped individuals were employed in 44 job categories.

Occupational Area	Degree of Vision			
	20/200 or better	20/200 to total	Totally blind	Total Number
Professional				
Lawyer	0	0	2	2
Teacher-Public School	22	30	9	61
Teacher of the Blind	3	4	2	9
Teacher-College	0	11	1	12
Taxpayer Service Rep.	1	1	5	7
Computer Programmer	13	18	10	41
Social Work-Blindness	3	7	4	14
Social Work-Other Agency	10	19	7	36
Sub totals	52	90	40	182
Non-Professional				
Industrial	288	248	64	600
Food Service	53	61	9	123
Laundry	29	13	6	48
Hotel-Motel	23	18	2	43
Hospital	40	39	6	85
X-Ray or Photographic Technician	0	30	13	43
Clerical	67	64	29	160
Sales (Not Blind-Made Products)	70	32	7	109
Sales (Blind-Made Products)	3	26	10	39
Self-employment	79	75	37	191
Sub totals	652	606	183	1441
Total (Professional and Non-Professional)				1623
Other				110
Grand Totals	704	696	223	1733

Table 4.5 Occupational classification and level of vision of 1733 visually handicapped individuals placed in employment by 77 counsellors for the blind (After Dickey & Vieceli 1972).

A number of workers from the Danish Institute for the Blind and Partially Sighted have investigated the occupational prognosis of specific eye diseases. They have recognised that the partially sighted do not constitute an homogenous group. Warburg (1959), Jensen (1960) and Bech (1961) concentrated on progressive diseases whilst some disorders considered to be non-progressive were studied by Norn (1964; 1966; 1968).

Norn (1964) studied 71 individuals with congenital idiopathic nystagmus, aged 15 years and over, who had attended the Eye Clinic of the Institute in the years 1927-63. Distance visual acuities in the better eye, recorded at the time of the last examination, ranged from 6/60 to 6/9. Thirty-five had been educated in ordinary schools and the remainder in schools for the partially sighted. Norn found that four subjects had settled in occupations considered typical of blind persons such as upholstery and brush making. Five were undergoing training at the time of the investigation and two were "under public care of mental defectives." The remainder had been involved in normal employment covering occupations such as children's nurse, shop assistant, housewife, chemist, industrial worker and farm worker.

Norn concluded that the occupational prognosis for individuals with congenital idiopathic nystagmus was "surprisingly good." He cited a similar finding by Monrad-Frantzen (1959), who had followed-up former pupils of the Copenhagen School for the Partially Sighted. Among 35 cases in which nystagmus was the main diagnosis, he found that only one individual had been directed towards employment for the blind.

Norn (1966) carried out a similar study on 26 ocular alibinos, fifteen of whom had been educated in schools for the partially sighted. Visual acuity in the better eye at the time of the first examination ranged from 4/60 to 6/18.

Norn found that three individuals had ended up in the traditional occupations of the blind: brush-maker, telephone operator and punch - card operator, respectively. Fifteen subjects had undertaken normal employment covering occupations such as teacher, shop assistant, unskilled labourer, industrial worker, baker and accountant. The remaining eight individuals were still receiving training at the time of the study.

Norn considered that the occupational prognosis for ocular albinos was similar to that facing those with congenital idiopathic nystagmus. He concluded that :

> "...... despite ..... an appreciable visual handicap, patients with ocular albinism are to an amazing degree able to follow an employment."

These findings are similar to those of Fonda, Thomas and Gore (1971) in the U.S.A. They reported the results, by Thomas, of an investigation into the educational and vocational placement of albinos residing in New Jersey. Twenty-seven individuals were being educated in normal schools, one in a class for slow learners and seven in college. Sixteen albinos were gainfully employed and two were housewives. Fonda et al found no typical pattern to the type of employment. Examples of occupations held by albinos were: college librarian, food catering supervisor, school teacher, auto mechanic, shipping clerk, office boy, stenographer, cook, factory hand, beautician, farmer, aircraft design engineer, special education director and vending stand operator.

Fonda et al considered it might be

> " ..... surprising to some ..... (that)... highly trained and educated albinos are able to find professional employment and to perform duties one usually associates with a need for normal vision ....."

Norn's (1968) study examined the occupational prognosis of individuals with achromatopsia. His sample, selected in the same manner as his previous studies, consisted of nineteen subjects. Fifteen individuals had vision in the better eye, of less than or equal to 6/60. Vision in two cases was a good 6/60 whilst in the remaining two individuals it was 6/24 and 6/9 respectively. Seven of the nineteen subjects had attended a normal school.

Norn found that three individuals had employment as a brush-maker, paint-brush maker and telephone operator. A further three subjects were still receiving training at the time of the study. The remaining individuals were all employed in 'open jobs'. Occupations included factory hands, clerk, housewife, housemaid, poultry-farm assistant and shipping. Norn concluded that the occupational prognosis for those with achromatopsia was remarkably good despite the accompanying severe reduction in vision.

Reviewing his three studies, Norn considered that occupational prognosis was most favourable in congenital idiopathic nystagmus, less so in albinism and poorest in achromatopsia.

Warburg (1959) surveyed the occupational progress of 74 individuals with excessive myopia who had been examined at the Danish Institute in the years 1925-1957. Individuals attending school at the time of the investigation were excluded from the study.

The study investigated the occupations of patients who, as pupils, had been trained under the auspices of the Institute. It also examined the employment of individuals immediately prior to their qualification for welfare benefits in later life as a result of deteriorating vision. The subjects in the sample were grouped into three categories; those with mental disturbances, those who had received training or rehabilitation and those who did not wish for rehabilitation.

Thirteen individuals were considered to have "mental afflictions". Ten of these were mentally retarded and three were psychiatric cases. Visual acuity in the better eye at the time of admission ranged from 3/60 to 6/18. Of the ten retarded individuals, four were admitted without previous employment and four had been agricultural workers. Of the remainder, one had been in domestic service whilst the other had been studying book binding. One individual was retrained in weaving and two in brush making. Two subjects went into domestic work and one into an apprenticeship. Three patients were considered untrainable.

The second group, comprising 37 individuals without mental disturbances, had received training or rehabilitation. Twenty-seven had been unable to continue their original occupation and ten were admitted after leaving school. Approximately 30% of the group were aged 36 years or more at the time of the first examination. Visual acuity in the better eye at the first examination ranged from light perception to 6/9. Of the 27 individuals unable to continue in employment, 80% had been taught traditional blind persons' crafts. The remainder, with one exception, were trained in the more modern occupations for the blind. The vocational training of the ten former pupils was in marked contrast to the rehabilitation of their more elderly peers: only two individuals had received training in the traditional occupations.

The third group comprised 24 individuals who had been examined at the Institute but did not wish to be rehabilitated. Twelve of these individuals were no longer gainfully employed whilst the remainder still continued in their original occupation. Fifty one per cent of the group were aged 36 years or over at the time of the first examination. Visual acuity in the better eye, assessed at this examination, ranged from perception of light to 6/12.

Warburg compared the data from the subjects in his latter two categories. He found that it was

> "...characteristic that within the same types of job some are forced to cease work whilst their eye sight is still better than that of others."

Warburg additionally cited the pertinent results from the studies reported by Monrad-Frantzen (1959) and Delthill (undated). Monrad-Frantzen had followed up former pupils of the Copenhagen School for the Partially Sighted. Of the 22 excessive myopes, 17 had undertaken normal occupations. Delthill had described the vocational guidance of 48 individuals carried out by Hollier-Larousse in Paris at L'Institute National d'Etude du Travail et d'Orientation Professionelle. Warburg listed the suggested occupations for each of the 17 myopic subjects. Perusal of the list suggests that at least 15 of the suggested occupations required the use of residual vision.

Warburg, in conclusion, stated that there was

> " ..... good reason to maintain a very optimistic view concerning the vocational guidance of these patients ..... "

He suggested that unskilled labour and agricultural work were the most suitable occupations for males and that domestic service and cleaning were well suited for females. Warburg also concluded that when vision deteriorated to an extent that prevented normal employment, the chances of rehabilitation were similar to other types of acquired blindness.

In 1961 Bech reviewed the occupational prognosis of 107 individuals with chronic iridocyclitis seen at the Danish Institute. Visual acuity recorded in the better eye at the initial examination was less than 6/60 in 74% of the cases. Thirty six per cent of the sample had developed the disease before the age of ten years.

Twenty-five of the 107 individuals were found to be in normal employment. Bech considered that clerical work and telephone operating were "very suitable occupations" and that physiotherapy was also a suitable occupation for females. Fifty-five per cent of the sample were employed in typical occupations for the blind and additionally supplemented by a disability pension. Twelve per cent were "without any occupational possibilities".

Bech concluded that the social prognosis of the disease

" ..... cannot be said to be wholly bad ..... "

Jensen (1960) reviewed 133 cases of primary buphthalmos seen since 1882 in the Eye Clinic of the same Institute. He excluded 44 cases from his sample; the majority of whom were under 16 years of age. One third of the remaining 89 subjects were under 30 years of age and two-thirds under 50 years. The disease was bilateral in 87 cases. Of the two unilateral cases, the second eye of one individual was normal, whilst in the other subject it had phthisis following keratomalacia. Only 16 patients had attended normal schools. Visual acuity, at the time of the first examination was less than or equal to 6/60 in 83% of the 89 individuals, total blindness being present in almost one quarter of the sample. The visual acuity ranged from 6/60 to 6/6 in the remaining 15 subjects. Of the 74 individuals who received subsequent examinations, 85% had visual acuities of less than or equal to 6/60 (total blindness in 60% of the cases) at the time of the last examination.

Jensen assessed the progress of the disease in terms of visual acuity, visual field and intra-ocular pressure. He considered that the condition had remained unchanged in 32 individuals during an observation period which ranged from 2 to 40 years. The condition had deteriorated during the same period in 31 individuals (i.e. one of the three measurements had become worse). Improvements were found in six patients. The remaining 20 cases could not be assessed.

Jensen determined the number of individuals who had remained in the employment "which had primarily been recommended" and the number who had changed occupations. Forty-seven subjects had remained in their primary occupation whilst 34 had changed to other types of work. Of these latter individuals only 11 had changed because of "visual considerations".

Twenty-eight subjects (31%) were employed in the "old" traditional occupations of the blind. Seventeen individuals were either musicians or piano tuners. Eleven per cent were employed in the more modern occupations for the blind such as telephone operator, clerks or physiotherapy. Twenty-seven individuals were employed in normal occupations such as gardening or farming, domestic work, unskilled work, shop assistant and compositor.

Fonda, Thomas and Gore (1969) reported on the visual, educational and vocational attainments of 70 patients, aged between 7 and 22 years, visually impaired as a result of congenital cataract. Fifty-nine of these patients functioned with their aphakic eye.

Fonda et al determined the educational or vocational attainment in 57 of the 70 patients. Thirty-nine of these were in education, 13 were gainfully employed and 4 were unemployed. Of those in employment, 3 patients were professionally placed in the law, teaching and computor programming. The non-professional occupations included vendors, factory hands, a trucker's helper (sic) and an operator of an amusement ride. Two subjects were employed in workshop facilities.

Fonda et al found no pattern to the vocational attainment of these patients and concluded that the choice of occupation should not be influenced by this particular disorder. Fonda et al however, considered that the presence or absence of additional physical or mental handicap was an important factor in determining the future prospects of these patients.

5 RATIONALE FOR THE RESEARCH

5.1 Aims of the study

The study, as already shown, developed as a direct consequence of the difficulties experienced by teachers, clinicians and careers officers in placing partially sighted school leavers in appropriate employment. The long term aim of the research, therefore, was to devise a means by which successful occupational placement could be repeatedly achieved. The more immediate objectives, however, were twofold: to produce a technique for the measurement of visual ability and to investigate the additional factors determining successful employment of the partially sighted school leaver.

5.2 Outline of the study

The overall design of the study had been determined in the early negotiations with the DH.S.S. Indeed, the project itself was seen as the logical continuation of the previous work carried out in the Department of Ophthalmic Optics, University of Aston in Birmingham (Green, 1976).

The study was designed to be longitudinal in nature. The first stage of the work involved an investigation of visual ability, using partially sighted pupils in their final year of schooling. It was envisaged that the investigation would necessitate development work in the laboratory and field work in the schools for the partially sighted. The laboratory work involved the design and construction of equipment and the development of the accompanying techniques of examination. The field work covered the updating of clinical data and the evaluation of the prototype techniques for investigation of visual ability. The second stage of the project comprised a follow-up study, by questionnaire, to elicit the subsequent occupational success of each individual and the non-visual aspects influencing employment. After completion of these two stages, it was intended that the visual ability data and the non-visual data would be compared with the assessment of occupational success.

The subjects for the study were to be selected from the captive groups available in the special schools for the partially sighted. In particular, it was envisaged that much of the study would be centred on Exhall Grange School, Coventry. This school was considered to be particularly suitable as it has the largest number of partially sighted pupils in the United Kingdom (Marshall, 1978b). Additionally, the school has the advantage of being located within a reasonable travelling distance of the University of Aston in Birmingham. The study was designed also to include pupils from the West of England School for the Visually Handicapped, Exeter and the Joseph Clarke School, London. It was anticipated that a sample size of between 75 and 100 partially sighted subjects would be required for the investigation. In addition, information would be collected, where appropriate, from control groups of normally sighted individuals.

It was intended to commence the study with the field trials of Green's visual ability tests (Green, 1976). The subsequent approach to the visual ability research depended upon the results from this initial trial.

It was hoped that, in this way, the study would reveal some of the factors influencing successful employment of the partially sighted school leaver. Such information would then be of benefit to those teachers, careers officers and clinicians involved in the occupational placement of the visually handicapped.

It was acknowledged, that a number of problems were inherent in the design of the study. The investigation, by concentrating solely on the special schools for the partially sighted, would ignore the large number of pupils receiving education alongside their sighted peers in normal schools. The problems of actually locating such partially sighted pupils and the logistics of their subsequent examination were considered to be beyond the limited resources of the study. Consequently it was accepted that any findings from the study would only be representative of individuals who had attended special schools for the partially sighted.

The use of a postal questionnaire was a further weakness in the design of the study. The application of such a technique, dependent as it is on the use of vision, seemed likely to increase the chance of obtaining an even lower response rate than that often encountered with questionnaires sent to the normally sighted.

It was also realised that the longitudinal nature of the study would inevitably mean that analysis of occupational success would be carried out using visual ability and other data obtained some twelve months earlier.

It was envisaged that the visual ability field work would be undertaken in a number of schools for the partially sighted. The fact that the examination of the youngsters would take place under differing conditions was a further limitation in the design of the study. It was considered, however, that if careful attention was paid to the luminance levels, the variance due to the difference in the various surroundings would not necessarily invalidate the conclusions that could be drawn from the statistical analysis.

An alternative approach to the research had to be ruled out at an early stage owing to the limited manpower available. This approach involved occupational visual task analyses being carried out on partially sighted individuals already in employment. This procedure would have enabled a taxonomy to be compiled of the visual and other characteristics necessary for various occupations. It was considered that, in the long term, this approach would probably be the most beneficial. The anticipated time and difficulty involved in obtaining a sufficiently large sample size was thought likely to prove unacceptable and the costs prohibitively high.

5.3 Procedure

The detailed aspects of the experimental design were determined as the study progressed. Certain decisions were made prior to the commencement of the practical work, whilst others were implemented as a result of experience gained in the field.

It was decided to conduct the visual ability investigations on final year pupils from the three academic years 1976-79. The subsequent follow-up of each academic year would then take place approximately one year after the individuals had left school.

It was agreed that the statistical analysis of the data should be undertaken largely by computer techniques. Occupational success would be the dependent variable with the visual ability and other data being regarded as independent variables.

The primary technique for analysis would be correlational analysis. This would enable a multiple predictor approach to be used in the investigation of occupational success.

The field trials of Green's visual ability tests revealed a number of limitations in design. As a result, it was decided to abandon any further work on these tests and to concentrate the research on the more fundamental aspects of visual ability.

Several points, appropriate to the overall design of the study, were noted during the field trials of Green's tests. In particular, the trials highlighted the difficulty of obtaining sophisticated visual measurements from a visually impaired population. The necessity for the pupils to forego lessons in order to act as subjects was a further limitation. The latter aspect was of considerable importance as most pupils were in their C.S.E. or G.C.E. examination year. Consequently, it was recognised that a feature of the subsequent techniques for investigation of visual ability should be the rapid collection of accurate and repeatable information.

It was also clear from this early work that it would be impossible to adopt a complex experimental design for the investigation of visual ability. This was largely due to the problem of working around the restrictions imposed by school routine. In addition, the unpredictable absenteeism of the pupils was a further hindrance to experimental design.

The most obvious starting point for the resumption of the visual ability research was considered to be the assessment of visual impairment. This decision was justified on the grounds that visual impairment was thought to be the precursor of visual ability (See Fig 3.1).

It was decided to assess visual impairment in terms of visual acuity, visual fields and colour vision. In addition, it was agreed to investigate performance on a complex visual task: the ability to correctly resolve a moving target was considered appropriate as it represented a task more closely related to the everyday visual environment. Throughout the investigations, special emphasis was placed on the development of repeatable and speedy methods of assessment. Some of the methods adopted in the study made use of commercially available instruments and equipment whilst others necessitated the construction of special apparatus. Each method was developed and validated in pilot studies on samples from Exhall Grange School, before being subsequently used in the assessment of pupils from other schools. The development of such techniques was a continuous exercise; consequently, during the three years of field work, varying numbers of pupils were assessed with each method.

As time went by, the research gradually took on a distinctive pattern. Visual ability investigations were carried out at the schools during term time, whilst during the school holidays, results were analysed , equipment modified, designed and built.

Two limitations were present in this approach to the investigation of visual ability. The limited manpower inevitably meant that the data from the various methods of assessment was obtained over many months. Consequently inter subject variation existed within any one method as a result of the differing times at which data was collected. In addition, an intra subject variability arose because of the impracticality of collecting, on one occasion, the required data from the various methods of assessment.

As the study progressed, it became apparent, from discussions with teachers and the pupils themselves, that a notable proportion of partially sighted school leavers entered some form of further education or training. Indeed, it was realised that the acquisition of the envisaged sample of 75-100 individuals in employment would be a difficult task. In addition, it was felt that this sample size might prove to be insufficient for isolating the numerous variables considered likely to influence visual ability and occupational success. In an attempt to overcome these problems, it was decided to augment the sample in two ways. The investigation was extended to include the examination of individuals from two other schools for the partially sighted; whilst use was also made of the information available in the records of those attending other similar schools. It was considered necessary, with the manpower and monies available, to limit the study to the schools for the partially sighted in England. The two additional schools, Holmrook School, Liverpool, and Derby School, Preston, were chosen as each had a large number of final year pupils. In the selection of these schools, consideration was also given to obtaining a representative sample of pupils from the various regions of the country. Information on final year pupils was obtained from the records in eight other schools for the partially sighted, namely: George Auden School, Birmingham, East Anglian School, Gorleston-on-Sea, Nansen School, London, New River School, London, St.Vincent's School, Liverpool, Shawgrove School, Manchester and Temple Bank School, Bradford.

The enlargement of the study in this manner created a number of additional sources of error. The problem of inter and intra subject variation was exacerbated by the examination of pupils from two further schools. The reliance on data obtained from records was a further limitation in the design of the study, such information was not only "second hand" in nature but also dated in varying degrees.

Progress in the study was hindered by a number of problems. The majority of these arose from the need to carry out the visual ability investigations actually within the schools for the partially sighted. The distance of the schools from the University of Aston and the organisation involved in transporting and setting up the necessary equipment resulted in the loss of a substantial amount of time. The limitation of school hours, holiday and examination periods was a further problem. In addition, the clinical rooms used in the schools were often required by visiting medical and para medical personnel. Progress was particularly retarded by the lack of sufficient technical assistance for the construction of equipment. In contrast, the enthusiastic co-operation of the pupils , head teachers and teachers was of considerable benefit to the study.

6 COLLECTION OF BASIC CLINICAL AND BIOGRAPHICAL INFORMATION

6.1 Methods

The collection of basic clinical and biographical information on each youngster was considered to be an essential first stage of the investigation.

The clinical data was obtained in two ways. It was primarily gathered from the existing school records and, in the case of youngsters taking part in the experimental work, augmented by an up-to-date ocular and refractive examination. The records were inspected with the permission of the headteacher at each school involved in the study and, where necessary, with additional clearance from the school medical officer or consultant ophthalmologist. The requisite data was obtained in particular from the school ophthalmic records and from Form B.D.8 - the application for admission to the Blind or Partially Sighted Registers. It was additionally supplemented by information extracted from Form 10.M. - the school medical record. Information was gathered from these records on, for example, the primary and secondary ocular disorder, the age at onset of such disorders, the status of the visual field, the visual acuity, the refractive error and the date and type of registration.

The biographical information was obtained from the school educational records and included, for example, the home address, the date of admission to the school, the previous schooling and the type, date and value of the intelligence quotient.

The collection and use of clinical material in this manner was considered to be the only suitable approach commensurate with the constraints of time and available manpower. It was recognised, however, that the method was open to criticism in that the ophthalmic information contained in the school records was compiled by various clinicians over differing periods of time. Indeed, in discussing the purposes, accuracy and effective uses of the Blind Register, Brennan & Knox (1973) point out that there is no regular cross checking of standards between different ophthalmologists. This view is also in agreement with that of Bryars & Archer (1977) who criticise the use of "second hand data" in relation to studies determining the prevalence of visual impairment. They consider that surveys which incorporate a substantial amount of such data have "only limited authority".

It was considered essential that the youngsters taking part in the visual ability experimental work should receive an up-to-date refraction.

The methods used for the refractive examination of the youngsters were based upon the recommendations of Fonda (1970), Faye (1976), Mehr & Fried (1975) and Wolffe (1976). The examination included both retinoscopy and subjective refraction; the emphasis placed upon each of the two techniques during the examination varied according to the individual clinical circumstances.

Retinoscopy was routinely undertaken at a standard viewing distance of 2/3m.,but reduced viewing distances were used whenever necessary. Subjective refraction was carried out using a Landolt ring chart. The observation distance, determined by the youngsters' level of acuity, usually varied between 6m. and 1.5m. Appropriate modifications were made to the spherical correction in order to compensate for these reduced viewing distances. The spherical component of the refraction was assessed using bracketing techniques

p.99

initially of +2.00DS/-2.00DS and then of +1.00DS/-1.00DS combinations (Wolffe 1976). The astigmatic correction was checked with the aid of a +1.00/-1.00 crossed cylinder. In individuals exhibiting a marked difference in acuity between the two eyes, the subjective refraction was first carried out on the better eye. In cases of eccentric fixation, both the retinoscopy and the subjective refraction were undertaken along the habitual direction of gaze.

The use of a cycloplegic, although considered desirable, was ruled out at an early stage of the project due to the potential disruption to the youngsters' schooling.

The accuracy of the refractive technique cannot be determined in the absence of an accepted clinical standard for comparison. Fonda (1970), however, maintains that an error of 1.00D in the spherical correction, or of 2.00D in the cylindrical correction, is not appreciable to patients with an acuity of 20/200 or less. Some indication of the potential tolerance in the accuracy of the refractive technique can also be gained from various clinical opinions. Mehr & Fried (1975), for example, consider that large cylindrical corrections can frequently be found which do not improve acuity and, as a result, can consequently be ignored. This opinion is also held by Bier (1960) and Faye (1970), with the former authority maintaining that cylinders of 1.00D to 1.50D at distance and 2.00D to 3.00D at near can be disregarded provided a reduction in acuity does not occur. Faye (1976) similarly considers that astigmatic errors should only be corrected if the patient reports improvement at near or with a telescopic lens. In contrast, Faye (1970) believes that when dealing with cases of aphakia secondary to congenital cataract and also in myopia, every attempt should be made to establish the full correction, including the exact axis and degree of cylinder.

7. VISUAL SEARCH

7.1 Introduction

In 1976, Green described the development of two tests designed to measure visual ability. The tests were both similar in nature and were based on visual search.

The process of visual search involves a sequence of fixations on certain objects within a defined visual field. Visual search in the normally sighted has been extensively documented and many factors are known to be involved in this function. Some of these factors have been discussed, for example, by Gottsdanker (1960). Green's tests were devised around one particular factor, the competition determinant. This aspect involves the situation in which a target is clearly distinguishable from the immediate background, but is difficult to detect because it can be confused with other non-target stimuli that are also present in the search area (Bloomfield 1975). The target may differ from the non-target in terms of colour, contrast, shape and size. Other factors which affect the detection task are the heterogeneity, number, density and distribution of the non-targets and the size of the search area.

Green's tests were based on the fact that search time, the time taken to locate and identify the target stimulus, increases with increase in the number of non-targets (Eriksen 1955; Erickson 1964; Smith 1962; McGill 1960). This finding has been found to be valid irrespective of whether, for example, the target stimulus is different in shape from the non-targets (Brody, Corbin & Volkman 1960; Johnston 1965), is a different digit in a display of differing numbers, or is a letter pair contained within other letter pairings (Ciskova 1967). In addition, search time has been found to increase with increase in the heterogeneity of the non-target stimuli (Eriksen 1953) and decrease with reduction in the size of the targets compared to the non-targets (Bloomfield 1970). Green's tests were designed to measure the relationship between response time and display complexity.

The targets for Green's Test A consisted of annuli bisected along their diameter by a continuous line. The non-targets were annuli of an identical size containing a vernier break along the diameter (Fig. 7.1). The targets for Test B were the annuli containing a vernier break and the non-targets the annuli with the continuous line. The latter test thus required a critical discrimination of the targets. Both the targets and the non-targets in each test were black on a white background.

Each test consisted of 42 displays. The displays were arranged in 7 distinct groups containing 10, 15, 20, 25, 30, 40 and 50 non-targets respectively. Each group comprised six displays containing 0, 1, 2, 3, 4 and 5 target stimuli among the non-targets. The orientation and position of both target and non-target stimuli were randomly distributed in each of the displays. The displays in both tests were presented to each subject in a random, but identical sequence.

The displays were presented in the form of 35 mm transparencies and, in the case of partially sighted youngsters, were front-projected from a distance of 3m. In the case of normally sighted observers, the displays were projected and viewed from a distance of 6m. The display field measured 75 x 50 cm. at this distance. The size of the vernier break within the target stimulus was equivalent to two minutes of arc when the display was projected and viewed from 6m.

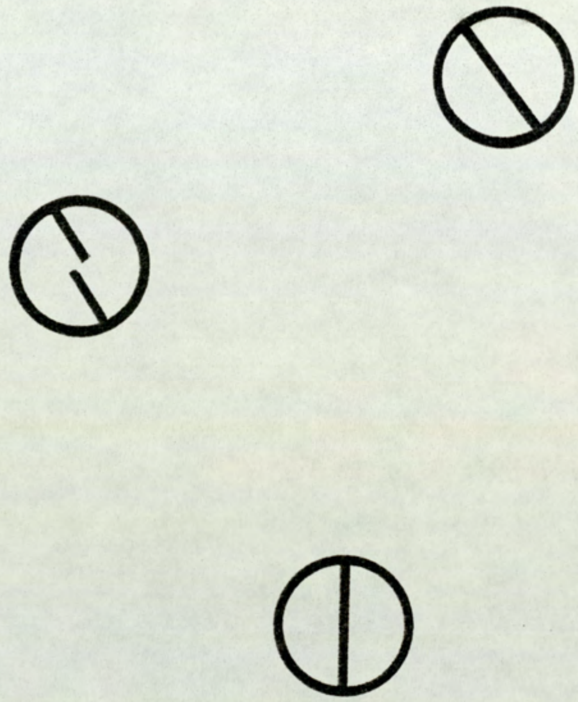


Fig. 7.1 Target and non-targets for Green's visual ability tests.

The thickness of the annulus and bisector was also equivalent to 2' of arc at this distance. The display field measured 135 x 90 cm. at the 3m. projection distance. The partially sighted youngsters viewed the display at a threshold distance which permitted correct resolution, in 4 out of 5 trials, of a stimulus containing a 1 minute of arc vernier break at 6m. Green states that such youngsters usually viewed the display from a distance of 3m. or less.

The apparatus for the tests consisted of a projector linked to a timing mechanism which in turn was linked to a printer. The examiner initiated the display. The timing mechanism was activated by the projector when the shutter was in the fully retracted position. It was terminated by the subject using a hand held button, on completion of the particular visual search. The time taken to search the display and make the appropriate response was recorded by the printer. A positive sign was printed for a correct response alongside the time and a negative sign for an incorrect response. The presentation of the succeeding display was then initiated by the examiner.

The mean search time was plotted against the number of non-targets The linear regression equation describing the relationship between mean search time and display complexity was calculated by the method of least squares. The number of errors made by the observer was also recorded.

Green carried out a control study of each test using 5 normally sighted observers. A study of the two tests was also undertaken on a sample of 16 partially sighted youngsters.

Green calculated the regression characteristics for each of 5 normally sighted observers. He obtained a mean and standard deviation for the slope, based on these 5 observers, and from these values he calculated the maximum limits of the gradient expected in the normal population. He similarly calculated the mean number of errors and the accompanying standard deviation made by the normally sighted subjects and determined the maximum number of errors expected in the normal population. Green then analysed the response characteristics of the partially sighted and compared the results with those previously calculated for the maximum limits in the normally sighted population.

7.2 Field Trials of Green's Tests

In view of the limited nature of the previous field trials of these tests, it was considered desirable to carry out a more extensive investigation before proceeding further in the research. Indeed, this decision had previously been agreed with the sponsors of the study.

The two tests were, therefore, given further field trials on 40 final year pupils from the 1976/77 academic year at Exhall Grange School. The experimental procedures were those described by Green with the exception that the times and number of errors made by each subject were recorded manually instead of by printout.

The luminance of the background and the contrast between stimuli and background were not specified by Green in his report. Both factors, however, are known to affect search performance (Fry 1962; Townsend 1958). The tests were consequently undertaken in normal room lighting. The screen luminance was 22 cdm^{-2} and the contrast between the target stimuli 57.1%. Half the sample were examined with Test A followed by Test B. The order of the tests was reversed for the remaining subjects. The second of the tests was administered on a different day.

The threshold viewing distance was determined for each subject. A slide containing a display of 5 target and 20 non-target stimuli was then demonstrated to the subject. The youngster was told to count the number of target stimuli on each slide and to press the hand-held button and call out the answer immediately the search had been completed. As recommended by Green, the subject was instructed to be as quick and as accurate as possible. The youngster was informed that the displays each contained between 0 and 5 stimuli. Five displays were then presented as a practice session. The subject was informed of any errors that had been made.

As a result of the field work, a number of errors were discovered in the basic design of the two tests. The threshold viewing distance was found to vary with the level of visual acuity. Of the 40 partially sighted pupils examined, 38 viewed the display at a distance of less than 3m. Most of the subjects with an acuity of less than 6/60 viewed the display from 0.5 m. whilst in some cases, the viewing distance was as little as 20cm. Indeed, subjects with a short working distance had to walk in a parallel direction to the screen in order to complete the search satisfactorily. In these cases, the front projection system created a shadow of the subject on the screen which impeded the search. It was calculated that the actual field searched by an observer at 20 cm. was 225 times as large as the field searched at a distance of 3m. The testing procedure was also found to be unsuitable for youngsters with poor acuities who were confined to a wheelchair. These particular problems were not reported by Green in his pilot study. The discrepancy between the findings from the two studies may well have been due to the differences in the level of distance acuity possessed by the youngsters in the two samples. Indeed, of the 16 partially sighted subjects in Green's sample, 8 had acuities of 6/24 or better. In contrast, the corresponding figures for the current sample show that only 12 of the 40 youngsters achieved this level of acuity.

The scoring procedure adopted by Green was dependent upon the time taken to search each display. The number of errors made during each particular search was considered as a secondary aspect. The precise manner in which the response data was treated is, however, not clear from the report. In a preliminary study on normally sighted individuals, Green had plotted the regression characteristics between search time and display complexity using only those times for which a correct response had been recorded. Green also adopted this technique in a similar early study involving partially sighted youngsters. The results from the current investigation clearly show the inadequacy of this approach. The mean error score for the 40 observers on Test A was 14.78 and the standard deviation 8.37 The modal error score was 13, with the maximum number of errors being 36 and the minimum 2. A similar finding was evident for the results of Test B. In the vast majority of cases, therefore, the mean response time for each of the 7 complexity data points would have thus been based on a differing number of (correct) observations. Indeed, this point is clearly illustrated by the results of two youngsters from Test A: subjects S.McD. and P.H. In the case of youngster S.McD., with a total score of 11 correct responses out of a possible 41, the mean score for the display containing 10 non-targets would have been based on one correct observation. In contrast, the scores for the 15, 20, 25 and 30 non-target displays would have each been calculated from 2 correct answers, whilst those for the 40 and 50 display levels would have been based on only one observation respectively.The mean score exhibited by subject P.H. for the 10 non-target level would have been calculated from all 6 correct observations. The mean values for the 15, 25 and 30 display levels would have each been determined from 4 correct answers whilst those for the 40 and 50 non target displays calculated from 2 correct scores only. The individual scores for the two subjects are shown in Figs. 7.2 and 7.3.

Inspection of Green's data shows that the mean error score for his 16 subjects on Test A was 14.31 with a standard deviation of 9.44. The modal error score was between 10 and 13 with the maximum number of errors being 34 and the minimum 3. Similar results are found for the 12 youngsters assessed by Green on Test B: a mean of 12.83 a standard deviation of 6.23 and a mode of 13. Indeed, in his preliminary study of partially sighted observers, Green found that the numbers of correct observations were insufficient for calculating the regression curve. He consequently utilized a straight line joining the mean response time for each of the two extreme levels of display complexity.

It is also possible that Green based the mean response time on both the correct and incorrect observations for each display complexity. In view of the number of errors made by the youngsters,this second approach would also seem to be equally unsatisfactory. The results are listed in Tables 7.1 and 7.2.

The design of either scoring procedure thus did not seem to adequately allow for the differentiation between those subjects who completed the search making many errors, and those making fewer errors.

It was suggested that a more suitable experimental design would be the measurement of the time required to make a correct search or the number of search errors made over a given period of time. The

NUMBER OF TARGETS

DISPLAY COMPLEXITY	0	1	2	3	4	5
10	x	x	x	x	√	x
15	√	x	x	x	√	x
20	√	x	x	x	√	x
25	√	x	x	√	x	x
30	x	√	√	x	x	x
40	x	√	x	x	x	x
50	x	x	√	M	x	x

Fig. 7.2 Accuracy of Visual Search for Subject S.McD. (√ indicates a correct response; X an incorrect response).

NUMBER OF TARGETS

		0	1	2	3	4	5
	10	√	√	√	√	√	√
	15	√	√	√	x	x	√
	20	√	√	√	x	√	√
DISPLAY COMPLEXITY	25	√	√	x	√	x	√
	30	√	√	√	x	√	x
	40	√	√	x	x	x	x
	50	√	x	√	M	x	x

Fig. 7.3 Accuracy of Visual Search for Subject P.H. (√ indicates a correct response; X an incorrect response).

SUBJECT	NUMBER OF ERRORS	SEARCH TIME (secs)	SUBJECT	NUMBER OF ERRORS	SEARCH TIME (secs)
S.McD.	30	635	E.E.	21	496
A.S.	11	624	R.E.	16	536
J.W.	22	428	D.O'D.	14	723
P.H.	15	558	D.H.	5	643
S.F.	18	868	A.B.	3	548
N.R.	2	548	N.A.	31	729
P.W.	6	702	D.S.	22	858
P.L.	8	1113	A.M.	13	541
V.C.	6	652	A.P.	6	690
G.M.	13	527	L.L.	14	480
A.S.	32	623	L.H.	11	353
N.T.	9	476	L.P.	5	665
E.L.	18	449	D.B.	13	397
C.T.	15	668	S.E.	8	1055
A.M.	17	660	I.B.	23	576
M.T.	21	623	J.N.	5	613
J.B.	11	653	M.P.	12	580
D.D.	6	436	B.G.	16	655
S.McN.	15	445	S.P.	16	433
J.M.	26	387	R.G.	36	852

Table 7.1 Number of errors and total search time for 40 partially sighted youngsters on Green's Test A.

SUBJECT	NUMBER OF ERRORS	SEARCH TIME (secs)	SUBJECT	NUMBER OF ERRORS	SEARCH TIME (secs)
S.McD.	13	419	E.E.	7	385
A.S.	21	448	R.E	14	793
J.W.	30	336	D.O'D.	16	667
P.H.	11	551	D.H.	18	535
S.F.	15	576	A.B.	9	468
N.R.	4	491	N.A.	20	535
P.W.	8	606	D.S.	24	751
P.L.	9	855	A.M.	14	517
V.C.	7	644	A.P.	19	587
G.M.	4	523	L.L	15	438
A.S.	16	628	L.H.	3	301
N.T.	19	536	L.P.	9	707
E.L.	14	445	D.B.	18	376
C.T.	14	579	S.E.	9	814
A.M.	22	487	I.B.	30	468
M.T.	10	478	J.N.	15	516
J.B.	16	569	M.P.	4	714
D.D.	8	341	B.G.	17	534
S.McN.	18	357	S.P.	9	711
J.M.	25	358	R.G.	31	594

Table 7.2 Number of errors and total search time for 40 partially sighted youngsters on Green's Test B.

former approach, for example, is often used in experiments utilizing visual search (Neisser 1963; Neisser & Beller 1965; Drasdo & Murray 1978).

It was decided, as a result of the field work, to forgo any further work on the two tests. It was felt that the errors in design were of a sufficient magnitude to necessitate substantial modifications to the two tests. Consequently, it was thought that the time for such an undertaking could be more profitably spent in the investigation of other aspects of visual ability and the production of new performance tasks.

8 VISUAL ACUITY

8.1 Rationale for the investigation of visual acuity

An assessment of the distance visual acuity of the partially sighted youngsters was considered to be appropriate for several reasons.

The functional integrity of the eye is most commonly measured in terms of distance visual acuity and this practise has received much attention over the years, useful reviews being those of Westheimer (1965) Riggs (1966) and Rubin (1970). Although distance Snellen acuity merely expresses the capacity of the eye to recognize black letters on a white background,it is almost routinely used to describe the sighted capability of the visually handicapped. The validity of this practise has been questioned in recent years on the grounds that the measurement alone, does not provide a reliable indication of the ability to use and perform with residual sight. Nevertheless, with the exception of the study reported in 1973 by Carroll & Hibbert, and described earlier (Section 3.2), there has been no systematic investigation of the relationship between distance Snellen acuity and performance with residual vision. Consequently, the direct influence of visual acuity on visual ability is unknown as is the extent and importance of any interactive effect involving such acuity.

Distance visual acuity is also frequently used in the consideration of the occupational potential of the visually handicapped. The relationship between distance acuity and occupational performance among this group is, however, similarly unknown.

The measurement of near visual acuity was also considered to be a relavent aspect in terms of the study. The influence of near acuity on both visual ability and occupational success is not known. Among the visually handicapped, however, the acuity at near is sometimes different from that recorded at distance (Section 3). It was hypothesized that performance with residual vision might be correlated more closely with near acuity than with distance acuity. Indeed, Faye (1976) points out that reading acuity, in particular, has important functional implications in that it expresses the individual's ability to read. The work of Carroll & Hibbert (1973) (Section 3.2) is also in accord with the belief that near acuity might provide a better indication of both visual ability and occupational success.

The aim of the visual acuity investigation was therefore considered to be twofold; to develop suitable techniques for recording both the distance and the near acuity of the partially sighted youngsters and to relate the findings to the subsequent level of occupational success.

8.2 Rationale for the methods of investigation

The techniques and procedures adopted for determining the distance and near acuities were the result of considerable discussion amongst the research workers involved in the project.

Two distinct methods of investigation were used. One method involved measuring distance and near acuity in the conventional manner using commercially available letter charts. It was suggested that if such a measure of acuity proved to be a reliable indicator of job capability, the necessary instrumentation and techniques would then be readily available and familiar to those involved in the management of the partially sighted youngster. The second method for measuring distance and near acuity utilized apparatus and techniques specifically designed for the assessment of the visually handicapped.

It was hoped that by eliminating some of the limitations associated with the conventional type of measurement, the influence of visual acuity on both visual ability and job capability could be more accurately defined.

8.3 Rationale for the techniques used in the conventional acuity assessment

Visual acuity can be measured under many different experimental conditions; a useful summary is that of Riggs (1966). The principal clinical variations involve differences in the test material, any refractive correction and, when dealing with the visually handicapped, variations in the viewing distance and the use of low vision aids.

Distance acuity is traditionally undertaken at a viewing distance of 6m.(20ft). In cases where the acuity is less than 6/60, the viewing distance is usually reduced until recognition of the 6/60 letter is achieved. Some authorities advocate that, when dealing with the visually handicapped, shorter viewing distances should be used from the outset (Fonda 1970; Faye 1970; 1976). This latter approach has two distinct advantages. It permits the use of rows containing a greater number of letters and it engenders a desirable sense of achievement in the visually handicapped individual since test type can usually be read from the outset (Mehr & Freid 1975). Measurements undertaken at reduced viewing distances, when recorded on a chart containing unequal progressions in letter size, cannot accurately be related on a simple geometrical basis to those recorded at 6m. In addition, some visually handicapped individuals show a non-uniform increase in both visual acuity and visual ability with decrease in viewing distance (Lie 1977; Lederer 1978). Furthermore, variations in the format of the recorded measurement are frequently seldom understood by those involved with the visually handicapped such as teachers and careers officers. It was, therefore, decided to measure distance acuity in the conventional manner using a viewing distance of 6m. It was felt that such an approach would permit greater standardisation of experimental conditions and would yield information more readily understood by those dealing with the partially sighted. P 126

Distance visual acuity can be measured with a number of different test types under varying conditions of target contrast and illumination. Indeed, numerous test charts are commercially available for this purpose; a useful review is that of Sasieni (1976*). Indeed, the number of test charts currently available are so diverse that, as Bennett (1965) states, "they no longer provide a comparable basis for estimating visual acuity". The charts consist essentially of either upper case letters, lower case letters, Landolt rings, illiterate Es, numbers, Sheriden-Gardiner tests, pictorial symbols or the initial teaching alphabet. The upper case letters are available in non serif form and in either a 5 x 5 or 5 x 4 construction. (Many of the older charts in use have serif letters). At least 24 letters of the alphabet are represented in the various upper case test charts. It was felt that the most suitable approach would be to utilize a chart conforming to the specifications of the British Standards Institute (B.S.4274 : 1968). Such charts have previously been used for similar research purposes (Drasdo & Haggerty 1976; 1981) as they provide an accepted set of stimulus parameters. It was felt that the chart would thus ensure uniformity of measurement throughout the various schools for the partially sighted.

Under B.S. 4274, visual acuity can be measured using either Landolt

* This review has subsequently been updated by Sasieni (1981).

rings, illiterate Es or a series of 10 Snellen letters. It was felt that although the use of Landolt rings or illiterate Es might approximate more closely to the principal of equal legibility, the use of Snellen letters would aid communication with the youngsters and thus facilitate recording of acuity.

It was decided to record the acuity with the current refractive findings in situ. This approach was adopted in the interests of achieving standardised experimental conditions. It was accepted, therefore, that the proposed method would ignore the level of vision obtained either with the habitual spectacle correction or supplemented with any distance low visual aid.

The near acuity of the visually handicapped is normally measured either at a standard test distance or at the distance which permits a maximum resolution of the test material. The former measurement provides an indication of what can be achieved at the normal working and viewing distance whilst the latter permits an evaluation of the best attainable near acuity. The level of near acuity achieved must be considered in relation to the corresponding viewing distance. Indeed, Fonda (1970) points out that there is a great difference in the reading speed and the type of work that can be undertaken with an acuity, for example, of 8 point type at 2 inches and the same acuity at 16 inches. This opinion is also shared by Cunliffe (1968; 1973) who draws attention to the differences between the viewing distances used in the classroom situation and those in industry. It was therefore decided to determine near acuity at a conventional viewing distance since it was felt that the measurement would yield information more comparable with the occupational performance of the normally sighted. It was also felt that the use of viewing distances selected by the youngsters would not facilitate standardisation of the experiment and would be dependent upon such factors as the provision, use and strength of any low visual aid.

The test material for the assessment of near acuity usually consists either of reduced Snellen test type or passages of continuous prose. The selection, use and variation in near vision test types has been discussed in detail by a number of authors (Law 1951; 1952; Mehr & Freid 1975; 1976; Gilkes 1977; José & Atcherson 1978). It was considered that the most suitable approach, in the absence of an appropriate British Standards specification, would be to adopt the recommendations issued by the Council of the Faculty of Ophthalmologists (Law 1952). This recommendation advocates that near acuity should be assessed at a viewing distance of 35 cm either with reduced Snellen letters or with paragraphs of lower case Times Roman print. The reduced Snellen letters, when veiwed at the conventional distance, subtend visual angles equivalent to those at 6m. The limitations inherent in the design of the standard distance chart in relation to use among the partially sighted, thus also apply to the near chart when viewed at the conventional distance. In particular, the chart is unsuitable for use in those cases where the near acuity is less than 6/60 equivalent. In contrast, the recommended print size for the continuouse prose covers a range from 5 point to 48 point corresponding approximately to a range of Snellen equivalents from 6/15 to less than 3/60. It was felt that the sizes of the continuouse prose would be adequate for use among the partially sighted, but that a pilot study would be necessary to determine the suitability of the reduced Snellen letters.

8.4 Materials and methods

The distance acuity assessment and the near acuity pilot experiment were carried out on a sample of 37 final year youngsters from the 1976/77 academic year at Exhall Grange School.

A commercially available indirect letter chart (Keeler Instruments Ltd., London) was used for measurement of distance visual acuity. The chart conformed to the British Standards specification and was used in conjunction with a mirror at a distance of 3 metres. The screen luminance was 460 $cdm.^{-2}$ and the contrast 94.3%. The recommended luminance of the immediate surround, achieved by appropriate positioning of angle poise lighting was 46-50 $cdm.^{-2}$.

The near visual acuity was determined with a reduced Snellen letter chart contained in a conventional booklet of near vision test types (Clement Clarke Ltd., London). The booklet was supported on a 45^{o} perspex lectern and diffusely illuminated by an angle poise lamp such that the page luminance was equal to that of the distance chart. The viewing distance of 35 cm. was controlled by the use of an adjustable chin rest which prevented excessive anterior-posterior head movements. The exact distance was constantly monitored with the aid of a ruler positioned at the side of the subject. The lectern and chin rest combination also served to present the test material in a plane perpendicular to the subject's line of sight. The entire apparatus was supported on a vertically adjustable instrument table.

Approximately half the sample were first assessed at distance and then at near with the remaining youngsters being examined in the reverse order. All subjects wore the previously determined refractive correction in trial lens form. An addition of +2.75DS was used at near in order to avoid the necessity for any accommodative effort. Acuity was determined binocularly followed by measurements for the right and left eyes separately.

8.5 Results

The majority of the 37 youngsters (59.5%) had binocular distance visual acuities of between 6/60 and 6/36+1. Ten youngsters (27.0%) obtained a score of 6/60 and 12 covered the range 6/60+1 to 6/36+1. An acuity of less than 6/60 was found in 4 of the youngsters, being 5/60 in three cases and 1/60 in the fourth instance respectively. In contrast, 11 youngsters had an acuity of better than, or equal to, 6/24-1. The distribution of distance acuity among the 37 youngsters is shown in Table 8.1.

Fourteen youngsters were found to have a binocular near acuity corresponding to between 6/60 and 6/36+1 with 9 obtaining a score of 6/36+1 equivalent. The analysis also showed that 22 of the 37 youngsters (59.5%) had a near acuity of equal to or better than 6/24-1. Of these 22 youngsters, 13 possessed acuities in the range 6/24-1 to 6/18+2. In contrast, two individuals had an acuity of 6/60 and one of less than 6/60. The assessment of the near acuity in one youngster could not be carried out owing to the presence of an extensive physical impairment. The distribution of the near acuity among the 37 youngsters is given in Table 8.2.

The findings for the distance acuity assessment were in good agreement with the guidelines issued by the D.H.S.S. concerning the eligibility of children for admission to the blind or partially sighted registers. These guidelines recommend that children with acuities of between 3/60 and 6/24 should be educated in special schools by methods involving sight. The results showed that 28 of the 37 youngsters conformed to this classification. The findings can also be compared with those from the study by Fine (1968). She collected data from the clinical records of 1,374 partially sighted children born between

Level of distance acuity	Number of Youngsters	%
No Perception of Light	-	
Perception of Light	-	
Hand Movements	-	
Counting Fingers	-	
$\frac{1}{60}$	1	2.7
$\frac{2}{60}$	-	
$\frac{3}{60}$	-	
$\frac{4}{60}$	-	
$\frac{5}{60}$	3	8.1
$\frac{6}{60}$	10	27.0
$\frac{6}{60} +1 \rightarrow \frac{6}{36} +1$	12	32.4
$\frac{6}{24} -1 \rightarrow \frac{6}{24} +1$	3	8.1
$\frac{6}{18} -2 \rightarrow \frac{6}{18} +2$	5	13.5
$\frac{6}{12} -2 \rightarrow \frac{6}{12} +2$	2	5.4
$\frac{6}{9} -3 \rightarrow \frac{6}{9} +3$	1	2.7
Total	37	100%

Table 8.1 Results of Pilot Investigation
Distribution of distance visual
acuity among 37 youngsters.

Level of Acuity	Number of Youngsters	%
Less than $\frac{6}{60}$	1	2.7
$\frac{6}{60}$	2	5.4
$\frac{6}{60}+1 \rightarrow \frac{6}{36}+1$	12	32.4
$\frac{6}{24}-1 \rightarrow \frac{6}{24}+1$	7	18.9
$\frac{6}{18}-2 \rightarrow \frac{6}{18}+2$	6	16.2
$\frac{6}{12}-2 \rightarrow \frac{6}{12}+2$	3	8.1
$\frac{6}{9}-3 \rightarrow \frac{6}{9}+3$	3	8.1
$\frac{6}{6}-4 \rightarrow \frac{6}{6}$	2	5.4
Unable to assess	1	2.7
Total	37	100%

Table 8.2 Results of Pilot Investigation. Distribution of reduced Snellen near acuity for 37 youngsters.

1951 and 1960 and attending 34 special schools and 8 special classes in England and Wales. Of the 1,374 pupils in her study, 68 had acuities of between hand movements and 2/60 (4.9%), 511 between 3/60 and 6/60 (37.2%), 478 between 6/36 and 6/24 (34.8%) and 296 (21.5%) better than or equal to 6/18. Data was not available for the remaining 20 youngsters. The sample size involved in the current study is considerably smaller than that in Fine's study. Nevertheless, the results show a similar trend, 35.1% (13 youngsters) having acuities between 3/60 and 6/60 and 62.1% greater than 6/60.

A statistical analysis of any possible difference between the level of the distance and near acuity could not be undertaken due both to the diversity of the ocular disorders within the sample and to the differing numbers within each disorder. It can be seen, however, that the level of acuity for near was frequently better than that for distance. Indeed, 33 of the 37 youngsters (89.2%) had a near acuity corresponding to a distance equivalent of better than, or equal to, 6/60+1. In contrast, this level of acuity was obtained at distance by only 23 of the 37 youngsters (62.2%). The levels of acuity are compared in Table 8.3. The reason for the differences in the two types of acuity is not clear. One possible factor may have been due to differences in the legibility of the test types used for distance and for near; British Standard letters being used in the former case, but not in the latter. A further possible cause may have occurred from the lack of adequate control of the near viewing distance, an enhanced near acuity resulting from a closer observation distance.

The results from the pilot study suggested that the presentation of the near test types at the conventional viewing distance of 35cm. would provide an adequate stimulus for binocular viewing in all but

Level of acuity	Distance	Near
	Number of Youngsters	
Less than $\frac{6}{60}$	4	1
$\frac{6}{60}$	10	2
$\frac{6}{60}+1 \quad \frac{6}{36}+1$	12	12
$\frac{6}{24}-1 \rightarrow \frac{6}{24}+1$	3	7
$\frac{6}{18}-2 \rightarrow \frac{6}{18}+2$	5	6
$\frac{6}{12}-2 \rightarrow \frac{6}{12}+2$	2	3
$\frac{6}{9}-3 \rightarrow \frac{6}{9}+3$	1	3
$\frac{6}{6}-4 \rightarrow \frac{6}{6}$	-	2
Unable to assess	-	1
Total	37	37

Table 8.3 Comparison of the distance and near acuities obtained from the initial sample of youngsters.

a small per centage of cases. It was consequently decided to adopt the reduced Snellen letters as well as the paragraphs of continuous prose for the remainder of the study.

A number of modifications were made both to the apparatus and to the procedure as a result of the experience gained from the initial assessments. It was felt that, in order to reduce any potential learning effect, the distance chart should contain 3 sets of British Standard letters, corresponding to the binocular, right eye and left eye assessments. In order to ensure consistency of measurement, it was proposed to use the same chart for each particular observation state throughout the remainder of the study. Consequently a further two panels of British Standard letters were obtained for the test chart. These were produced by Rayner Optical Co. Ltd.

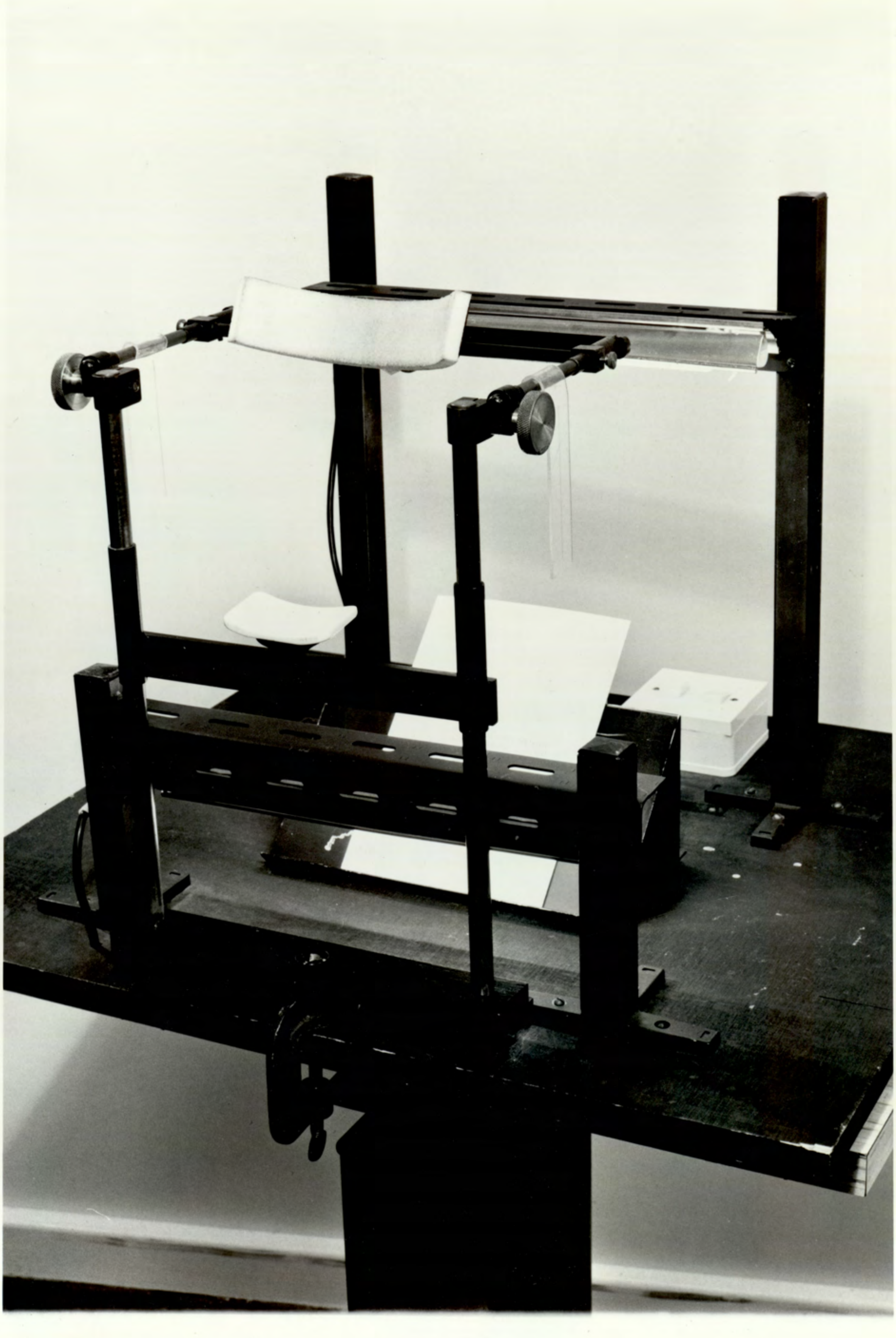
It was similarly decided to utilize 3 sets of reduced Snellen letters for the near acuity assessment. In addiiton, it was felt that the use of British Standard letters would also be desirable. The near charts, specially prepared for the study, were 1/17 photographic reductions of distance charts printed on 9" x 6" white cartridge boards (Levin 1977). The format of the charts corresponded to the Faculty of Ophthalmology recommendations (Law 1952) and the selection of letters was different from that at distance.

The passages of continuous prose were photographic reproductions of commercially available test material mounted on individual cartridge boards.

It had been recognized in the early stages of the assessment that the method of near visual acuity presentation was unsatisfactory. In particular, it had been found necessary to standardize the illumination level before the assessment of each youngster and to constantly monitor the viewing distance. In order to overcome these problems, an apparatus was specially constructed which provided a uniform target illumination and precise control over the viewing distance.

The apparatus (Plate 8.1) essentially consisted of a 45^{o} lectern, a light source and a head rest. It was mounted on a baseboard which, in turn, was supported on a vertically adjustable instrument column. The lectern, 25 cm.long, 10 cm.high with a 1.5 cm.lip, was made from 16 guage aluminium. The light source consisted of two 60 watt, 284 mm.,strip lamps each mounted in an appropriate reflector. One lamp was positioned 23 cm.directly above the lectern and the other 20cm.immediately in front. The lamps were each connected to a commercially available dimmer switch (M.K. Electric Ltd., London) which provided the facility for altering the target illumination. Uniformity of the target luminance (220 cdm^{-2}) was achieved by appropriate positioning of the two dimmer switches. The head rest essentially consisted of two parts, a chin support and a forehead rest positioned at right angles to each other. The two sections were freely adjustable; the chin support in the vertical plane and the forehead rest in the horizontal plane. Appropriate positioning of these sections permitted the head to be supported at an angle of 45^{o} from the vertical and at any specified viewing distance. Measures of the particular viewing distance were obtained free of parallax by aligning the subjects' eyes with two perspex markers suspended from either side of the horizontal section of the head rest.

Overleaf ... Plate 8.1. The apparatus used for determining the near acuity of the youngsters from the 1977/78 and 1978/79 academic years.



The revised distance and near acuity measurements together with the continuous prose assessment were carried out on 164 final year pupils from the 1977/78 and 1978/79 academic years.

Half the sample were first assessed at near and then at distance with the order being reversed for the remainder. The sequence of presentation of the two near vision tests was alternated at random throughout the investigation.

The results for the binocular distance acuity assessment were broadly similar to those obtained in the pilot study. Thirty-four of the 164 youngsters (20.7%) had an acuity of 6/60 and 37 were in the range 6/60 +1 - 6/36 +1. Indeed, the majority of the sample (61.0% - 100 youngsters) had acuities of between 6/60 and 6/24 +1. An acuity of less than 6/60 was found in 39 cases (23.8%). Of these 39 youngsters, 32 had acuities between 3/60 and 5/60. The remainder of the sample (25 youngsters) obtained a score of better than or equal to 6/18 -2. The distribution of distance acuity among the sample is given in Table 8.4.

A binocular near acuity equivalent to 6/60 was recorded in 33 of the 164 youngsters (20.1%) and a value of between 6/60 +1 and 6/36 +1 in a further 47 cases (28.7%). The analysis also revealed that a total of 33 youngsters had been unable to see the 6/60 equivalent letter at the specified viewing distance. This finding was in marked contrast to that of the pilot investigation where only one out of 35 youngsters had encountered the same difficulty. Twenty-eight of the 164 youngsters (17.1%) were found to have an acuity of better than or equal to 6/18 -2. The near assessment of the remaining youngster could not be carried out due to the sudden illness of this individual. The distribution of the reduced Snellen binocular acuity is given in Table 8.5.

Level of acuity	No. of Youngsters	%
No perception of light	-	
Perception of light	-	
Hand movements	-	
Counting fingers	-	
$\frac{1}{60}$	1	0.6
$\frac{2}{60}$	6	3.7
$\frac{3}{60}$	9	5.5
$\frac{4}{60}$	12	7.3
$\frac{5}{60}$	11	6.7
$\frac{6}{60}$	34	20.7
$\frac{6}{60}$ +1→ $\frac{6}{36}$ +1	37	22.6
$\frac{6}{24}$ -1→ $\frac{6}{24}$ +1	29	17.7
$\frac{6}{18}$ -2→ $\frac{6}{18}$ +2	15	9.1
$\frac{6}{12}$ -2→ $\frac{6}{12}$ +2	6	3.7
$\frac{6}{9}$ -3→ $\frac{6}{9}$ +3	3	1.8
$\frac{6}{6}$ -4→ $\frac{6}{6}$ →	1	0.6
Total	164	100 %

Table 8.4 Distribution of binocular distance visual acuity among the 164 youngsters

Level of acuity	No. of Youngsters	%
$\frac{6}{<60}$	33	20.1
$\frac{6}{60}$	33	20.1
$\frac{6}{60}+1 \rightarrow \frac{6}{36}+1$	47	28.7
$\frac{6}{24}-1 \rightarrow \frac{6}{24}+1$	22	13.4
$\frac{6}{18}-2 \rightarrow \frac{6}{18}+2$	19	11.6
$\frac{6}{12}-2 \rightarrow \frac{6}{12}+2$	3	1.8
$\frac{6}{9}-3 \rightarrow \frac{6}{9}+3$	4	2.4
$\frac{6}{6}-4 \rightarrow \frac{6}{6} \rightarrow$	2	1.2
Not assessed	1	0.6
	164	100 %

Table 8.5

Distribution of reduced Snellen near binocular visual acuity among the 164 youngsters.

The majority of the youngsters (100 individuals - 66.5%) obtained a continuous prose binocular acuity of between N12 and N36. Of the 109 youngsters, 33 had an acuity of N24, 22 had N18 and 21 had N36. An acuity of greater than, or equal to, N10 was obtained in 37 of the cases (22.6%). In contrast, 8 youngsters had an acuity of N48 whilst a further 10 youngsters had insufficient vision to read this level of print. The distribution of the continuous prose binocular acuity is given in Table 8.6.

Statistical analysis of any difference in the level of the distance acuity and that of the reduced Snellen acuity cannot be undertaken for the youngsters as a whole due to the many types of ocular disorder contained within the sample. Nevertheless, the overall results for the two acuities would seem to bear a closer resemblance than those of the pilot study. Of the 164 youngsters, 20.7% obtained a score of 6/60 at distance and 20.1% achieved the corresponding value at near. Thirty-seven individuals had a distance acuity of 6/60 at distance and 20.1% achieved the corresponding value at near. Thirty-seven individuals had a distance acuity in the range 6/60+1 to 6/36+1 compared with 47 at near. In contrast, 29 youngsters had a distance acuity of between 6/24-1 and 6/24 +1 at distance and 22 had the same range at near. An acuity of <6/60 was recorded from 23.8% of the sample at distance and from 20.1% at near. The distribution of the distance and near acuities are compared in Table 8.7.

A test-retest reliability study (Anastasi 1976) was undertaken on a sample of 20 final year pupils chosen at random from the 1977/78 academic year. The retest procedure was carried out, after an interval of 7 days, in exactly the same manner as that of the initial assessment. The results are listed in Tables 8.8 - 8.10.

Level of Acuity	No. of Youngsters	%
N5	9	5.5
N6	8	4.9
N8	10	6.1
N9	2	1.2
N10	8	4.9
N12	13	7.9
N14	20	12.2
N18	22	13.4
N24	33	20.1
N36	21	12.8
N48	8	4.9
<N48	10	6.1
	164	100

Table 8.6 Distribution of continuous prose binocular acuity for the 164 youngsters.

Level of Acuity	Distance	Near
	% of Youngsters	
$\frac{6}{<60}$	23.8	20.1
$\frac{6}{60}$	20.7	20.1
$\frac{6}{60}+1 \rightarrow \frac{6}{36}+1$	22.6	28.7
$\frac{6}{24}-1 \rightarrow \frac{6}{24}+1$	17.7	13.4
$\frac{6}{18}-2 \rightarrow \frac{6}{18}+2$	9.1	11.6
$\frac{6}{12}-2 \rightarrow \frac{6}{12}+2$	3.7	1.8
$\frac{6}{9}-3 \rightarrow \frac{6}{9}+3$	1.8	2.4
$\frac{6}{6}-4 \rightarrow \frac{6}{6} \rightarrow$	0.6	1.2
Not assessed	-	0.6
	100 %	100 %

Table 8.7 Comparison of distribution of distance and reduced Snellen acuities among the sample of 164 youngsters.

BINOCULAR DISTANCE VISUAL ACUITY

Subject	Initial	Repeat
P.J.	$\frac{6}{36}$ +1	$\frac{6}{36}$ +1
D.O.	$\frac{6}{18}$ +1	$\frac{6}{12}$ -2
R.P.	-	$\frac{6}{24}$ +1
K.S.	$\frac{6}{60}$ +1	$\frac{6}{36}$
A.B.	$\frac{6}{60}$	$\frac{6}{60}$
M.L.	$\frac{3}{60}$	$\frac{4}{60}$
W.M.	$\frac{4}{60}$	$\frac{5}{60}$
M.S.	$\frac{6}{60}$ +1	$\frac{6}{60}$
P.H.	$\frac{6}{24}$	$\frac{6}{24}$
S.B.	-	$\frac{6}{18}$ -2
C.E.	$\frac{6}{24}$	$\frac{6}{24}$
J.W.	$\frac{6}{24}$	$\frac{6}{24}$
K.L.	$\frac{6}{36}$ +1	$\frac{6}{36}$
S.G.	$\frac{6}{60}$	$\frac{6}{60}$ +1
M.C.	$\frac{5}{60}$	$\frac{6}{60}$
N.P.	$\frac{4}{60}$	$\frac{6}{60}$
H.M.	$\frac{4}{60}$	$\frac{5}{60}$
S.P.	$\frac{6}{60}$ +1	$\frac{6}{60}$
P.G.	$\frac{2}{60}$	$\frac{3}{60}$
A.U.	$\frac{6}{24}$ +2	$\frac{6}{18}$ -1

Table 8.8 Test - retest reliability results of binocular distance acuity assessment.

BINOCULAR REDUCED SNELLEN ACUITY

Subject	Initial	Repeat
P.J.	$\frac{6}{24}$ -1	$\frac{6}{36}$
D.O.	$\frac{6}{18}$	$\frac{6}{18}$
R.P.	$\frac{6}{18}$ -1	$\frac{6}{18}$ -1
K.S.	$\frac{6}{60}$ +1	$\frac{6}{36}$ +1
A.B.	$\frac{6}{60}$	$\frac{6}{60}$ +1
M.L.	$\frac{6}{<60}$	$\frac{6}{<60}$
W.M.	$\frac{6}{<60}$	$\frac{6}{<60}$
M.S.	$\frac{6}{60}$	$\frac{6}{60}$
P.H.	$\frac{6}{60}$ +1	$\frac{6}{24}$ -1
S B.	$\frac{6}{18}$ -1	$\frac{6}{24}$ +3
C.E.	$\frac{6}{18}$ -1	$\frac{6}{24}$ +3
J.W.	$\frac{6}{24}$ +1	$\frac{6}{18}$ -1
K.L.	$\frac{6}{60}$ +1	$\frac{6}{36}$ +1
S.G.	$\frac{6}{<60}$	$\frac{6}{<60}$
M.C.	$\frac{6}{60}$ +1	$\frac{6}{60}$ +1
N.P.	$\frac{6}{<60}$	$\frac{6}{<60}$
H.M.	$\frac{6}{<60}$	$\frac{6}{<60}$
S.P.	$\frac{6}{60}$	$\frac{6}{60}$
P.G.	$\frac{6}{<60}$	$\frac{6}{<60}$
A.U.	$\frac{6}{18}$ -1	$\frac{6}{12}$

Table 8. 9 Test - retest reliability results for the reduced Snellen binocular near acuity assessment.

CONTINUOUS PROSE ACUITY

Subject	Inital	Repeat
P.J.	N18	N18
D.O.	N5	N5
R.P.	N8	N8
K.S.	N12	N12
A.B.	N24	N24
M.L.	N36	N48
W.M.	N24	N24
M.S.	N36	N36
P.H.	N14	N14
S.B.	N6	N6
C.E.	N6	N6
J.W.	N10	N8
K.L.	N14	N12
S.G.	N24	N24
M.C.	N24	N24
N.P.	N36	N36
H.M.	N36	N36
S.P.	N24	N24
P.G.	N48	N48
A.U.	N6	N5

Table 8.10 Test - retest reliability results for the continuous prose binocular near acuity assessment.

The conventional visual acuity chart does not contain equal intervals of measurement. The resulting data must thus be considered on an ordinal basis. The statistical treatment of visual acuity in general has been discussed by Hallden (1972).

The degree of distance acuity test - retest reliability was expressed in terms of the ordinal correlation coefficient. Spearman's r_s. The correlation was based on data from 18 of the 20 youngsters (the results from the remaining two youngsters were not available owing to illness). The data from the binocular observation was converted from the standard notation to decimal form, partial scores being transformed by a process of linear interpolation (Drasdo & Haggerty 1976; 1981) shown in Table 8.11. The correlation was then calculated from this data using the formula corrected for tied scores (Siegel 1956).

The magnitude and level of statistical significance of the correlation ($r_s = 0.959$, $t = 13.53$, $df = 16$, $p < 0.001$; indicated that the distance acuity assessment yielded highly repeatable data over a period of 7 days.

The data from the reduced Snellen assessment was similarly converted to decimal format. The degree of test - retest reliability was also expressed in terms of Spearman r_s. The correlation was based on data from all 20 youngsters. The value and significance ($r_s = 0.971$, $t = 17.75$, $df = 18$, $p < 0.001$) indicated that the reduced Snellen acuity assessment also produced highly repeatable results over a period of 7 days.

A similar degree of reliability was also found for the continuous prose assessment ($r_s = 0.992$, $t = 33.61$, $df = 18$, $p < 0.001$).

-7	-6	-5	-4	-3	-2	-1	Full Score	VA	Full Score	+1	+2	+3	+4	+5	+6	+7
								$\frac{1}{60}$								
								$\frac{2}{60}$								
								$\frac{3}{60}$								
								$\frac{4}{60}$								
								$\frac{5}{60}$								
							0.1	$\frac{6}{60}$	0.1	0.14						
						0.14	0.17	$\frac{6}{36}$	0.17	0.20	0.22					
					0.20	0.22	0.25	$\frac{6}{24}$	0.25	0.26	0.29	0.31				
				0.26	0.29	0.31	0.33	$\frac{6}{18}$	0.33	0.36	0.40	0.43	0.47			
			0.36	0.40	0.43	0.47	0.50	$\frac{6}{12}$	0.50	0.53	0.56	0.59	0.61	0.64		
		0.56	0.56	0.59	0.61	0.64	0.67	$\frac{6}{9}$	0.67	0.71	0.75	0.80	0.84	0.88	0.92	0.96
0.71	0.75	0.80	0.84	0.88	0.92	0.96	1.0	$\frac{6}{6}$								

Table 8.11 Intermediate Snellen decimal values.
(After Drasdo & Haggerty 1976; 1981).

The relationship of visual acuity to the subsequent occupational success of these youngsters will be discussed in Section

8.6 Rationale for a modified method of acuity assessment

The design and use of conventional distance letter charts in relation to the measurement of visual acuity amongst the visually handicapped, has been criticized by various workers (Bailey & Lovie 1976; Bailey 1978; Sloan 1980; Taylor 1981). The principal objections to the standard chart concern the number of letters per row, the range of letter sizes which are available at the poor end of the acuity scale and also the non-uniformity of the spacing between letters and between rows.

The majority of the charts that are commercially available in this country comprise letters ranging in six unequal steps from a size of 6/60 to a level of at least 6/6. These charts normally contain one letter at the 6/60 level and two at the 6/36 level. Three letters, arranged in two sizes, thus cover a change in visual angle from 6' to 10'. In contrast, the same charts frequently provide 18 letters in 3 sizes to cover a change in visual angle from 1' to 2' i.e. from 6/6 to 6/12. The region of the chart most frequently used in the assessment of the visually handicapped thus has the fewest number of letters per row and the largest change in visual angle.

The lack of an adequate number of letters per row at the poor end of the scale militates against the accurate measurement of visual acuity for several reasons. The level of acuity recorded can be influenced by the crowding phenomenon whereby individuals with disorders of the macula can show a better acuity for single letter presentations. In addition, the accuracy of the measurement process itself is limited by the restriction in the range of letters. An important factor, closely associated with the number of letters per row, is the degree of spacing between letters and between rows. It has been shown by Flom, Weymouth and Kahneman (1963) that the legibility of test chart letters is reduced by the presence of nearby contours, widely spaced letters being more easily recognized than those which are situated closely together. Indeed, such contour interaction effects are prominent in cases of macular disturbance. The lack of constant progression in letter size is also a disadvantage. At the conventional viewing distance, the chart is not sufficiently sensitive for the assessment of low visual acuities whilst, if the viewing distance is reduced, inconsistant and erroneous levels of acuity can often be recorded.

A number of alternative test charts have been introduced over the years with the aim of overcoming one or more of the limitations associated with the conventional charts. The first charts were designed by Sloan (1959), Feinbloom (undated) and the American Medical Association (undated). In addition, two other charts have subsequently been described by Bailey & Lovie (1976) Bailey(1978) and Sloan (1980). The former charts were not commercially available in this country and were both considered to possess a number of design limitations. It was therefore decided to design and produce a chart meeting the requirements of the current study.

8.7 Design of the distance and near charts

The overall design of the distance chart was governed by two basic requirements; the apparatus had to be easily portable and be suitable for use in the confined spaces of the various school rooms used for the examination of the youngsters. In addition, any design had to permit the speedy assessment of visual acuity.

The initial discussions on the format of the distance chart were concerned with the most feasible method of test type presentation. The major difficulty effecting the design of the chart was the problem of size imposed by the use of test types subtending large minimum angles of resolution. Various proposals were considered; these included orthodox internally illuminated charts operating on the roller-blind principle or mounted on a rotatable drum and an externally illuminated chart presented in card form and supported on an easel. A fourth method was also put forward; this involved the use of a projection system. It was thought that whilst the necessary transparencies for such a chart might be difficult to produce, such an approach would best meet the requirementsof the study. After much discussion, it was decided to adopt the projection technique for generating the distance chart.

The use of a commercially available test chart projector was ruled out in the early stages of the study. Perusal of the appropriate manufacturers catalogues and of the literature (Sasieni 1973*) showed that such systems would not only have required extensive modification but were also prohibitively expensive. It was decided to utilize a Kodak Caroussel S-AV2000 slide projector. Such projectors are robust and offer a series of interchangable lenses which provide considerable scope for use.

The format of the distance chart represented a compromise between the ideal theoretical requirements and the demands of the practical situation. The design drew heavily on the recommendations contained

* Projection test charts have been more recently reviewed by Sasieni 1979.

in the appropriate specification from the British Standards Institute (BS4274 : 1968) and on the work of Sloan (1959). The resultant chart compared favourably with those subsequently described by Bailey & Lovie (1976) and Sloan (1980) and also with the recommendations published in 1980 by the American National Academy of Sciences.

A viewing distance of 3m was adopted as it was felt that this was the maximum compatible with the size of the schoolrooms. P.44.

The choice of the projector lens and projection distance was therefore governed primarily by the need for a system with a short throw. This requirement, in turn, dictated that the resultant optical system should provide sufficient magnification to permit the desired projected letter sizes. A suitable combination, commensurate with these aims was considered to be a 35 mm focal length projection lens in conjunction with a projection distance of 2m. A front projection technique was used in order to overcome the limitations of space within the schoolrooms. The use of such a format would also permit the subject to be seated away from the noise and heat of the projector. The magnification of the projection system was 57x.

The style and selection of the letters was chosen in order to conform to the British Standards specifications and consisted of 5 x 4 non-serifed English (Roman) capital letters : D, E, F, H, N, P, R, U, V, Z. These letters were shown by Coates (1935) and Woodruff (1947) to be of approximately equal legibility. It was felt that the use of Landolt rings or illiterate E's, although being more compatible with the principal of equal legibility would retard the aim of providing a speedy assessment of visual acuity.

It was felt that, due to the size of the envisaged test type, the only feasible design for the chart would be to allocate one row of letters to each transparency. It was decided to asign five letters to each row in order to provide an acceptable visual task. The use of an odd number was chosen to permit the facility, if desired, for applying a pass/fail criteria in cases of near threshold measurement.

The letters were arranged in a manner such that each of the 10 letters appeared only once in the first two rows. This pattern was then repeated for each two row combination.

A duplicate set of test types was also designed in order to provide, where necessary, a back-up facility for the first chart. The letters on this second chart were additionally arranged such that, for any given row, the five letters were different to those contained in the equivalent row on the first chart. It was hoped that these arrangements would reduce to a minimum any effect on the measurement of visual acuity arising from familiarity of the letters.

The spacing between, above and below each letter was equivalent to the letter size of the particular row with the remaining part of the transparency being blacked out. It was hoped that in this way, the effects of contour interaction would be minimised. Black letters on a white background were selected in accordance with the British Standards recommendation.

It was decided to follow accepted principles and design the range of letter sizes on a geometrical progression (Nicati 1874; Green 1905; Ogle 1953; Sloan 1959; Deutsche-Normen 1974). The progression was based on a multiplier of $\sqrt[3]{2}$ (r = 1.260) and centred around a value of 6/60. The use of a geometrical progression was considered appropriate as it permits constant increments in letter size. The particular value of r was chosen because it provided letter sizes similar to those contained in the Keeler A series charts (Keeler 1957). In addition, it had also been used in the chart described by Sloan (1959). The ratio forms a series in which the increments are approximately equal on a logarithmic scale with a graduation of 0.1 log unit. The letters contained in each successively larger row increase in size by approximately 26% of those in the preceding row. In addition, each letter is approximately 80% of the size of the letters in the immediate larger row. The use of such a scale was also in accordance with the opinion expressed by Ogle (1953) and, Westheimer (1979) that equal differences on a logarithmic scale represent equally perceptible differences. The letters were based purely for convenience around the value of 6/60. It was felt that this figure represented a widely recognised level of visual acuity.

It was decided to present the transparencies in ascending order of letter size with the aim of minimising the influence of any learning effect resulting from the use of only 10 letters. The criteria for threshold was to be taken as the first of two successive correctly identified presentations.

The method of statistical representation of the data was decided after considerable discussion with one of the research workers associated with the project (Hussey 1980). It was felt that the most appropriate technique would be to allocate a particular score to the letters contained in the various rows. It was decided that the 5 largest letters would each have a value of one and that the score for the individual letters in each subsequent row would increase by a value of one for every row. The smallest letters used in the scale were thus each worth a score of 12 with the maximum for the test of 390 indicating high visual acuity. The scoring system is illustrated diagramatically in Table 8.12.

Slide Number	Letter Score	Snellen Equivalent	Cumulative Score
1	1 1 1 1 1 V R E D U	6/240	5
2	2 2 2 2 2 N H P F Z	6/190	15
3	3 3 3 3 3 R N Z D H	6/151	30
4	4 4 4 4 4 P V E F U	6/120	50
5	5 5 5 5 5 V E F H R	6/95	75
6	6 6 6 6 6 Z N P D U	6/76	105
7	7 7 7 7 7 D H Z U F	6/60	140
8	8 8 8 8 8 R V P N E	6/48	180
9	9 9 9 9 9 D N R E P	6/38	225
10	10 10 10 10 10 F H V U Z	6/30	275
11	11 11 11 11 11 N Z R P H	6/24	330
12	12 12 12 12 12 F V E D U	6/19	390

Table 8.12. Range of letters, letter sizes and scoring procedure adopted for the modified distance acuity task.

Two techniques were proposed for the presentation of the near test type. These involved the use of a back projection system or the more conventional method of externally illuminated test material presented on cards.

Several projection methods were considered. These included the use both of a conventional slide projector and also commercially available projectors for presenting microfilm. These techniques were, however, ruled out due to the lack of edge definition resulting from the back projection. As a result, it was decided to adopt the conventional card system of test type presentation.

The design principles of the near charts followed, wherever possible, those for the distance chart.

It was decided to present the test material at a viewing distance of 25 cm. This value was chosen on the basis that it corresponded to the Keeler A series and to the distance of distinct vision used in the evaluation of magnification. The distance was less than that recommended by the Faculty of Ophthalmology but was, nevertheless, still considered to be compatible with the principle of arm's length vision advocated by Cunliffe (1968; 1973).

The charts also contained one line per card and 5 letters per line arranged in a $\sqrt[3]{2}$ progression around a value equivalent to 6/60. The letters covered an acuity ranging from an equivalent of 6/12 to 6/240. The spacing between, above and below the letters was identical to that for the distance presentation. Two different sets of charts were produced. The sequence of the letters on each line was different to that at distance, but followed the same general principle in that the letters appeared only once in the first two lines and in each subsequent two row combination.

The charts were presented and viewed with the aid of the near unit devised for the conventional near vision assessment. The luminance of the charts was 180 cdm^{-2} and the contrast 84.6 %.

The criteria for the threshold acuity was identical to that for the distance measurement. The scoring system was also similar; the maximum score, however, was 525 owing to the use of a greater range of letter sizes.

The letter charts were designed in the autumn of 1976 and were finally produced just over 2 years later. The delay in production occurred principally for two reasons. A considerable amount of time was initially spent in finding an industrial photographer capable of achieving the design requirements at a cost commensurate with the available finance for the study. Having achieved this end, many technical difficulties were encountered in the method of production.

The technique used to produce the charts was designed in close cooperation with the firm of industrial photographers. The process essentially consisted of two stages: the letters were first produced by a graphic artist (Harris 1977) and then photographically reduced to the specified sizes (Levin 1977; 1978).

The principal technical difficulties lay in the photographic reduction process. The first problem encountered was the loss of definition at the extremities of the letters, occurring as a result of the reduction. The second, more serious difficulty, was that of ensuring accuracy in the size of the letters produced on the transparencies. This latter problem was exacerbated by the magnification of the projection system; any error in the letter size on the transparency being magnified by 57 times.

The reduction process was modified on a number of occasions in order to increase the accuracy of the technique. The size of the reduced letters was constantly monitored with the aid of a light microscope and measuring eyepiece graticule.

8.8 Materials and methods

A pilot study to assess the suitability of the distance chart was carried out on a sample of 24 final year pupils from the 1978/79 academic year at Exhall Grange School. The sample was selected so as to encompass the widest possible range of conventional distance visual acuities.

A well defined procedure was adopted for the measurement of distance acuity. The youngsters were seated on a vertically adjustable stool and the previously determined distance correction was placed in trial lens form, before the subject. A demonstration transparency containing letters equivalent to 6/240 was then projected on to the screen and the task explained to the youngster. These two procedures which lasted approximately 3-4 minutes also served to adapt the youngster to the lighting levels of the room. The subject was then positioned at the correct viewing distance and the smallest set of letters projected onto the screen. Successive transparencies were shown until the subject correctly identified two consecutively presented letter sizes.

The near charts were piloted at a separate occasion on a sample of 12 youngsters from the 1978/79 academic year of Exhall Grange School. The sample was once again selected to provide the widest possible range of conventional distance acuities. The reduced number in the sample was due to the fact that the assessment was carried out in the last weeks of the academic year. Many youngsters had either already left school or were involved in both school and C.S.E. or G.C.E. examinations.

The youngsters all wore their current refractive correction supplemented by an addition of +4.00D to compensate for the viewing distance of 25cm.

8.9 Results

The apparatus and procedure was found to permit the rapid assessment of distance visual acuity. Indeed, considerable time was saved in the measurement of acuities below 6/60.

Several youngsters incorrectly identified the letter "D" at threshold and near threshold levels. In most of these cases, the "D" was misinterpreted as an "O". It was felt, however, that the edge definition of the "D" was satisfactory and that the inaccuracy probably resulted from a lack of critical observation on the part of the youngsters.

In 16 of the 24 cases, the first correctly identified letters were contained either within the line designated as threshold or in the immediately smaller line. In 8 cases, however, one or more letters were correctly recognized at a size two intervals (of $\sqrt[3]{2}$) below that taken as the threshold. A typical example is that of subject S.C. shown in Fig. 8.1 This finding suggested that the stimulus interval of $\sqrt[3]{2}$ i.e. a doubling in M.A.R. every 3 letter sizes, was possibly too sensitive. Special attention must thus be paid to this topic in any further field trials of the test.

The scores for the 24 youngsters are given in Table 8.13. The range of these values is largely due to the sample being selected on the basis of the widest possible range of conventional acuities.

Slide number	Letters
5	- - - - -
6	- - - - -
7	✓ × F A - - -
8	× ✓ × × ✓ O N P J P
9	✓ ✓ ✓ ✓ ✓ R V P N E
10	✓ ✓ ✓ ✓ ✓ D H Z U F

Fig. 8.1. Distance acuity score sheet for Subject S.C.

Distance acuity score	Number of youngsters
0 - 49	2
50 - 99	4
100 - 149	6
150 - 199	2
200 - 249	2
250 - 299	5
300 - 349	1
350 - 399	2
400 - 449	-
Total	24.

Table 8.13. Distribution of distance acuity score among the 24 youngsters. (A high score indicates a good acuity).

The data was compared with the conventional distance acuity scores obtained some 6 months previously (Table 8.14). association between the two acuities was expressed in terms of the Spearman correlation coefficient r_s. The correlation was based on 20 of the 24 youngsters. A conventional distance acuity measurement was not available in the remaining 4 youngsters. In two cases, the individuals had undergone eye surgery in the period between the conventional and modified assessment, whilst two youngsters had been unavailable at the time of the initial assessment. The correlation was statistically significant ($r_s = 0.902$ $df = 18$ $t = 9.83$ $p < 0.001$ and indicated that the two systems were evaluating the same function, i.e. Snellen acuity.

The modified distance acuity assessment was repeated on 22 of the 24 youngsters, after an interval of 4 - 5 days, in order to determine the degree of test - retest reliability (Anastasi 1976). The procedure was carried out in exactly the same manner as that of the first assessment. The mean score for the 22 youngsters at the second assessment was 206.9 compared to a value of 185.5 obtained at the first assessment. The difference between the means, however, was not statistically significant. ($t = -0.25$ $df = 21$ $p < 0.45$). The degree of test - retest reliability was expressed in terms of the Pearson correlation coefficient r. The value ($r = 0.97$ $df = 20$ $t = 17.84$ $p < 0.001$) was statistically significant and indicated that the assessment procedure yielded highly repeatable results after an interval of 4-5 days.

	Modified acuity score.	Snellen Equivalent	Conventional acuity
A.M.	86	$\frac{6}{95}$ - 1	$\frac{4}{60}$
P.S.	140	$\frac{6}{60}$	$\frac{6}{60}$
K.S.	140	$\frac{6}{60}$	$\frac{6}{60}$
S.C.	208	$\frac{6}{48}$ + 2	$\frac{6}{60}$
D.S.	126	$\frac{6}{76}$ + 3	$\frac{6}{60}$
D.C.	275	$\frac{6}{30}$	$\frac{6}{24}$ - 1
P.B.	280	$\frac{6}{38}$ + 3	$\frac{6}{36}$
K.H.	172	$\frac{6}{48}$ - 1	$\frac{6}{60}$
T.W.	11	$\frac{6}{190}$ -1	$\frac{6}{60}$
M.P.	308	$\frac{6}{30}$ +3	$\frac{6}{18}$ - 2
S.S.	87	$\frac{6}{95}$ -1	$\frac{6}{60}$
M.J.	18	$\frac{6}{190}$ +1	$\frac{3}{60}$
D.L.	297	$\frac{6}{30}$ +2	$\frac{6}{18}$ - 1
S.P.	366	$\frac{6}{24}$ +3	$\frac{6}{18}$ - 2
J.S.	60	$\frac{6}{120}$ +2	$\frac{4}{60}$
Y.W.	189	$\frac{6}{48}$ +1	$\frac{6}{60}$
M.Q.	378	$\frac{6}{19}$ -1	$\frac{6}{24}$ - 1
C.M.	286	$\frac{6}{30}$ +1	$\frac{6}{60}$ + 1
G.D.	256	$\frac{6}{30}$ -1	$\frac{6}{36}$
R.M.	237	$\frac{6}{48}$ +3	$\frac{6}{36}$

Table 8.14. Comparison of the results from the modified and conventional distance visual acuity assessments.

The near charts were found to permit the rapid assessment of near visual acuity.

Four of the 12 subjects experienced difficulty in identifying the letter D at threshold or near threshold levels. In 8 of the 12 cases, the first correctly recognised letters were contained within the threshold line or in the immediately smaller line.

The level of near acuity was compared with the results for the conventional assessment obtained some 6 months earlier. The degree of association between the two tests was expressed in terms of the Spearman correlation coefficient r_s. The value, r_s = 0.744, was statistically significant (df = 10, t = 3.517, $P<0.017$) and indicated that the two assessments were yielding a measurement of the same function, i.e. near Snellen acuity.

A test-retest reliability study was carried out after an interval of 7 days on 11 of the 12 subjects. The degree of reliability was expressed in terms of the Pearson correlation coefficient r. The value of the correlation, r = 0.945, was highly significant and indicated that the near acuity task also possessed a high degree of reliability over a period of 7 days. (df = 9, t = 8.668, $p < 0.001$).

The mean score for 11 of the 12 youngsters was 339.1 compared with that of 305.0 obtained at the first assessment. The difference was not, however, statistically significant (t = -1.03, df = 10, $p< 0.2$).

9 VISUAL FIELDS

9.1 Rationale for the investigation of the visual fields

The status of the visual field is considered to have an important bearing on performance with residual vision (Skydsgaard 1975; Mehr & Freid 1975; Faye 1976; Bailey 1978). Indeed, it has long been recognized that peripheral field defects such as concentric contractions and hemianopsias can impair mobility whilst centrally located scotomata can interfere with reading ability. It was considered essential, therefore, that the study should include an investigation of the peripheral and central fields. The aim of the investigation was felt to be twofold. The first stage involved the development of suitable techniques for measuring both the peripheral and the central functional visual fields of the partially seeing youngsters. The second stage was to compare the resulting data from these youngsters with the subsequent levels of occupational success.

9.2 Previous studies

Few studies of the partially sighted have involved an investigation of the status of the visual field. A notable exception was the study by Sloots-Smits, Meyer, Wibaut & Schappert-Kimmijser (1967). The subjects were 66 partially sighted children, 41 boys and 25 girls, who were being educated at two schools for the partially sighted in Holland. The peripheral visual field was investigated with a Goldmann perimeter. Although no results were given in the paper, Sloots-Smits et al reported that a "reasonable" visual field could be obtained, for most of the children, with a target of size I and an intensity 4. When such a field could not be obtained, an object of size III and intensity of 4 was used. Sloots-Smits et al reported "difficulties" in recording the visual field of patients with nystagmus and photophobia. The central visual field was plotted with a Jabo projection Bjerrum Screen. Where possible, the smallest target with "one filter" was utilized (the target size and the transmission of the filter are not specified in the paper). Sloots-Smits et al found a central scotoma in 29 cases and in 19 cases when the target was used without a filter.

9.3 Rationale for the methods of investigation

The particular methods used to investigate the visual field in the current study were the result of considerable discussion amongst the research workers involved in the project. A complete visual field profile defining the extent of the major isopters and the nature of the scotomata, represented the ideal. It was considered, however, to be outside the scope of the study since the time taken to acquire such information would place unacceptable demands both on the youngsters and on the research workers involved in the project. It was realised, therefore, that any technique of investigation would have to represent a compromise between the theoretical ideals and the constraints of the project.

The most suitable approach commensurate with these requirements was considered to be the identification of areas of total or near total loss of sensitivity. It was felt that this method would overcome the problem relating the depth of a field defect to visual ability and would define areas of visual loss unquestionably impairing the response of the individual.

The type of perimeter most suited to the requirements of the study was considered to be the bowl perimeter. Such instruments permit a precise control over target intensity and contrast and are widely used in clinical research.(Birch, Hamilton & Gould 1979: Harding, Crews & Pitts 1979). In addition a means of monitoring subject fixation is also provided. It was proposed to use a Zeiss Jena bowl perimeter as an instrument of this type was readily available in the Department.

The Zeiss Jena perimeter provides a selection of six stimulus sizes ranging in area from 0.0625 mm^2 to 64 mm^2, and four filter settings with transmissions ranging from 3.33% to 100% (Tables 9.1 and 9.2 The contrast between the target and background for the 4 filter settings are 33.0%, 60.0%, 81.2% and 100% respectively.

The normal isopter values for each of the stimulus combinations are not specified by Zeiss. Nevertheless, the most suitable stimulus size was felt to be setting V (64 mm^2) as this is considered by Wolffe (1977) to be clinically equivalent in size to a $\frac{10}{330}$ white target. It was recognised, however, that the corresponding filter setting commensurate with the detection of absolute or near absolute field loss, could not be selected without carrying out a study to ascertain the extent of the normal visual field for the various target intensities. The most suitable starting point, therefore, was considered to be the determination of an appropriate filter setting. It was hoped that following this preliminary stage, the particular stimulus combinations could then be applied to the investigation of the partially sighted youngsters.

Target Size Setting	Size of Target mm^2
O	0.0625
I	0.25
II	1
III	4
IV	16
V	64

Table 9.1 Target sizes available in the Zeiss bowl perimeter.

Filter Setting	Transmission of filter	Contrast between target and hemisphere
1	3.33%	33%
2	10.0 %	60%
3	33.3 %	81.2%
4	100%	100%

Table 9.2 Filter transmission and resulting target contrasts available in the Zeiss bowl perimeter.

The most suitable instrument for assessing the central field, commensurate with the requirements of the study, was considered to be the Friedmann Visual Field Analyser. This particular instrument was chosen since it permits the rapid assessment of the central field (Greve & Verduin 1972) and the precise control over stimulus parameters such as target intensity, contrast and ambient illumination (Friedmann 1966; Bedwell 1967). It was felt that a convenient starting point for the development of an examination technique would be to carry out an assessment of the youngsters involved, using the Friedmann in the conventional manner. Appropriate modifications to the procedure could then be made as necessary.

9.4 Establishment of Zeiss normal isopters

It was decided to establish the visual field norms for two of the four Zeiss filter settings , target intensities 1 and 3, in conjunction with target size V.

The subjects selected for the experiment were 20 clinically normal undergraduate students who were all familiar with the task of visual field plotting. The sample comprised males and females with a mean age of 20.86 years and a standard deviation of 1.21 years. years.

The preparation of both the instrument and the subjects was carried out in accordance with the recommended procedure described in the instrument manual. The subjects, correctly positioned on the chin rest, were instructed to look into the illuminated bowl of the perimeter. The room illumination was extinguished and the luminance of the projection surface adjusted to equal the luminance of the test target. The required task was then explained to the subject. After approximately 4 minutes, the left eye of the subject was occluded and the right eye examined.

The maximum extent of the visual field for target size V and intensity 1 was determined along each 30° meridian in the normal clinical manner. The value recorded for each meridian was the mean of 3 target presentations. An assessment was then carried out using stimulus combination V3. The entire procedure was then repeated, after a rest period, on the subject's left eye.

Of the two isopters obtained, that for stimulus combination V3 was, as expected, found to be the largest in both the right and the left eyes. The differences between the mean values along each meridian for the two combinations ranged in the right eye from 4.95° superiorly to 1.25° along the 330° meridian and in the left eye from 5.17° along the 15° meridian to 1.27° along the 300° meridian.

A comparison of the results for the two eyes showed that, for combination VI, the means along 6 of the meridians were greater in the right eye than in the left eye. The remaining meridians had mean values which were greater in the left eye than in the right. A similar pattern was present for combination V3. The mean values being higher for the right eye in 8 meridians and higher for the left eye in 4 meridians. The results of the experiment are given in Table 9.3.

It was decided to adopt target combination V3 as the test object to be used on the partially sighted youngsters. It was felt that this approach would provide a means for detecting, in a controlled manner, the presence of large and possibly incapacitating field defects. The procedure was also commensurate with the

Eye	Stimulus Combination	Temp.			Sup.			Nasal			Inf.		
R	V1	83.70	73.82	54.60	45.60	46.87	51.95	52.55	47.02	50.0	65.27	79.45	84.05
		1.61	6.83	7.88	6.47	6.70	5.48	3.51	4.68	5.97	4.08	2.21	1.78
R	V3	85.90	78.57	57.77	50.55	51.65	55.67	55.37	49.22	53.40	68.25	81.45	85.30
		0.95	6.07	7.64	5.65	6.20	5.30	3.10	5.44	6.18	3.13	2.57	1.41
L	V1	81.75	70.55	52.875	45.05	47.72	53.47	53.70	49.15	52.55	65.42	78.07	81.97
		2.00	5.54	6.61	6.21	6.52	5.41	3.99	5.21	6.06	4.33	3.08	2.61
L	V3	83.95	75.72	55.57	48.17	51.42	56.40	56.15	50.82	53.82	67.72	80.82	83.57
		1.38	6.41	7.16	5.45	6.08	4.84	3.44	5.24	5.99	4.06	2.25	1.93

Table 9.3 Mean and standard deviations of the extent of the visual field along 12 meridians for target combinations V1 and V3 - 20 normal observers.

limited time and manpower available for the study. Combination V3 rather than V4 (the largest and brightest) was adopted in order to permit detection of not only absolute defects, but also those of a very dense nature. This procedure thus provided the facility, if desired, for distinguishing between total and sub total field losses.

A purely qualitative approach was adopted for the description of the type and extent of field loss. The use of one or more of the various schemes designed to provide a quantitative evaluation of field loss (Spaeth, Fralick & Hughes 1955; Esterman 1968; Cebon 1969; Frisen 1970; Colenbrander 1975; Trost, Woolson & Hayreh 1979; Drasdo & Peaston 1980) was discussed in the early stages of the investigation. It was felt, however, that the use of such a system would have resulted in a relatively sophisticated analytical approach to what was in effect a coarse technique of investigation.

A purely arbitrary classification was adopted for the definition of a visual field contraction. A contraction was considered to have occurred if the extent of the field loss, in any one quadrant, was equal to or greater than half the linear distance from the limits of the normal isopter to the point of fixation. It was felt that although this approach might overlook some borderline youngsters, cases of undoubted field loss would certainly be identified.

9.5 Peripheral field investigation

The maximum extent of the visual field along the 12 principal meridians was determined initially on a sample of 40 final year pupils from the 1977/78 academic year at Exhall Grange School.

The pre-examination routine for the partially seeing youngsters was identical to that described earlier for the normally seeing subjects. A practice session was, however, then held to familiarize the subject with the required task; the target being demonstrated once along each of the 4 cardinal meridians.

A well defined sequence of target presentation was developed for the assessment of the partially sighted youngsters. The test target was presented twice along each of the 12 meridians during the examination. The initial presentation was along one of the four cardinal meridians. This was followed by a presentation along the next 30^{o} meridian and then by one along the immediate 60^{o} meridian. The fourth presentation of the target was along the original cardinal meridian, the fifth at 90^{o} to this and the sixth was along the same 30^{o} meridian as that examined with the second presentation. The sequence, illustrated diagrammatically in Fig. 9.1 was continued until all 12 meridians had each been examined on two occasions. The extent of the visual field along a particular meridian was taken as the mean of the two presentations. The initial cardinal meridian and the direction of subsequent presentations was randomized for each subject. The procedure was then repeated for the second eye of the subject. The order in which the two eyes were examined was also randomized.

9.6 Results and further investigations of the peripheral fields

Of the 40 youngsters, 29 were considered to have a full field in both eyes or in the sole remaining eye. A field defect was

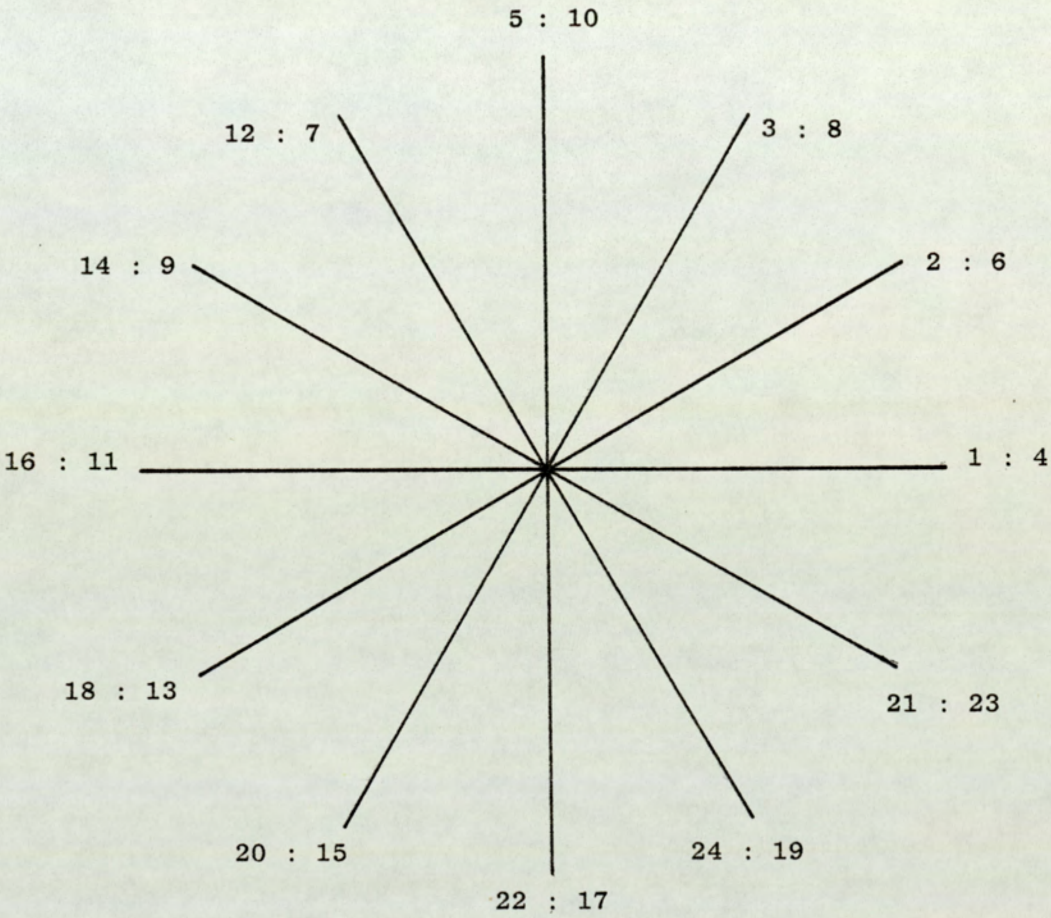


Fig. 9.1 Sequence of target presentation along the 12 principal meridians. The initial position (1) was randomized among the 4 cardinal meridians.

detected in 11 of the youngsters (27.5%). Of these, 9 showed field loss in both eyes or in the sole surviving eye and 2 were found to have a full field in one eye and a defective field in the other. A concentric contraction was found in 3 of the 10 right eyes, a scotoma in 2 cases, and a hemianopic type loss and an altitudinal type defect in one instance respectively. The remaining 3 eyes did not show any field loss to the stimulus combination. A concentric contraction was found in 4 of the 10 left eyes, a scotoma in 2 cases, and a quadrantic defect, an altitudinal type loss and a hemianopic type defect in one case each. The remaining field was full to the V3 target.

A test - retest reliability study was carried out during the assessment of the youngsters. The retest sample was chosen at random. The sample consisted of 10 youngsters and comprised 9 right eyes and 10 left eyes. Six of the 10 subjects had shown full fields in both eyes at the initial assessment. Two subjects had each exhibited contracted fields in both eyes and one youngster a contracted field in his sole remaining eye. The tenth subject had shown dense para central scotomata. The retest procedure was carried out in exactly the same manner as that of the initial assessment after an interval of between 11 and 14 days. The examiner was unaware as to the nature or presence of any particular field defect.

The degree of test - retest reliability for each subject was expressed in terms of the Pearson correlation coefficient, r, calculated from the paired responses for each of the twelve principal meridians. The nine values of r for the right eyes ranged from $r = 0.41$ to $r = 0.97$, with a mean value of $r = 0.91$ (Guilford 1965). Seven of the values were statistically significant at the 0.01 level or better. The corresponding values for the 10 left eyes ranged from $r = 0.43$ to $r = 0.97$ with a mean of $r = 0.92$. All but one of these values were statistically significant. In the case of the youngster with bilateral scotomata, the degree of test - retest reliability could not easily be expressed in terms of a statistical coefficient. Inspection of the field charts, however, revealed a good degree of similarity between the plots. The central 40° of the charts for this youngster are shown in Fig. 9.2 and 9.3. Of the three statistically non-significant results, two were from subject K.L. and one was from subject M.L. Both of these subjects had markedly contracted visual fields. The retest plots of subject K.L., although of a similar shape, were found to be smaller in size and this was also observed in the case of subject M.L. It was considered, however, that in qualitative terms, the test - retest reliability of these latter plots was satisfactory. The charts for these youngsters are shown in Figs. 9.4, 9.5, 9.6 and 9.7.

It was felt that the results of the pilot investigation and of the test - retest study were such as to merit a continuation of the investigation. Consequently, visual field plots were obtained from a further 133 final year pupils from the 1977/78 and 1978/79 academic years.

One hundred and twelve of the combined sample of 173 youngsters were found to have a normal field in both eyes for target combination V3. A normal field in one eye and a defective field

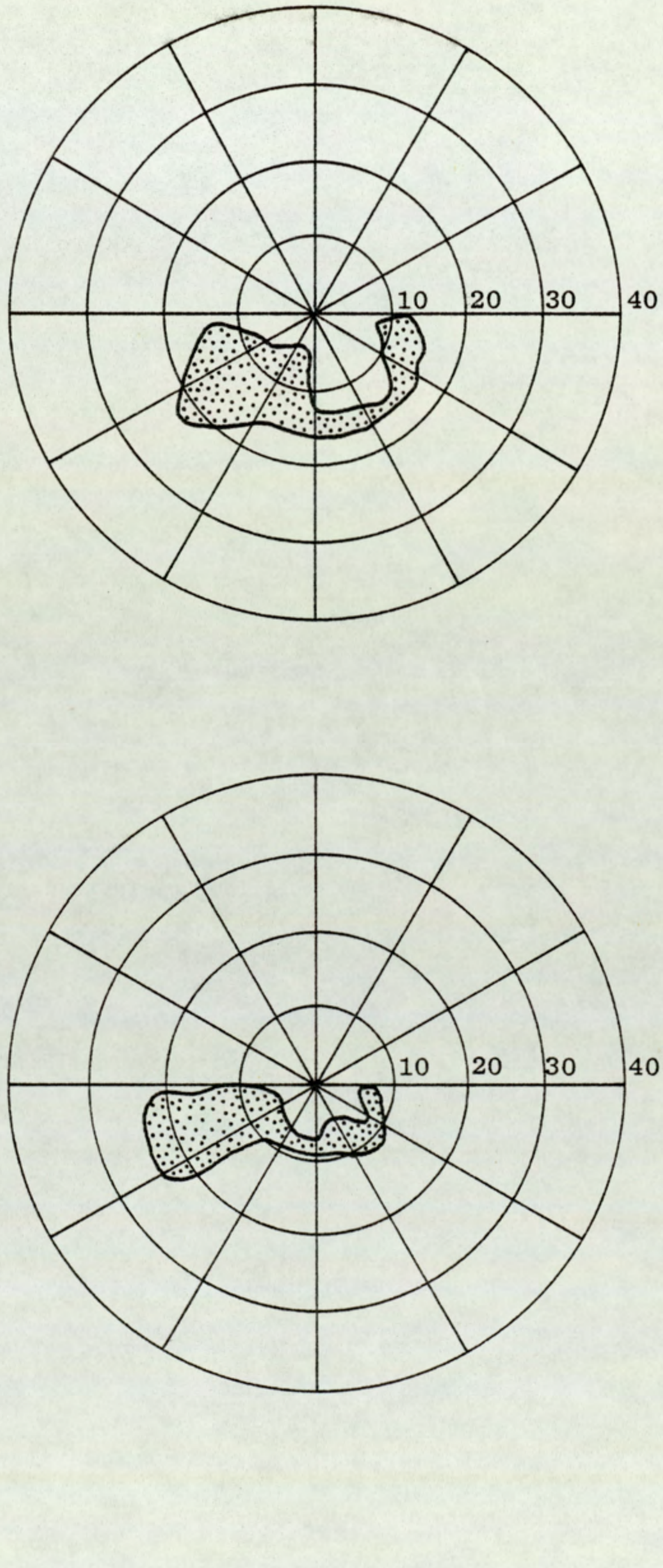


Fig. 9.2. Test (top) - retest (bottom) field plots (Zeiss perimeter) for subject S.R. - right eye. Peripheral field normal, shaded area indicates scotoma.

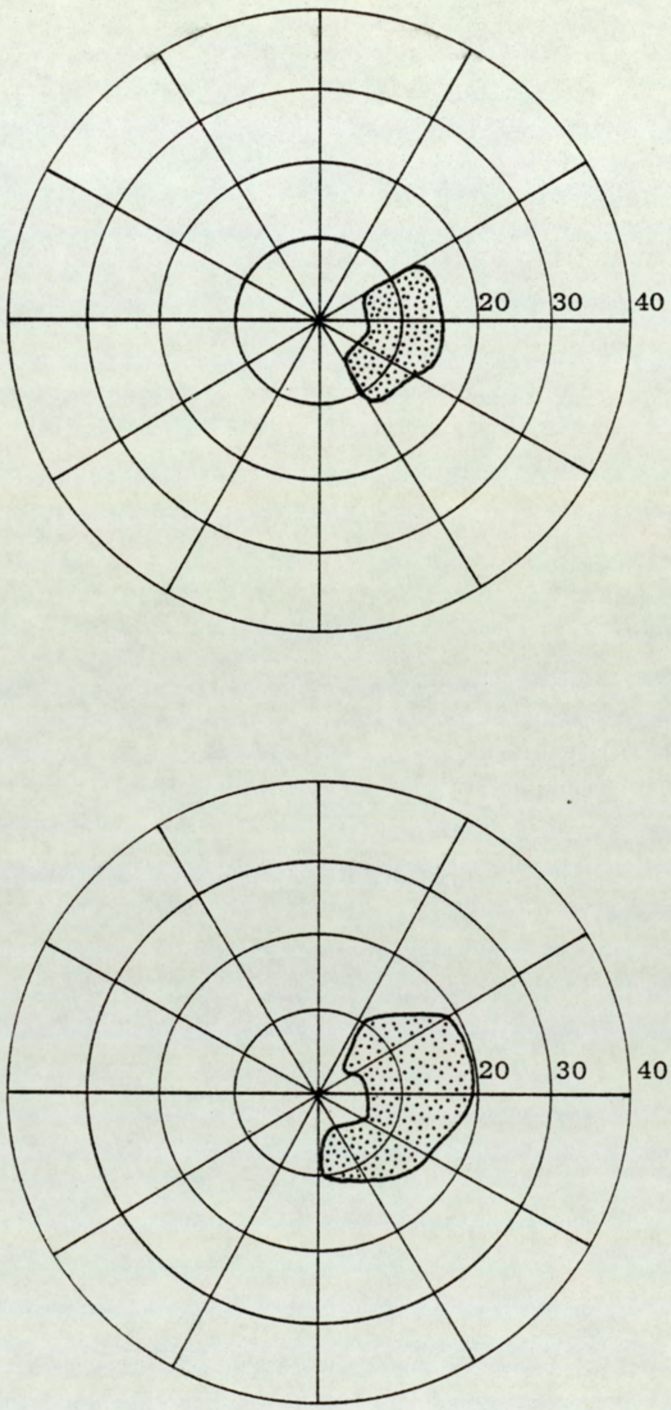


Fig. 9.3. Test (top) - retest (bottom) field plots (Zeiss perimeter) for subject S.R. - left eye. Peripheral field normal, shaded area indicates scotoma.

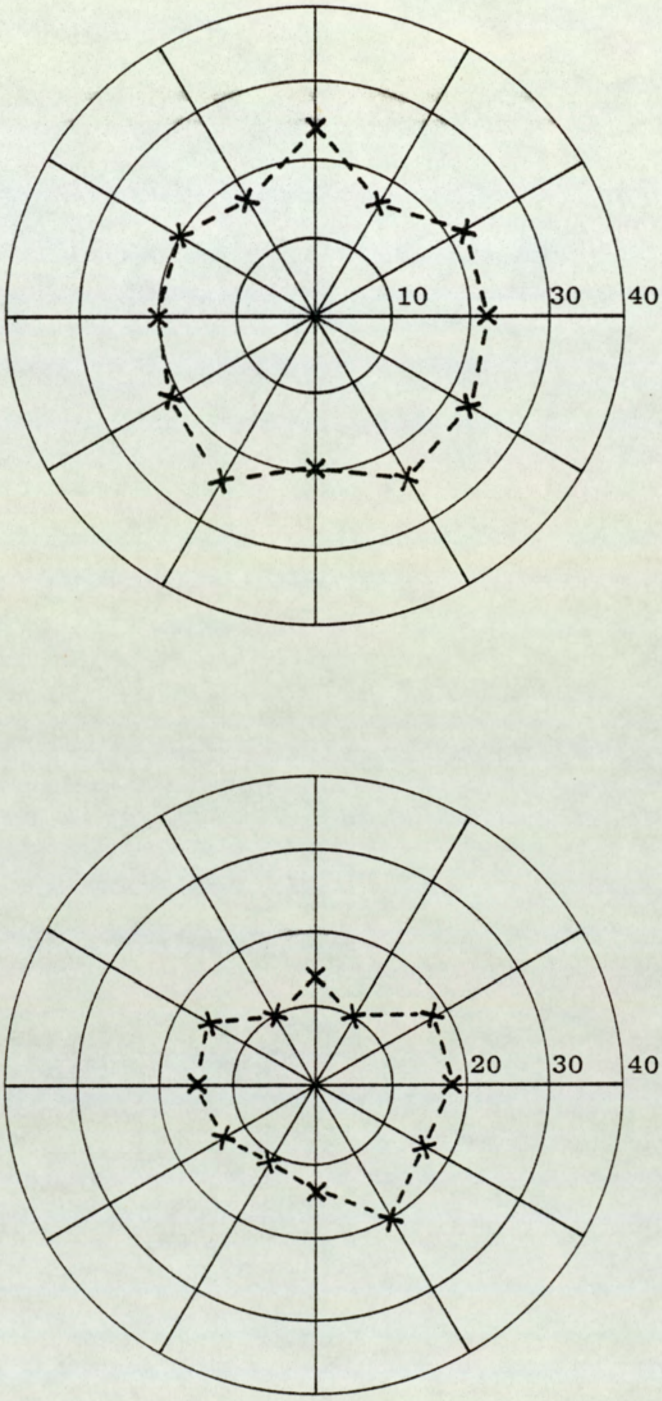


Fig. 9.4. Test (top) - retest (bottom) peripheral field plots for subject K.L. - right eye.

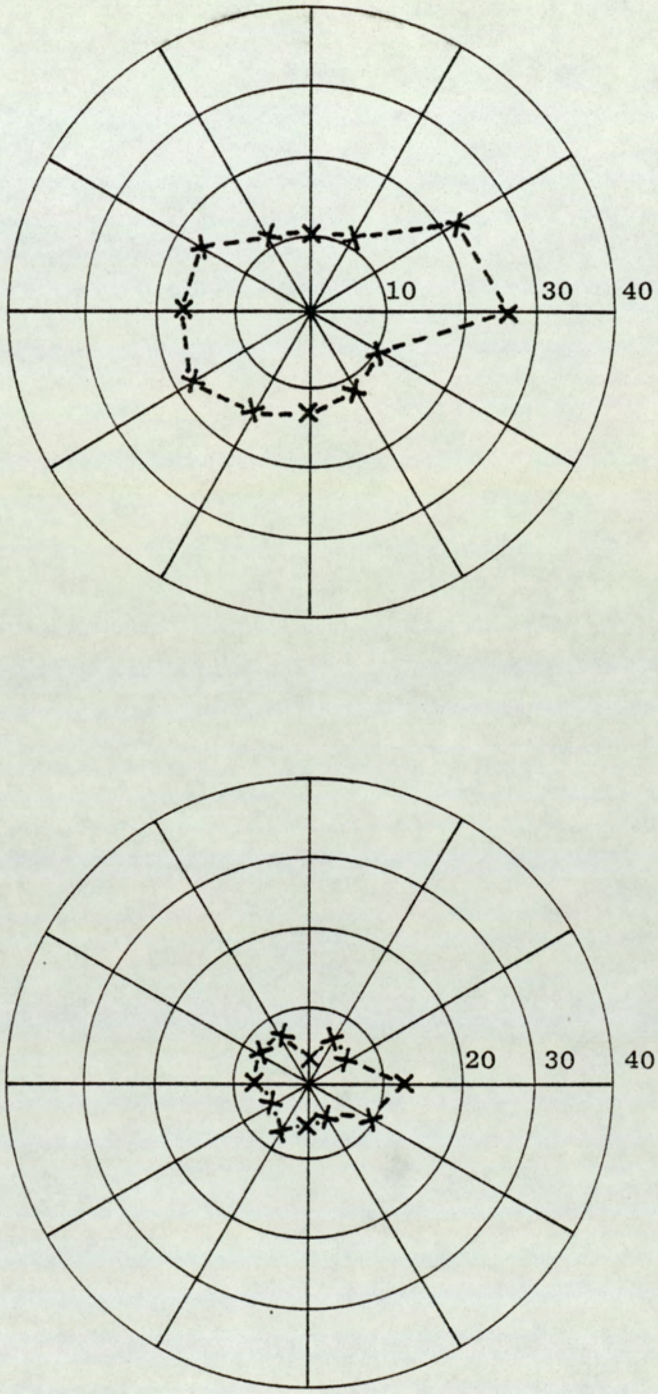


Fig. 9.5. Test (top) - retest (bottom) peripheral field plots for subject K.L. - left eye.

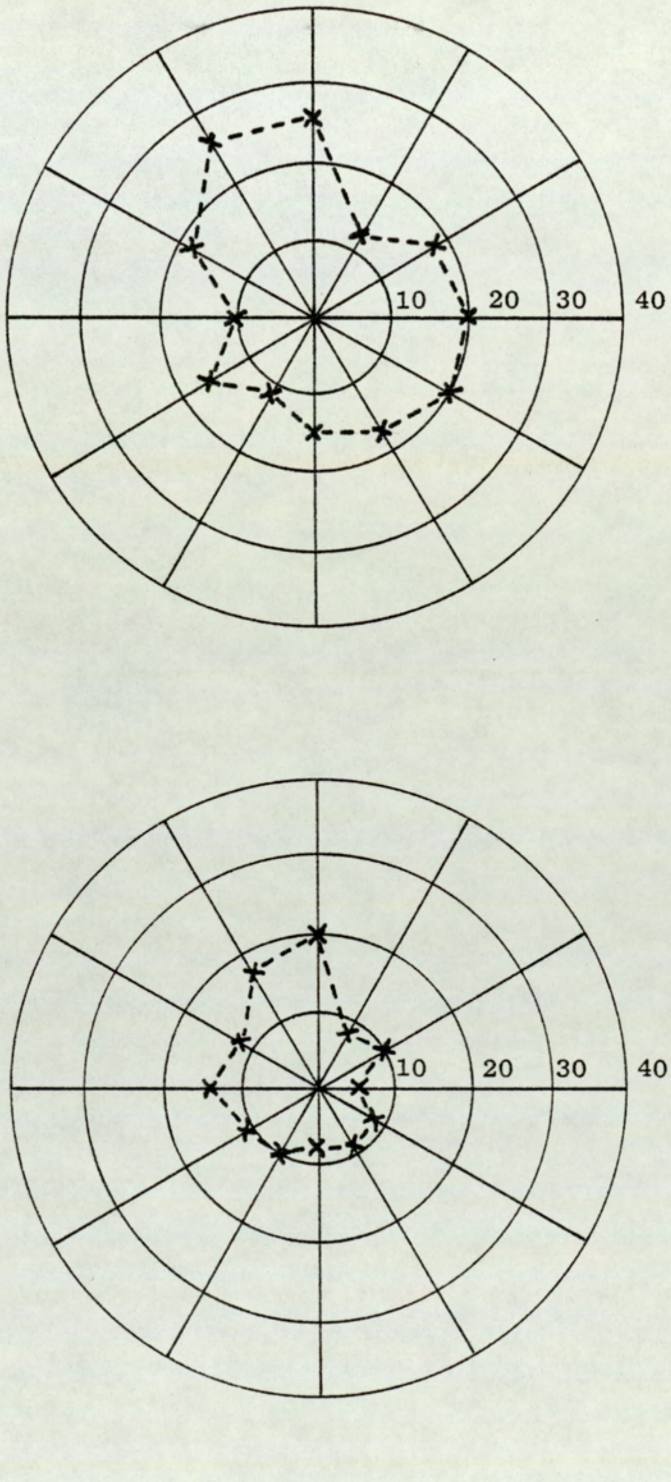


Fig. 9.6. Test (top) - retest (bottom) peripheral
field plots for subject M.L. - right eye.

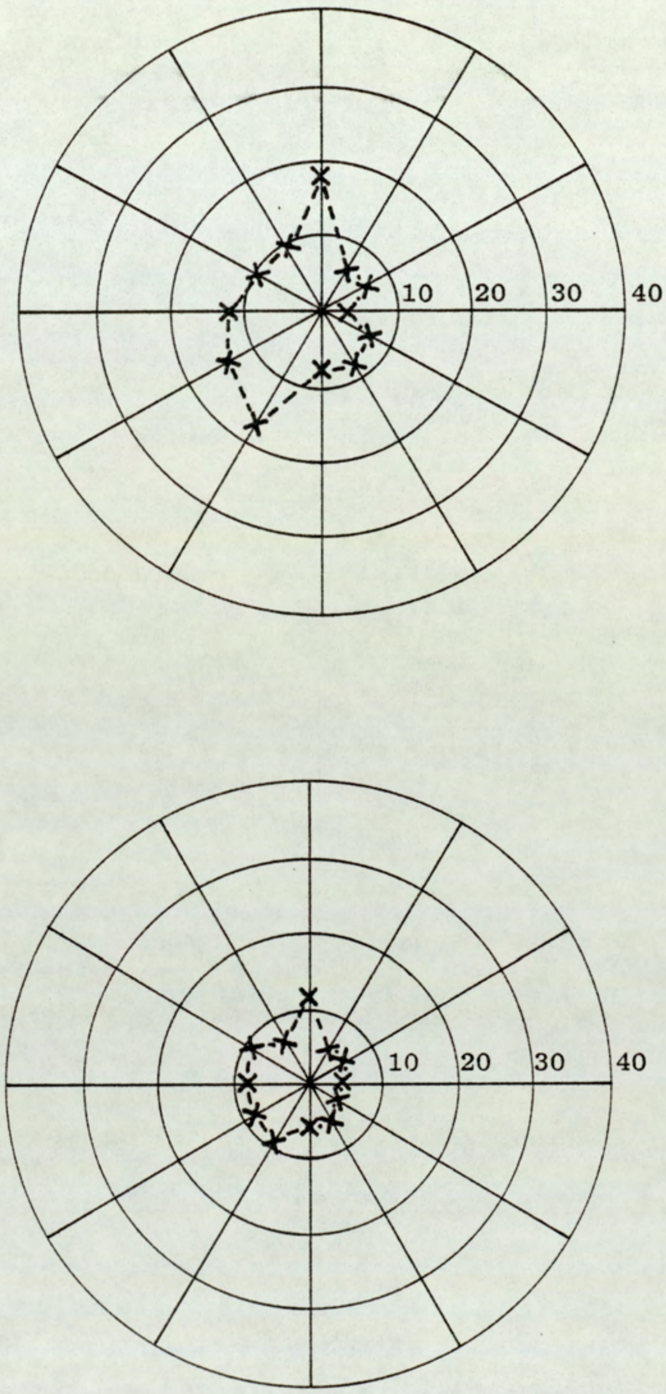


Fig. 9.7. Test (top) - retest (bottom) peripheral field plots for subject M.L. - left eye.

in the other was found in a further 26 cases and 33 youngsters (19.1%) exhibited defective fields in both eyes. (These latter two figures include youngsters with a totally blind or an enucleated eye). A positive evaluation of the field could not be made in a further 2 youngsters.

A field defect was detected in 92 eyes. Of these, a concentric contraction was found in 37 cases and a scotoma in eleven. An hemianopic type defect was present in 6 cases, two of which were bilateral. A quadrantic defect was noted in 4 cases, an altitudinal type defect in 6 instances, and a combined altitudinal and hemianopic type defect in one eye. Twenty-seven subjects were either monocular through enucleation or totally blind in one eye. The results are summarised in Tables 9.4 and 9.5.

9.7 Central Field Investigation

The pilot study with the visual field analyser used in the conventional manner was carried out on a sample of 11 final year pupils chosen at random from the 1977/78 academic year at Exhall Grange School.

The subject was seated before the Friedmann. The previously determined distance refraction together with the near correction for the viewing distance of 33 cm. was placed in full aperture trial lens form before the subject. The procedure was then explained and a practice session undertaken. These preliminaries, which lasted 3-4 minutes also served to adapt the youngster to the lighting levels of the instrument. An assessment of the right eye followed by that for the left was carried out on 6 of

	Subjects	%
Normal fields in both eyes	112	64.7
Defective field in both eyes	33	19.1
Defective field in one eye, normal in other	26	15.0
Uncertain	2	1.2
Total	173	100%

Table 9.4 Results of the peripheral field investigation of 173 youngsters.

	Right	Left
Concentric Contraction	18	19
Scotoma	5	6
Quadrantic type defect	-	4
Altitudinal type defect	3	3
Hemianopic type defect	3	3
Altitudinal/Hemianopic + quadrantic type defect	1	0
Enucleated	10	17

Uncertain (2 subjects : 3 eyes)

Total : 92 eyes

Table 9.5 Summary of the field defects detected with the Zeiss perimeter.

the youngsters with the order being reversed for the remaining 5 subjects.

It was felt, as a result of the pilot investigation, that the conventional operation of the Friedmann was unsuited to the requirements of the study. In particular, it was found that each youngster exhibited a wide and unsystematic variation in the threshold values for the 46 targets. Indeed, this variation was not less than 1.0 neutral density units in 10 of the 11 youngsters (17 eyes). In addition, all the youngsters showed thresholds less than corresponding to the age (2.0). A typical example of the field plots obtained in the pilot investigation is shown in Fig. 9.8. The length of time taken to carry out an examination, approximately ½ hour, was considered to be excessive and stemmed largely from the difficulties in defining the threshold levels. A further problem was also experienced in that ring scotomata were obtained in 3 cases of aphakia.

Consequently, it was decided to modify the technique of investigation with the aim of producing a method more suitable for use among the partially sighted. It was proposed to present the targets at 2 levels of intensity; namely at 1.0 and zero neutral density units. It was felt that this approach was compatible with the criteria of detecting areas of total or near total loss of sensitivity. The technique would thus provide the facility, if desired, for an evaluation of the central field in terms of three levels . seen at 1.0 neutral density units; seen at zero, but not at 1.0 ; and not seen at zero. In addition, it was considered that the revised procedure would considerably reduce the time taken to carry out a complete examination.

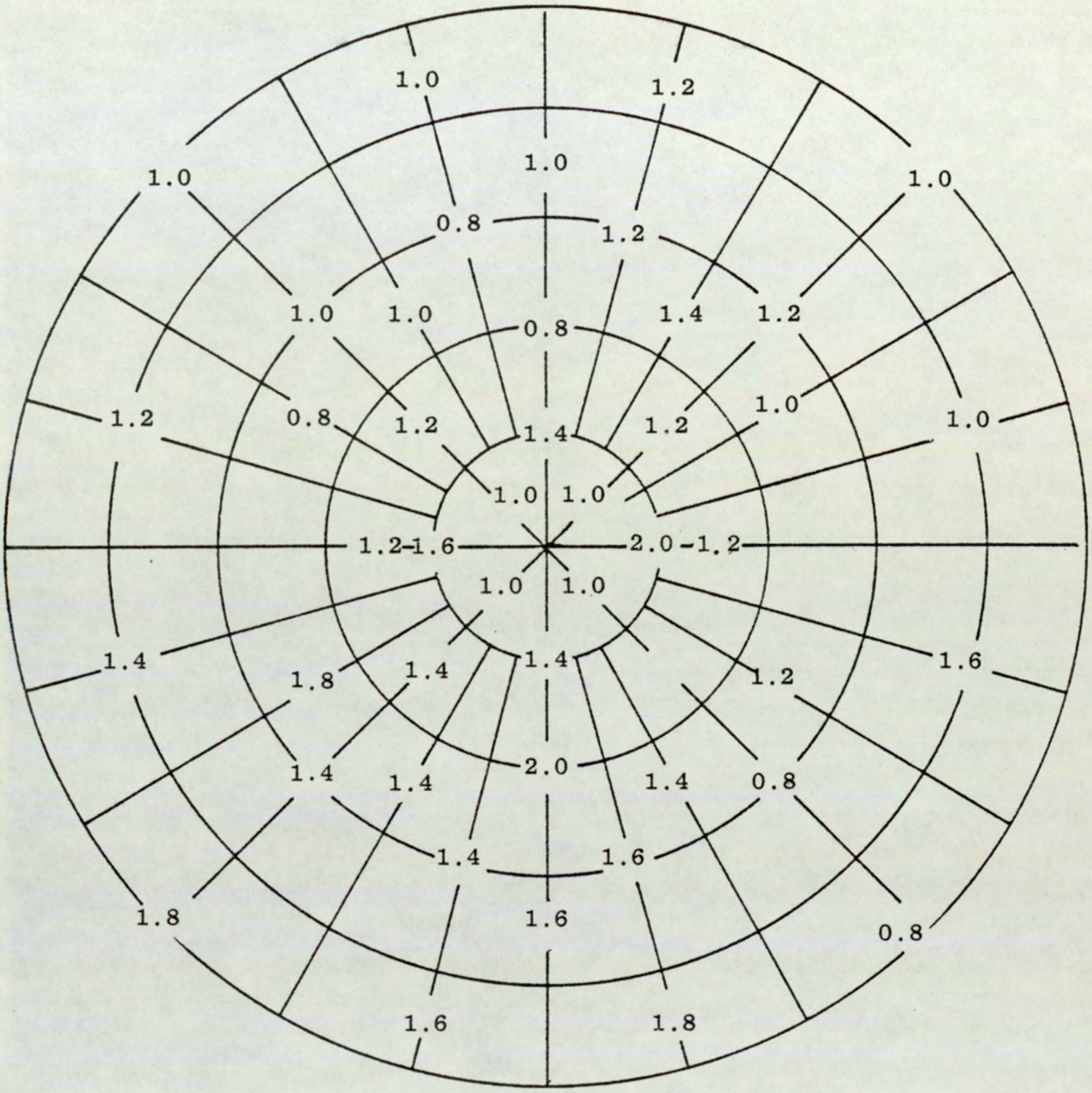


Fig. 9.8. Central field plot obtained with Friedmann operated in conventional manner.

The revised procedure was carried out on a sample of 73 final year pupils from the 1977/78 academic year.

A clear central field for both eyes at a filter setting of 1.0 was found in 38.4% of the sample. Six youngsters showed a full field at this setting in their sole remaining eye. A further 3 individuals had one clear field and one field with stimuli seen either at 1.0 or at zero neutral density units. Four had this level of field loss in both eyes and 4 in the sole eye. Twenty-eight individuals missed one or more stimuli at zero log units, 20 of these having this loss either in both eyes or in the single eye. The results are summarised in Table 9.6.

It was eventually decided to consider visual field loss purely in terms of stimuli missed without any filters in situ. It was felt that stimuli seen at full intensity or at a setting of 1.0 log units would indicate areas in which the loss of sensitivity was such that the response levels could not be meaningfully related to performance with residual vision.

An arbitrary classification was adopted for the qualitative evaluation of the type of field loss. Two more of the 4 centre targets (group P) missed at the zero filter setting were described as representing a paramacular/macular scotoma whilst 3 or more adjacent targets, elsewhere within the central 25^{o}, missed at this setting were defined as representing a field loss. The location of these defects was considered in terms of the specific quadrant affected. The upper temporal field quadrant of the right eye and the upper nasal field quadrant of the left eye were each denoted as quadrant I. This notation was continued in a clockwise direction for the remaining 3 quadrants of each eye, with the upper nasal

All stimuli seen 1.0 neutral density units in both eyes or in sole remaining eye.	34
All stimuli seen at 1.0 log units in one eye and all stimuli seen at either 1.0 or zero in other eye.	3
All stimuli seen at either 1.0 or 0.0 neutral density units in both eyes or in sole remaining eye.	8
All stimuli seen at 1.0 log units in one eye, some stimuli missed at zero filter setting in other.	4
All stimuli seen at either 1.0 or zero log units in one eye. Some stimuli missed at zero filter setting in other.	4
Some stimuli missed at zero log units in both eyes or in sole remaining eye.	20
Total	73 subjects

Table 9.6 Summary of the results obtained with the Friedmann modified method of investigation.

field of the right eye and the upper temporal field of the left being designated as quadrant IV.

Field loss conforming to this definition was found in 22 individuals. Of these, 12 had defects in both eyes or in the sole eye and 10 had a loss in one eye only. In three and four of these cases respectively, the para macular/macular defect was part of a more large scale field loss. (Table 9.7).

A test - retest reliability study was carried out during the assessment of the final year pupils from the 1977/78 academic year at Exhall Grange School.

The retest sample comprised 20 subjects and was selected in a quasi-random manner so as to contain approximately equal numbers of youngsters who had given normal and defective responses at the initial assessment. The final retest sample, however, consisted of 18 youngsters: two subjects who had previously given defective responses were unavailable at the time of retesting. The 18 youngsters represented 10 normal right eye responses, 9 normal left eye responses and 7 defective responses each from the right and the left eyes respectively.

The retest assessment was carried out in a manner identical to that of the test procedure after an interval of 6-7 weeks. The format of the data was such that it was not possible to adequately represent individual test - retest reliability in terms of a statistical coefficient (Hussey 1980). It was felt that the best approach would therefore be to describe the reliability, for the 18 youngsters as a whole, in terms of the contingency coefficient C (Siegel 1956).

<u>Field Loss</u>	R	L
Macular/paramacular scotoma	3	4
Macular/paramacular scotoma as part of a more substantial field loss	3	4
Field loss involving one or more quadrants: I,II, III, IV.	12	8
Total	18	16

Table 9.7 Summary of the field defects detected by the Friedmann modified method of investigation.

The test - retest data was consequently cast into a 3 x 3 contingency table representing the nine possible paired response categories for each of the 46 Friedmann stimuli. The table for the right eye observations (Table 9.8) contains the 46 paired responses made by the 17 youngsters. The contingency coefficient, calculated from the data in this table, has a value of C = 0.617 and is statistically significant ($x^2 = 481.86$, df = 4, $p < 0.001$). The table for the left eye responses (Table 9.9) contains the paired observations made by 16 youngsters. The corresponding value of C for this table is C = 0.585. This value is also highly significant $x^2 = 382.17$, df = 4, $p < 0.001$). The statistical significance of the test - retest data is mainly due to the large number of stimuli seen on both occasions at a filter setting of 1.0 log units.

Analysis of the data for the right eyes shows that of the 63 stimuli not seen at the full intensity on the first assessment, 40 (63.5%) were missed at the same level on the repeat examination. A similar pattern was also present in the results for the left eyes. Of the 78 stimuli not seen at this level on the first examination, 46 (59.0%) were again missed at the second assessment. It was suggested that these differences arose from the lack of a means to control changes in fixation by the subject. Test - retest data was also obtained from a further 5 youngsters exhibiting central field loss. In this instance, the second assessment was carried out after an interval of one day. An acceptable degree of reliability was also obtained from these youngsters. Two such examples are shown in Figs. 9.9 to 9.12.

RETEST

		1.0	0.0	X	
TEST	1.0	542 *459·9*	78 *125·2*	20 *54·8*	640
	0.0	10 *56·8*	62 *15·5*	7 *6·8*	79
	X	10 *45·3*	13 *12·3*	40 *5·4*	63
		562	153	67	

Table 9.8 Contingency table showing the Friedmann test - retest responses for 18 subjects - 17 right eyes. (A stimulus missed at a filter setting of zero is denoted as X) (The expected frequencies are shown in italics).

		RETEST			
		1.0	0.0	X	
	1.0	546 *472·4*	61 *86·3*	4 *52·3*	611
TEST	0.0	13 *36·3*	21 *6·6*	13 *4·0*	47
	X	10 *60·3*	22 *11·0*	46 *6·7*	78
		569	104	63	736

Table 9.9 Contingency table showing the Friedmann test -retest response of 18 subjects - 16 left eyes. (A stimulus missed at a filter setting of zero is denoted as X). The expected frequencies are given in italics.

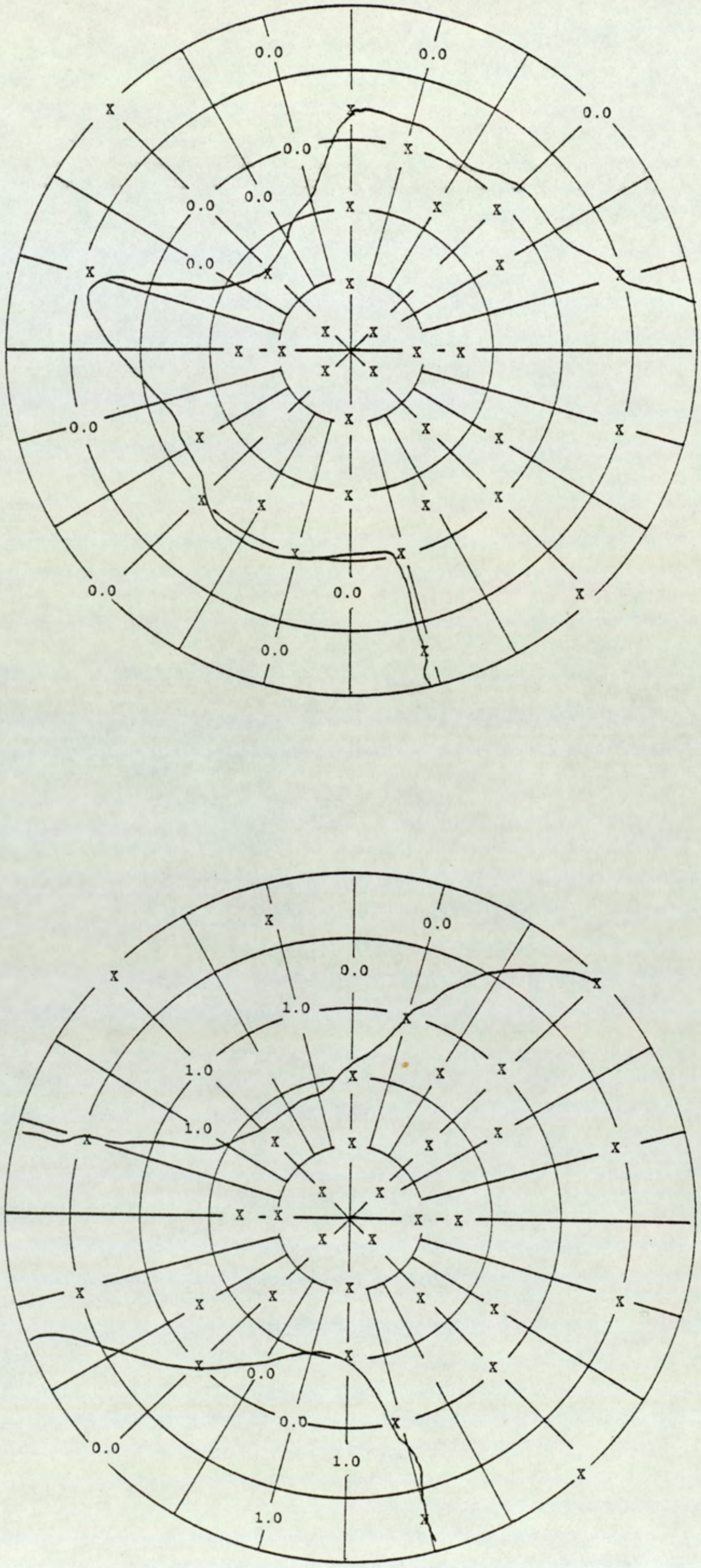


Fig. 9.9 Test (top) - retest (bottom) Friedmann central field plots. Subject S.L. - right eye. (X denotes stimuli missed at a filter setting of zero).

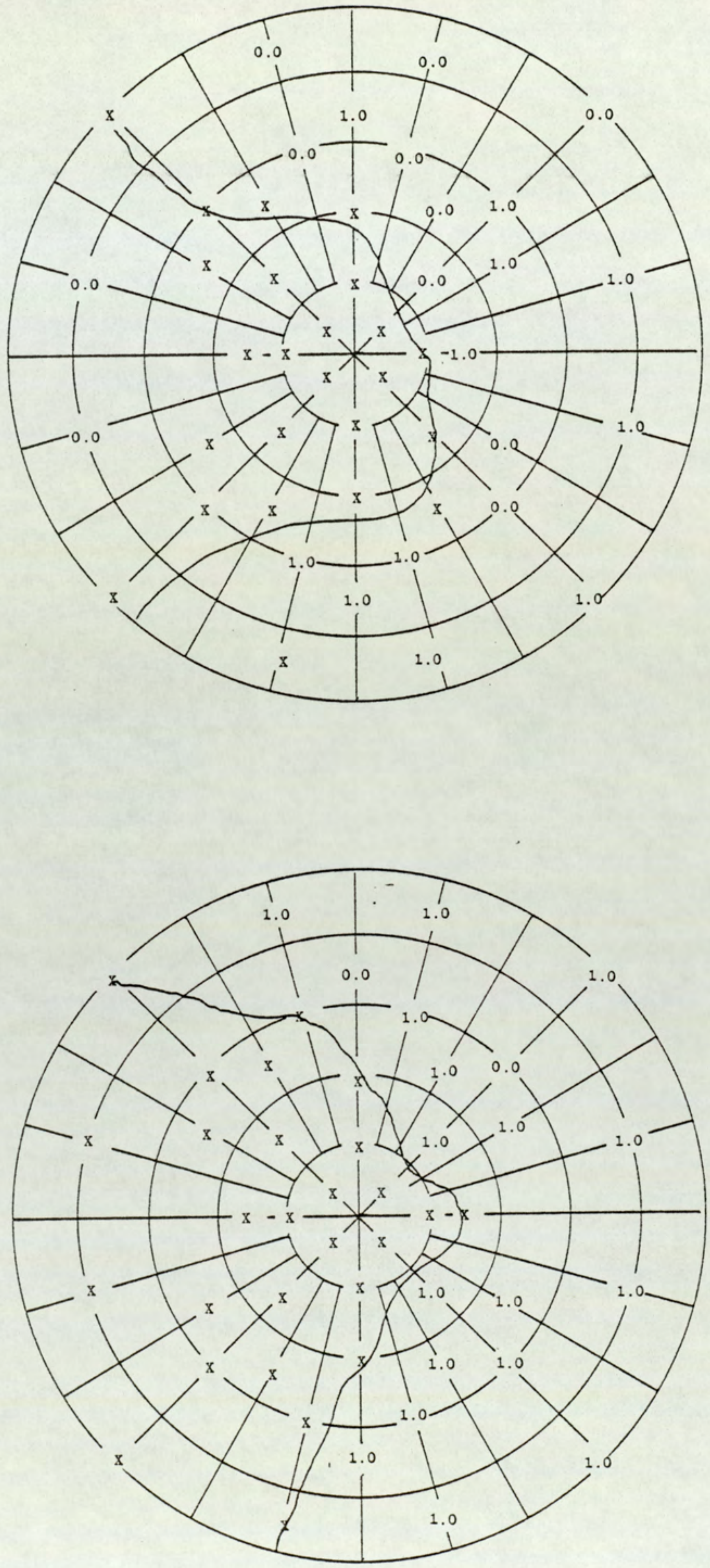


Fig. 9.10 Test (top) - retest (bottom) Friedmann central field plots. Subject S.L. - left eye. (X denotes stimuli missed at a filter setting of zero.

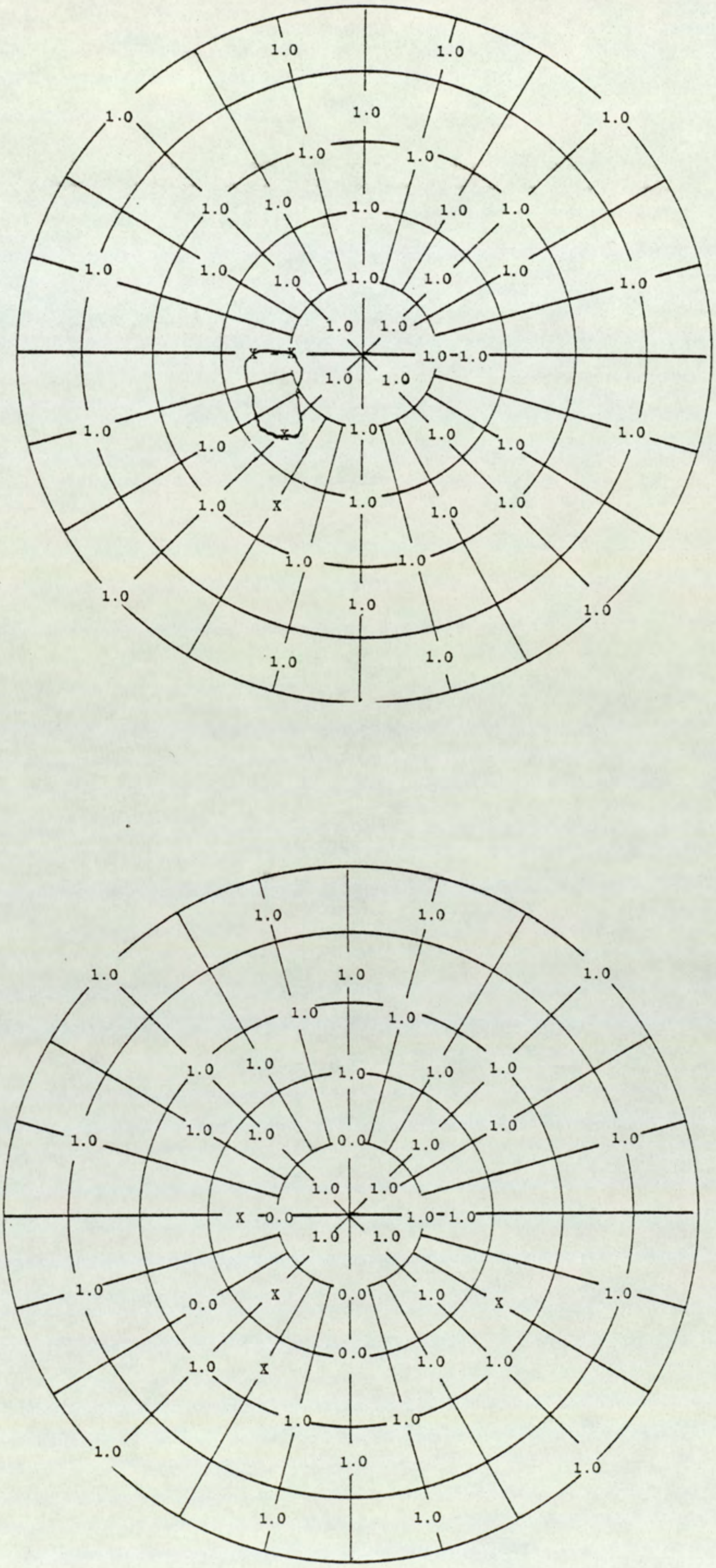
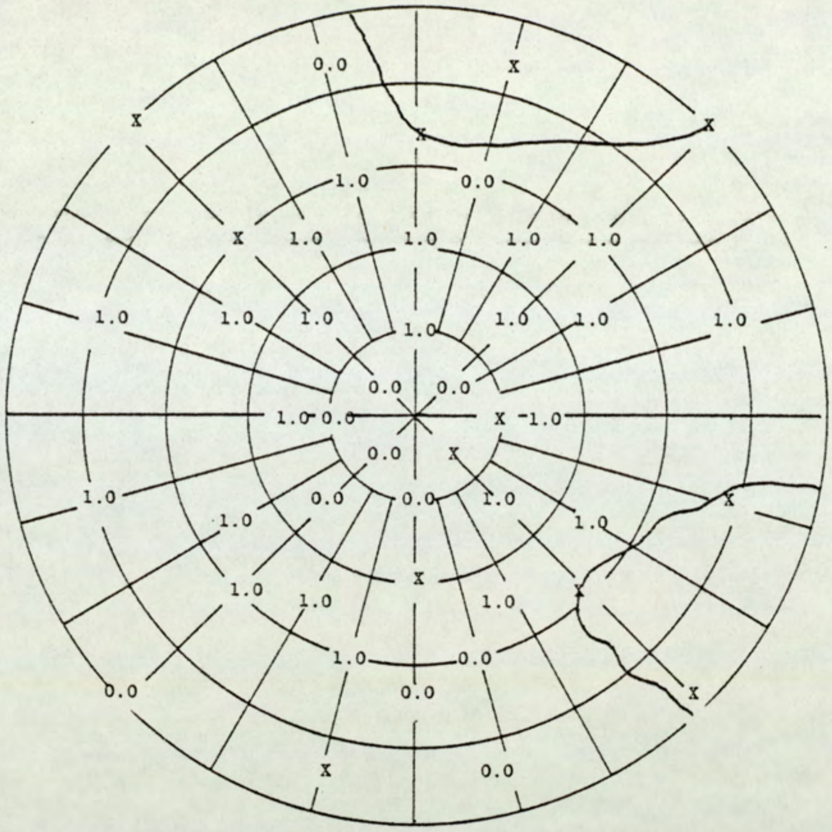


Fig. 9.11 Test (top) - retest (bottom) Friedmann central field plots. Subject D.R. - right eye. (X denotes stimuli missed at a filter setting of zero).



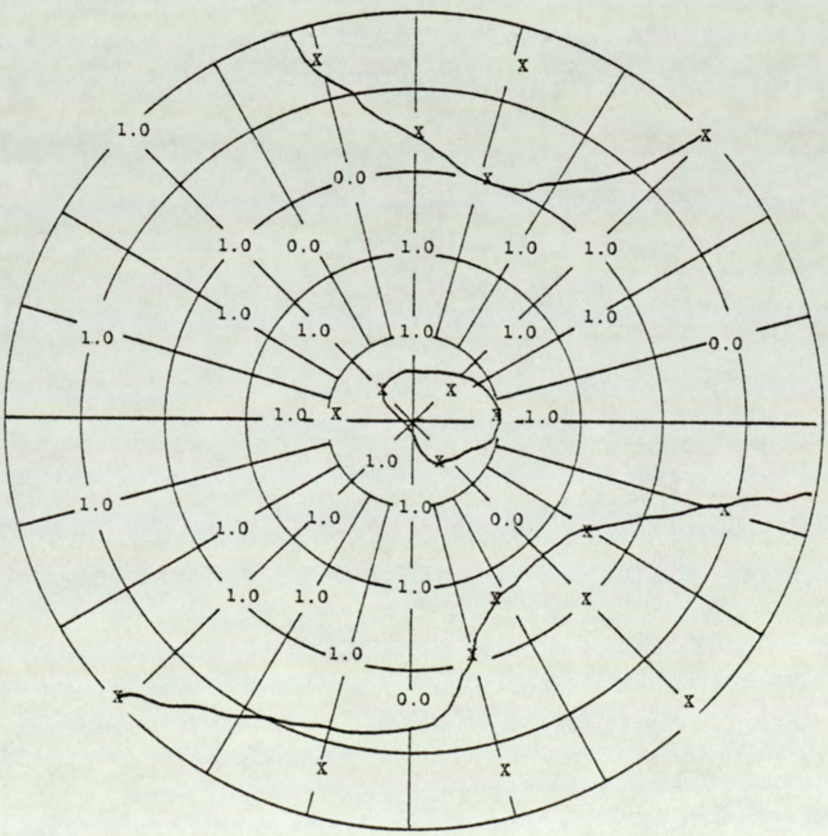


Fig. 9.12 Test (top) - retest (bottom) Friedmann central field plots. Subject D.R. - left eye. (X denotes stimuli missed at a filter setting of zero).

It was decided, as a result of the decision to score central field loss purely in terms of stimuli missed without any filters in situ (i.e. the zero setting), that the targets should be presented at full intensity for the remainder of the study. Such a procedure also had the additional advantage of reducing the time taken to carry out each individual assessment.

A total of 21 final year pupils from the 1978/79 academic year at two schools were examined with the revised procedure. The limited number of youngsters examined with this modified technique was due to lack of available time. A field defect, either in both eyes or in the sole remaining eye, was found in two cases whilst a further two youngsters showed monocular field loss.

The relationship between occupational success and field loss will be discussed in Section 15.

10 COLOUR VISION

10.1 Rationale for the Investigation of Colour Vision

An investigation of the colour vision of partially sighted youngsters was considered appropriate for two reasons. The influence of colour perception as a possible component of visual ability has been recognized by several workers (Zimmerman 1965; Richterman 1965; Sicurella 1977). Indeed, Sicurella (1977) clearly showed the significance of colour contrast in augmenting performance with residual vision.

The importance of colour vision in relation to industrial and occupational performance has been discussed by several authors (Cole 1964; Dreyer 1969; Taylor 1971; Voke 1978; 1980a;b). These commentaries, however, have largely been in the context of the implications for individuals with congenital colour deficiencies. Occupations involving the judgement of colour can essentially be divided into those in which safety requirements demand good colour perception and those in which the ability to successfully carry out the job is dependent upon good colour discrimination.

The proportion of individuals in the normally sighted population with colour vision anomalies is small. The choice of occupation for the vast majority is, therefore, not restricted by defective colour vision. The incidence of colour vision defects in the partially sighted population, however, is substantially higher. Indeed, it is considered that all eyes with reduced acuity due to retinal and neural diseases exhibit some type of acquired colour vision anomaly (Marré 1973). Consequently, the colour sense would seem to be an important factor in the consideration of occupational potential among this group.

The aim of the investigation was considered to be twofold; namely to develop a repeatable technique for assessing the colour vision of partially seeing youngsters and to compare the findings with the subsequent levels of occupational success.

10.2 Previous Studies

Much of the latter work on acquired colour vision deficiencies has been carried out by Cox 1960; 1961; Francois & Verriest 1961; Verriest 1963; and Marré 1973.

The current classification of acquired colour vision deficiency, based largely on the work of Verriest 1963, has been reviewed by Ball (1972); Grutzner (1972); Lyle (1974); Pinckers (1976). Four distinct categories of defect are presently recognised. The principal feature of the first type is the lack of a prominant axis of deterioration. It can occur either in a trichromatic or a monochromatic form. The second group has been labelled the type I red-green defect. It was first noticed in individuals with juvenile macular degeneration. The main confusion axis in the trichromatic stage lies between those for both the protan and the deutan. Anomoloscope results from individuals with this type of anomaly resemble protanomalous findings. At the dichromatic stage, the confusion axis lies initially between those for the protan and deutan and, later, between the deutan and tritan axis. Anomaloscope data at first are similar to that of a protanope and then subsequently to that of a typical monochromat. The type II red-green defect occurs in most diseases of the optic nerve and of the anterior visual pathway. The main confusion axis lies between those of the protan and the deutan. The deficiency is characterised by a deutan like discrimination defect. An associated blue-yellow defect is often present with this type of anomaly. The fourth category of deficiency is the blue-yellow defect which occurs in most diseases of the retina. It is characterized by a tritan like discrimination defect.

The colour vision of the visually handicapped, as a distinct group, has been the subject of several studies. Sloots-Smits, Meyer, Wibaut & Schappert-Kimmijser (1967) investigated the colour vision of 66 children attending two schools for the partially sighted in Holland. The children, 41 boys and 25 girls, were examined with the Nagel anomaloscope and the H-R-R and Ishihara pseudo isochromatic plates. Sloots-Smits et al reported that the number of children with disturbances of colour vision was markedly high. They found, however, that the status of the colour vision varied according to the particular test. Thirty of the 66 youngsters had normal colour vision with the anomaloscope, whilst 37 passed the H-R-R and Ishihara tests. Normal colour vision on all three tests was, however, found for only 25 of the youngsters.

Kaiser (1972) investigated the colour vision of six legally blind subjects who were attending the Canadian Institute for the Blind. The age of the subjects ranged from 29 to 57 years with a median value of 46.5 years. Four of the subjects had corrected distance acuities in the better eye of 20/200. The acuity of the remaining two subjects was 20/400 and 3/200 respectively. The six subjects, together, possessed a wide variety of ocular disorders.

Colour vision was examined with the H-R-R plates and a colour naming procedure developed by Boynton, Schafer & Neun (1964). The targets for the colour naming procedure were 19 monochromatic lights, rear projected onto a ground glass screen, and subtending a field of 15^{o}. The colours were produced by filtering light from a xenon arc lamp through a continuous interference filter. The luminance of each colour was equated by filtering through a circular neutral density wedge. The wavelength of the lights ranged from 470 to 650 nm. The lights each had a half band width of 12 nm and were separated by 10 nm. The subjects were essentially instructed to describe the colour of the field in terms of four colour names: red, yellow, green and blue. The stimuli were each presented once and in random order. The interval between presentation of each target was not less than two minutes.

Kaiser reported that three subjects produced a normal response to the H-R-R plates, one was found to be a mild protan and two were unable to carry out the task. A normal colour naming response was found for the subjects categorized as normal on the H-R-R test. In addition, the mild protan subject gave colour naming results indistinguishable from the normal response. Abnormal colour naming results were obtained from the individuals who were unable to carry out the H-R-R task.

Genensky, Petersen, Clewett & Moshin (1975)investigated the colour discrimination of 13 male and 6 female visually handicapped observers. The age of the sample ranged from 9 to 84 years, with a median value of 38 years. The most frequently occurring ocular disorders among the sample were congenital cataract, macular degeneration, retrolental fibroplasia, optic atrophy and pathological myopia. The distance visual acuity in the better eye ranged from 20/600 to 20/30, the median acuity being 20/160.

Genensky and his colleagues used four tests to assess the degree of colour vision. Two of the tests, the H-R-R. pseudo - isochromatic plates and the Farnsworth D15 test, involved standard clinical methods while the remaining two, a modified D15 and a Colour Chip Transmission Test, were specially devised for the investigation. The modified

D15 test consisted of test circles with an area of more than five times that of the standard test. The Colour Chip Transmission Test basically consisted of a fluorescent light source contained in a light-box. One side of the light box consisted of a frosted glass and a matt-black board containing 11 different coloured filters each mounted behind an aperture one inch in diameter. An additional aperture without a filter, served as a control for the experiment. The targets could be viewed singly or in any combination. The veiwing distance for both the H-R-R. and the Transmission Test was selected by the patient.

A normal result was found for six of the 16 individuals who were assessed with the H-R-R plates. The remaining ten subjects, however, were unable to cope with the task. In contrast, a result was obtained from all but two of the 19 subjects who were examined with the D15 test. These two subjects, when assessed with the larger version of the test, were able to undertake the task satisfactorily. The colour deficiencies indicated by the D15 tests compared favourably with those of the Transmission Test.

10.3 Rationale for Method of Investigation

The method of colour vision assessment for the current study was decided after much discussion amongst the research workers associated with the project. It was proposed to use the second edition of the H-R-R pseudo isochromatic plates developed by Hardy, Rand & Rittler (1954a, b; 1956) and The City University Colour Vision Test (City Test) introduced by Fletcher (1972; 1975; 1976; 1978)*. It was felt that these tests represented a useful compromise between the theoretical and the practical demands of the study.

*A second edition of The City University Colour Vision Test has subsequently been published (Fletcher 1980a, b).

The various types of colour vision test have been reviewed in recent years by several authors (Linksz 1971; Voke 1973; Adams 1974). Most of the clinical techniques of investigation, such as the pseudo-isochromatic charts and the colour matching tests, are primarly designed to detect the congenital type of colour vision anomaly and are not very satisfactory for assessing acquired defects of colour vision (Marré 1973). It is perhaps for this reason that Ball (1972) advocates the use of a battery of tests for the investigation of such defects.

The H-R-R test is considered to be the most suitable of the pseudo-isochromatic charts for investigating acquired defects (Francois & Verriest 1961; Verriest 1963; Marré 1973). The disadvantage of the pseudo-isochromatic tests, however, is that they are based on the confusion loci of known congenital types of defect and cannot be adapted to accept the variations of colour confusion encountered in acquired defects (Francois & Verriest 1961; Lakowski 1969; Smith 1972; Marré 1973; Edbury 1974; Lyle 1974).

The City Test is based on Farnsworth's DI5 test which is, itself, derived from the Farnsworth Munsell 100 hue test introduced by Farnsworth (1943). The latter test covers the complete hue circle and permits the expression and direction of both the main, and any secondary, axis of confusion. The 100 hue test is also considered to be the most reliable clinical pigment test for investigating acquired anomalies of colour vision (Marré 1973; Edbury 1974). Indeed, it is widely used for documenting both congenital and acquired deficiencies (Verriest et al 1962; Roth 1966; Dubois-Poulson 1972). It is, however, rather laborious as it takes approximately 15-20 minutes to administer and to score the result. In contrast, the D15 test has the advantage of being easy to perform and simple to evaluate; a result can be obtained and scored for most subjects in less than five minutes (Voke 1973). It is considered to be particularly suitable in cases where the visual acuity, visual field and colour discrimination are all very poor (Francois & Verriest 1961). In addition, it can be used with children as young as 4-5 years of age. The test was originally designed to separate normal and mildly colour defective observers from those with moderate to severe colour deficiencies and who could thus be expected to experience difficulties with colours (Adams 1974). Indeed, it is generally agreed that individuals who pass the D15 test should have no difficulty performing tasks involving colour even if other tests have categorized the observer as being colour defective (Cole 1964; Linksz 1971). As a consequence, mild colour defectives can of course be missed with the test (Marré 1973; Edbury 1974). It was felt that the format of the City Test was most suited to the requirements of the study in that it was compact and capable of facilitating a speedy assessment of colour vision.

The H-R-R test is designed to be administered at a viewing distance of 30 inches (76.2 cm). The dimensions of the three symbols used in the test subtend, at this distance, approximately $4^{\circ} \times 4^{\circ}$, $4.3^{\circ} \times 4.9^{\circ}$ and $5^{\circ} \times 5^{\circ}$ respectively.

It has been reported, however, that partially sighted observers often experience difficulty in successfully carrying out the H-R-R. task even at reduced viewing distances (Kaiser 1972; Genensky et al 1975). Indeed, Genensky et al maintain that the visual complexity of the H-R-R. test is such that it can "play havoc" with many partially sighted people. They suggest that the format of the test is a major reason for the poor performance encountered among this group.

The effect of reduced acuity on performance in relation to the Ishihara pseudo-isochromatic test has been debated, from a theoretical aspect, by Gordon & Field (1978); Taylor & Woodhouse (1979) and Gordon (1979). Two of these workers, Taylor & Woodhouse, point out that the line width of an Ishihara figure subtends approximately 20' at the normal 75 cm.viewing distance of the test. They consider that as the task is equivalent to a distance acuity of 3/60, it should be seen by observers possessing normal colour sense and an acuity equal to or better than this value. The line width of the H-R-R symbols is greater than those of the Ishihara figures and the viewing distances of the two tests are similar. Consequently, it could be assumed on this basis, that the H-R-R test would be suitable for individuals with poor acuities.

It was felt that the reported clinical findings regarding the visibility of the H-R-R. plates by the partially sighted outweighed the theoretical considerations. It was, therefore, decided to administer the plates at a viewing distance of 33 cm. It was hoped that the increased visual angle resulting from this procedure would aid resolution of the plates by the partially sighted observers in the study. In addition, it was considered that a viewing distance of 33 cm more closely approximated both the habitual viewing distance of these individuals and also the more usual work interface. The line width of the symbols subtended approximately 115' at this distance while the total angular subtents of the three symbols were $9.0^{\circ} \times 9.0^{\circ}$, $10.0^{\circ} \times 11.3^{\circ}$ and $11.5^{\circ} \times 11.5^{\circ}$ respectively. These values thus bear close comparison to the 10° field adopted for the C.I.E. (1964) supplementary observer (Stiles 1958; Speranskaya 1958).

The City Test is designed to be administered at a viewing distance of approximately 35 cm (Fletcher 1975). The individual circles of colour subtend approximately 1.4° at this distance while the overall field subtends an angle of 7.3°. A reduced viewing distance of 25 cm. was, however, selected in order to render the test more appropriate for use among the partially sighted. The corresponding angular subtents at this modified distance were 2.0° and 10.2° respectively.

10.4 Materials and Methods

A G.E.C. colour cabinet was used to provide the appropriate light source for the two colour vision tests. The tests were mounted inside the cabinet and supported on a 45° perspex lectern.

The particular viewing distance for each test was maintained by the use of a chin rest. The rest allowed lateral head movement and prevented excessive anterior-posterior movement. The angle of the rest also served to position the subject's line of sight in a plane perpendicular to the test targets. The appropriate viewing distances (33 cm for the H-R-R plates and 25 cm for the City plates) were achieved by altering the distance between the colour cabinet and the chin rest and by adjusting the height of the rest. The tests were administered in a lightproof room with all normal room lighting excluded.

The initial investigation was carried out on an unselected sample of 37 final year pupils from 1976-77 academic year of Exhall Grange School, Coventry.

A well defined procedure was adopted for the assessment of the subjects. The youngsters were seated on a vertically adjustable stool. The previously determined refractive correction was placed in a trial frame and positioned before the subject. The left eye was occluded and the appropriate correction for the H-R-R viewing distance of 33 cm.

placed before the right eye. The use of a viewing distance lens avoided the necessity for any accommodative effort on the part of the youngster. The H-R-R. test was placed in situ and the task explained with the aid of the demonstration plates. These procedures, which lasted 4-5 minutes, also served to adapt the youngster to the lighting levels of the colour cabinet. An assessment of the right eye was then carried out. The right eye was occluded following this assessment and the viewing distance lens for the City Test placed before the left eye. The positions of the chin rest and colour cabinet were altered to achieve the desired 25 cm.viewing distance. The H-R-R plates were replaced with the City Test and the task explained to the subject. The left eye was then examined with the City Test. A binocular assessment was then carried out with the H-R-R plates. Subsequent assessments were undertaken on the right eye with the City Test and on the left eye with the H-R-R plates. A final binocular assessment was then carried out with the City Test. The mode of presentation of the two tests is summarized diagramatically in Table 10.1

The plates of both tests were administered in a particular order. The screening plates of the H-R-R test were presented to the right eye in an ascending sequence and in randomized orders for both the left eye and the binocular assessment. The diagnostic plates were shown, where appropriate, in the normal sequence. The plates of the City Test were administered in separate randomized orders for each of the three modes of examination. The sequence of presentation of the plates for the two tests is shown in Tables 10.2 and 10.3. It was hoped that such a procedure would minimise the influence of any learning effect on the results from the two tests.

No set time period was alloted for either test, but all subjects were encouraged to respond as quickly as possible. The remaining

		H-R-R. Test	City Test
	Right	1st	4th
EYE	Left	5th	2nd
	Both	3rd	6th
		Sequence	

Table 10.1. Showing the order of presentation of the H-R-R and The City University Colour Vision Tests

	EYE		
	Right	Left	Both
SCREENING PLATES	1	4	1
	2	2	4
	3	1	2
	4	5	5
	5	6	3
	6	3	6

Table 10.2. Showing the order of Presentation of the H-R-R Screening Plates

	EYE		
	Right	Left	Both
PLATE NUMBER	2	10	6
	1	5	4
	7	1	8
	6	7	3
	10	6	10
	8	2	2
	5	9	9
	9	3	1
	4	8	7
	3	4	5

Table 10.3. Showing the order of presentation of The City University Colour Vision Test plates.

instructionsto the subjects were as described in the appropriate test manuals.

10.5 Results, Modifications and Further Investigations

Fourteen youngsters (37.8%) gave normal responses to the H-R-R. test under all viewing conditions, namely monocularly and binocularly. Seven subjects (18.9%) were found to have definite colour deficiencies under similar viewing conditions.

An additional 10 subjects (27.0%) although giving normal responses with binocular viewing, failed to satisfactorily discriminate one plate (screening plate 3) when viewing it under monocular conditions. In some subjects, this failure was found to involve only one of the two functioning eyes, whilst in others, both eyes were affected. Six of the ten subjects, however, subsequently gave the correct response to this plate when it was presented at reduced viewing distances ranging from 25 to 10 cm. Two of the youngsters were unable to see one of the symbols on this plate (the triangle) at any distance. The other two subjects were not retested.

A further two subjects failed screening plate 3 under all viewing conditions, but identified the remaining plates correctly.

Two of the 35 youngsters, under similar viewing conditions, failed screening plate 3 and one other of the screening plates. The remaining two youngsters in the sample were unable to understand the requirements of the H-R-R test. The results are summarized in Table 10.4.

Twenty-four of the 37 subjects in the sample (64.9%) gave normal responses to the City Test under all viewing conditions. Five subjects (13.5%) were found to be colour defective under similar observation states. Three youngsters showed a colour deficiency when the right

CATEGORY	Number of partially sighted youngsters
Normal response under right, left, and binocular viewing conditions.	14
Colour defective response under right, left and binocular viewing conditions	7
Normal response under binocular viewing conditions, but unable to correctly identify plate 3 when viewed monocularly with either/or both the right and left eyes	10
Unable to identify plate 3 under right, left and binocular viewing conditions - otherwise normal response.	2
Unable to identify plate 3 and one other screening plate under right, left and binocular viewing conditions.	2
Unable to understand test	2
Total	37

Table 10.4 Showing a summary of the responses to the H-R-R plates by the 37 partially sighted youngsters.

and left eyes were examined separately, but a normal response when the plates were viewed binocularly. One youngster gave a normal response both binocularly and with one eye, but was found to be colour defective in the other eye.

Inconclusive results were obtained from two subjects who were shown to have normal colour vision with each eye independently, but were found to be defective when the plates were viewed binocularly. A third youngster gave a defective response both when viewing binocularly and with one eye, but a normal response when viewing monocularly with the other eye. One youngster, who was unable to understand the requirements of the H-R-R plates, was also unable to respond to the City Test. The results are shown in Table 10.5.

A comparison of the results from the two tests showed that four youngsters gave defective responses on both the H-R-R and the City plates. Two subjects were normal on the City Test, but defective on the H-R-R test, whilst one subject showed the reverse. The greater proportion of individuals producing a normal response on the City Test was largely due to the numbers who solely had failed plate 3 in the H-R-R test.

It is difficult to understand whether the failure to correctly identify the third H-R-R plate was due to a true colour deficiency or to an artifact associated with the nature of the plate. Of those who failed this plate only, seven had some form of congenital cataract and three were diagnosed as being albinos. It is possible therefore that the failure was associated with the intensity of the task illumination and the saturated nature of the symbols contained in the plate. It was nevertheless felt that the nature of the results was such as to warrant a continuation of the experiment on a larger sample of youngsters.

Category	Number of partially sighted youngsters
Normal response under, right left and binocular viewing conditions	24
Colour defective response under right, left and binocular viewing conditions	5
Normal response under binocular viewing conditions but defective under right and left observation states	3
Normal response under binocular viewing conditions and with one eye, defective with second eye	1
Colour defective response with binocular viewing conditions and with one eye, normal response with second eye	1
Inconclusive	2
Unable to understand test	1
Total	37

Table 10.5 Showing a summary of the responses to The City University Colour Vision Test by the 37 partially sighted youngsters.

It had become apparent, however, in the early stages of the colour investigation that the size and weight of the colour cabinet was such as to preclude its use in the remaining two years of the study. Consequently, considerable attention was paid to the choice of an alternative method for producing the desired type of illumination.

The illumination recommended for the H-R-R test is C.I.E.standard illuminant C or a close approximation to this source (Hardy, Rand and Rittler 1957). The appropriate illumination for the City Test is either daylight from a blue North sky or light from a tungsten lamp filtered to a colour temperature of 6500°K. Certain fluorescent tubes are, however, also acceptable for this test (Fletcher 1975).

A major problem in the area of colour vision testing is the lack of an inexpensive and readily available artificial source of daylight. The source of illuminant C recommended for the H-R-R plates is the Macbeth Easel lamp. This consists essentially of an inside frosted, 100 watt,incandescent bulb used in conjunction with a heat resistant filter possessing a transmittance biased towards the shorter wavelengths. A major disadvantage of this source, however, is the cost estimated in 1978 to be approximately $260.

An alternative technique for generating the desired type of illumination is the use of incandescent lighting converted by gelatin filters placed between the subject's eye and the test material (Crone 1961; Pokorney,Smith and Trimble 1977; Higgins, Moskowitz-Cook and Knoblauch 1978). The more common method, however, is the utilization of daylight fluorescent light sources (Sloan 1943; Schmidt 1952; Fukuda 1967; 1968a; b; Richards, Tack and Thome 1971; Frisen and Hedin 1972). Such sources are cheap to buy, possess a low working temperature, a stable emission over time and a high mechanical resiliance.

It was felt that a fluorescent tube would be the most convenient method of generating the desired illumination. The particular type of tube - the Thorn "Artificial Daylight" - was selected after discussions with the Thorn Lighting Company (Ayers 1977) and others familiar with the problem (Ball 1977; Yorke 1977). This 20 watt 2 ft. tube is equivalent to C.I.E. standard illuminant D at 6500°K and has a colour rendering index of Ra = 95. The nominal percentage light output in the six spectral bands is given in Table 10.6 and is illustrated graphically in Fig. 10.1. In addition, its characteristics closely resembled the output of a tube used by Frisen and Hedin (1972).

A specially designed instrument housing was used to support two 2 ft. fluorescent tubes. The mounting was made of 3/16 mild steel and was held in place on a plywood baseboard by Dexion tubular framework. A 45° lectern, positioned below the fluorescent tubes, facilitated presentation of the tests. The height of the tubes from the baseboard (59 cm.) was selected in order to provide an intensity of illumination of 660 Lux at the midpoint of the lectern. The viewing distance was controlled by the use of a combined head and chin rest previously described in Chapter 8. The complete apparatus was used in conjunction with an instrument table and was readily portable (Plate 10.1).

The pilot study also showed that a considerable proportion of the time taken to carry out the experiment was spent in assessing individuals who gave normal responses on each test under all three observation states. It was felt that the time could usefully be reduced by modifying the method of presentation. It was proposed to initially present each test either to the sole remaining eye or to the two eyes viewing binocularly. An investigation of each eye, independently, would only be carried out if the presence of a colour deficiency was revealed under the initial viewing condition. It was recognised that this modified

Band No.	Band Limits mμ	Normal percentage light output
I	400-455	0.79
II	455-500	11.2
III	500-540	23.1
IV	540-590	43.7
V	590-620	14.4
VI	620-760	6.8

Table 10.6 Nominal light output for "Artificial Daylight" fluorescent tube at 6 band widths.

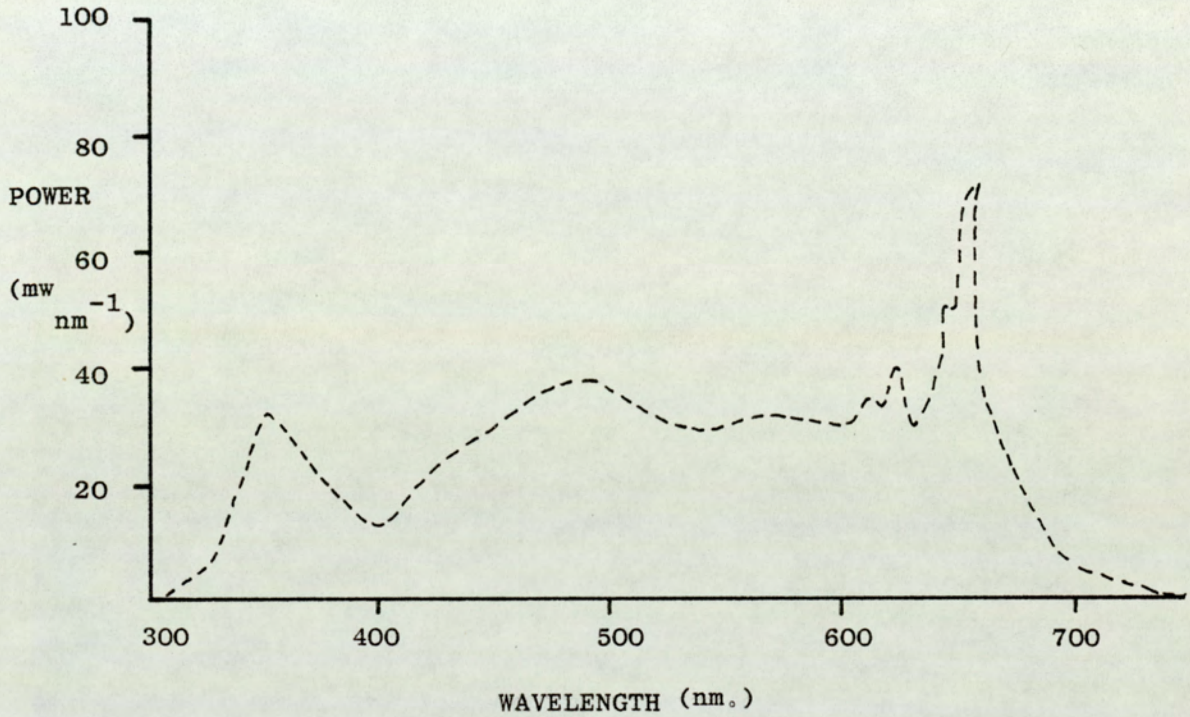
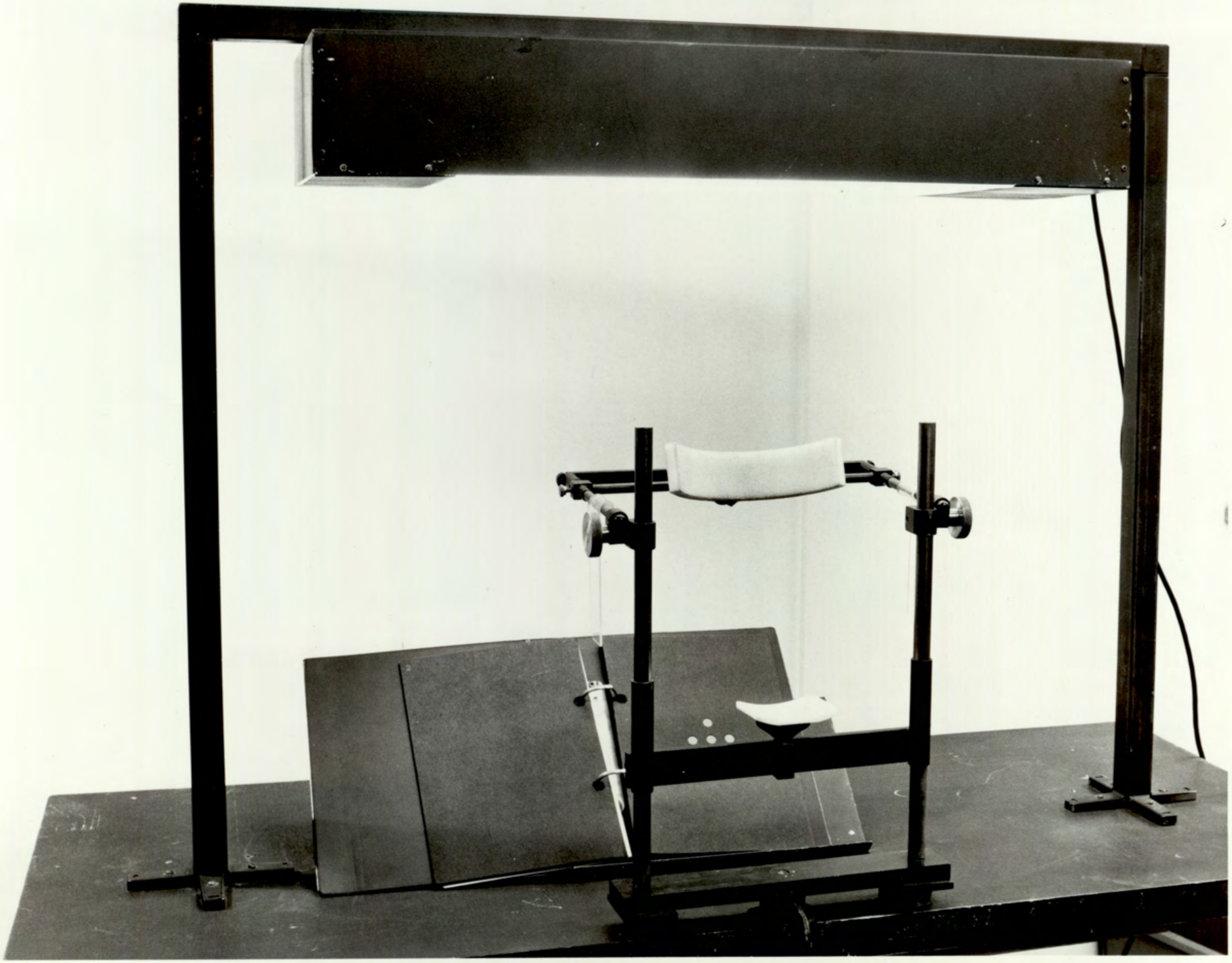


Fig. 10.1 Spectral distribution of a 1500 mm Artificial Daylight fluorescent tube at 65 W.

Overleaf ... Plate 10.1. The apparatus used for the colour vision assessment of the youngsters from the 1977/78 and 1978/79 academic years.



procedure would result in some loss of information about the colour vision of certain individuals. Indeed, the proposed procedure would fail to completely document the colour vision status of those individuals giving a normal response under binocular viewing, but who, if examined under monocular conditions, would show a colour deficiency in one eye and a normal response in the other eye. Nevertheless, it was felt that this omission could be justified on the grounds that the binocular viewing state more closely simulated the normal situation. In addition, the revised procedure would also reduce the time spent away from school lessons.

The revised method of colour vision assessment was initially carried out on youngsters from the 1977/78 academic year. The experiment was then subsequently continued on individuals from the 1978/79 school year. A total number of 116 pupils were examined with the City Test and 162 with the H-R-R test. The difference in the number of youngsters examined on the respective tests was principally due to the lack of available time, the 1977/78 school year ending before the City Test could be administered to the youngsters at Exhall Grange School.

A colour vision deficiency, either in the sole remaining eye or under binocular viewing conditions, was found in 62 of the 162 (38.3%) youngsters examined with the H-R-R Test. The remaining 100 individuals gave a normal response under similar viewing conditions.

The colour vision defects were classified in a manner similar to that of Cox (1961), namely as being either red-green (R-G), blue-yellow (B-Y) or red-green and blue-yellow combined (R-G/B-Y). The classification of colour vision type described in the test instructions was not considered appropriate since it was felt that it had been principally developed for categorizing congenital colour vision anomalies.

Forty-one of the 62 youngsters gave defective R-G responses and normal B-Y responses. Of these, 23 were mildly R-G defective, 14 medium and 4 strongly deficient. The remaining 21 colour defective subjects (33.9%) gave both abnormal R-G and abnormal B-Y responses.

None of the 62 subjects responded normally to the R-G plates and abnormally to the B-Y plates. The overall findings for the 62 youngsters are summarized diagrammatically in Table 10.7.

The relatively large proportion of youngsters categorized as possessing strong R-G and strong B-Y defects is principally due to the inclusion within this group of four subjects either diagnosed as, or suspected of, having congenital achromatopsia. Seven individuals who passed all but plate 3 and one youngster all but plates 3 and 4, were included in the mildly R-G defective group.

Of the 116 youngsters examined with the City Test 35, (30.2%) were found to be colour defective when viewing either binocularly or with the sole functioning eye. The remaining 81 youngsters gave normal

	B-Y			
R-G	NORMAL	MILD	MEDIUM	STRONG
NORMAL	100			
MILD	23	4		2
MEDIUM	14	2	1	1
STRONG	4	1		10

Table 10.7 Diagram showing the H-R-R responses of the 162 partially sighted observers.

responses under similar viewing conditions. The defective responses were categorized in a manner similar to that for the H-R-R results. Thirteen of the observers gave R-G deficient responses while 15 were found to be B-Y defective and 7 R-G/B-Y defective. The results are summarized in Table 10.8.

In order to determine the test-retest reliability of the results (Anastasi 1976), a number of final year pupils from the 1978/79 academic year at Exhall Grange School were re-examined.

The retest sample was selected so as to contain 18 youngsters who had responded normally at the initial assessment and 12 who had given colour defective responses. The proportion of abnormal to normal respondants (2:3) was deliberately chosen to ensure an adequate number of colour defective observers. The final retest sample, however, comprised 28 individuals as one youngster from each category was unavailable at the time of retesting.

The colour vision tests were administered after an interval of 14 days; the procedure adopted being identical to that followed at the first assessment.

The test - retest results from both colour vision tests were considered in terms of the previously normal respondents and also in relation to the colour defective respondents.

The 17 observers who had previously given a normal response on the H-R-R test, all showed a normal result at the second assessment.

The form of the H-R-R test - retest data from the colour deficient youngsters was such that it was not possible to represent, statistically, the reliability for each individual observer. It was therefore decided to determine the reliability for the 11 youngsters considered as a group. The data was cast into a 4 x 4 contingency table with the aim of defining the degree of reliability in terms of

NORMAL	81
R-G	13
B-Y	15
R-G/B-Y	7
	116

Table 10.8 City Test responses of the 116 partially sighted observers

the Contingency Coefficient C (Siegel 1956). The contingency table illustrated in Table 10.9 contains the paired observations on all 20 H-R-R plates made by the 11 colour defective observers. It caters for the four possible response options; namely both symbols correctly identified (√√), both incorrectly recognized (xx) and the two combinations, respectively, of one symbol correctly and one incorrectly identified (x √ and √ x). The response option for plates 5, 8 and 9, where only one symbol was required to be recognized, was categorized as belonging to the appropriate √√ or xx cell.

The use of the Contingency Coefficient is only appropriate when fewer than 20% of the cells in the contingency table have expected frequencies of less than five and also when each cell has an expected frequency of greater than one (Siegel 1956). In contingency tables where this situation does not pertain, it is necessary to combine categories in order to increase those expected frequencies which are deficient. The expected frequency calculated for each cell of the contingency table in Table 10.9 has a value of less than five in ten of the 16 cases. In addition, four of these cells have expected frequencies of less than one.

The only realistic combination of categories was considered to be a merger of cells 2 and 3, involving those cases in which only one symbol was correctly identified, ie those marked √ x and x√. Such a merger, however, would have resulted in the masking of information concerning the nature of the test-retest reliability, which, in turn, would have lead to an inflated value of both the magnitude and also the significance level of C.

An indication of the reliability of the test-retest data can, however, be obtained by comparing the responses in the four corners of the contingency table (Hussey 1981). The responses from these four

RETEST

	√√	√x	x√	xx	
√√	96 54·54	 4·54	2 3·64	2 37·27	100
√x	4 6·54	6 0.54	 0.44	12 4.47	12
x√	4 5·45	 0·45	5 0·36	1 3·73	10
xx	16 53·45	4 4·45	1 3·56	77 36·52	98
	120	10	8	82	220

TEST

Table 10.9 Contingency Table showing the test - retest H-R-R responses for 11 colour defective partially sighted observers. The expected frequencies are shown in italics.

cells are illustrated in Table 10.10. The Contingency Coefficient C, calculated from this table, has a value of C = 0.63 and is highly significant (X^2 = 128.32, df = 1, $p < 0.001$). It can thus be concluded from the magnitude and significance level of this coefficient that the H-R-R assessment procedure yielded highly repeatable data over an interval of two weeks.

The test - retest data from the City Test was analysed in a similar manner to that of the H-R-R task. The seventeen observers who had previously recorded a normal response again recorded a normal result when the assessment was repeated.

The format of the response options to the City Test was such as to prevent the statistical representations of the test - retest data from the individual colour defective youngsters. Consequently, the reliability of the results was considered in terms of the group as a whole. The test - retest data were cast into a 4 x 4 contingency table representing the possible combinations of paired responses. The table, illustrated in Table 10.11 contains the observations by the 11 colour defective youngsters on each of the 10 City plates.

The data in this table is not amenable to statistical analysis: frequencies of less than one are contained in eight of the cells which, in turn, cannot be meaningfully amalgamated. A qualitative indication of the degree of reliability of the data can, however, be gained by simple inspection of the cells within the table. The cells forming the diagonal from the top left to the bottom right of the table correspond to a perfect correlation between the test and retest data. Eighty of the 110 observations (72.7%) are contained within these four diagonal cells. Of these 80 observations, 66 are contained in the cell corresponding to a normal colour sense test - retest response. The overall distribution of the responses within the table thus suggests a good degree of reliability for the City Test over a period of 2 weeks.

RETEST

		√√	xx	
TEST	√√	96 57·46	2 40·53	98
	xx	16 54·53	77 38·46	93
		112	79	191

Table 10.10 Modified Contingency Table showing the responses from each of the four corner cells of the original Contingency Table.

RETEST

			R-G		B-Y	
		Normal	Protan	Deutan	Tritan	
	Normal	66 *58·89*	3 *3·59*	7 *12·21*	3 *4·31*	79
R-G	Protan	1 *1·49*	1 *0·09*	*0·31*	*0·11*	2
R-G	Deutan	5 *11·93*	1 *0·73*	10 *2·47*	*0·87*	16
B-Y	Tritan	10 *9·69*	*0·59*	*2·01*	3 *0·71*	13
		82	5	17	6	110

Table 10.11 Contingency Table showing the test retest City Test responses of 11 colour defective partially sighted observers. The expected frequencies are indicated in italics.

The incidence of detected colour vision anomalies within the two samples, 30.2% for the City Test and 38.3% for the H-R-R plates, can be compared with the results from similar studies amongst the partially sighted. Sloots-Smits, Meyer, Wibaut & Schappert-Kimmijser (1967) in their study of 66 partially sighted pupils, found that 56.1% passed both the H-R-R and Ishihara tests. The precise number solely passing the H-R-R test, however, is not stated in the paper. In 1972, Kaiser reported that three of his six subjects gave normal responses to the H-R-R test, and in a similar study Genensky, Petersen, Clewett & Moshin (1975) obtained a normal H-R-R result from six of their 16 subjects (37.5%).

The study by Genensky et al (1975) also found that 10 of the subjects were unable to carry out the H-R-R test. This latter finding, however, is not substantiated by the present study and may have arisen as a result of the differences in the nature of the two samples. The sample used by Genensky et al contained, for example, four observers over the age of 75 years; whereas the subjects in the current study were all aged 20 years and under.

The proportion of youngsters who failed plate 3 and passed the remaining plates (7 out of 162 individuals - 4.1%) was similar to that found in the pilot study (2 youngsters - 5.4%).

The results from the H-R-R test can be interpreted in relation to the known types of acquired colour vision anomaly. Approximately one-third of the 62 colour defective observers (33.9%) showed R-G/B-Y deficiencies ranging from mild to strong in nature. The majority of these observers could be considered to have colour deficiencies of the type II R-G whilst others could be expected to have either overall trichromatic or monochromatic reductions in sensitivity. The remaining

41 colour defective observers (66.1%) gave abnormal R-G responses and normal B-Y responses. It is unlikely, however, that these responses were all of the type I R-G category. The results would therefore tend to suggest that the H-R-R test failed to detect some secondary B-Y deficiencies associated with the type II R-G defect. In addition, the test also failed to identify any youngsters with the single B-Y type of deficiency.

The results from the City Test can also be compared with the known types of acquired colour vision deficiency. Thirteen of the youngsters giving defective responses on this test showed B-Y anomalies (37.1%) and 15 (42.9%) were found to be R-G defective. The remaining 20% gave R-G/B-Y responses. The results, however, must be interpreted with caution as each test plate only permits assessment of one confusion axis. A subject may, for example, be both R-G and B-Y defective, but may give a R-G deficient response to a particular test plate. The weakness of the test in this respect may thus account for the relative lack of apparent R-G/B-Y colour deficient observers.

The findings from the two tests can also be compared with each other. Sixty-eight of the 116 subjects (58.6%) gave a normal response on both the City and H-R-R tests. Seven youngsters were considered to be normal with the H-R-R plates but to be defective on the City Test. Five of these seven individuals gave deficient B-Y responses and one a combined R-G/B-Y deficiency. These findings are consistant with the suggestion that the H-R-R plates are less sensitive than the City Test for the detection of acquired B-Y deficiencies. In contrast, 13 youngsters were found to be normal with the City Test, but to have anomalies when examined with the H-R-R plates for assessing R-G deficiencies. It must be remembered, however, that seven of the eleven subjects had only failed plate 3 on the H-R-R test. In addition, a further nine youngsters were categorized as being B-Y defective with the City Test, but as either R-G or R-G/B-Y with the H-R-R test. R-G deficiencies on both tests were found in nine cases and combined R-G/B-Y deficiencies in five cases. One youngster was R-G/B-Y on the City Test, but only R-G with the H-R-R plates. The results from the two tests are compared in Table 10.12.

These findings are in good agreement with those of Verriest & Caluwaerts (1977; 1978). These workers examined 18 cases of acquired red-green anomaly and 16 cases of acquired blue-yellow deficiency. They used a number of colour vision tests including the City and H-R-R tests. The City Test detected 12 of the R-G subjects whilst with the H-R-R plates all 18 cases were identified. In contrast, the City Test isolated 12 of the 16 blue-yellow deficient observers compared to the 11 that were detected with the H-R-R test. Verriest & Caluwaerts concluded that of the various tests used in their study for detecting acquired blue-yellow deficiencies, the City Test was the best. It is also interesting to note that Cole (1964), in discussing congenital colour deficiencies, reported that the H-R-R plates were unreliable for detecting congenital tritanopia.

The relationship of colour deficiency to the subsequent occupational success of these youngsters will be discussed in a later section (Section 15).

H-R-R

CITY TEST	Normal	B-Y	R-G	B-Y/R-G	
Normal	68	2	11		81
B-Y	5	1	3	6	15
R-G	1		9	3	13
B-Y/R-G	1		1	5	7
	75	3	24	14	116

Table 10 12 Contingency table showing a comparison of the results obtained with the C.U.C.V.T. and the H-R-R test for 11 partially sighted observers.

11 DYNAMIC VISUAL ACUITY

11.1 Introduction

The resolution threshold of a test target moving with a constant angular velocity at a fixed observation distance has been termed dynamic visual acuity (DVA).

The most extensive study of DVA was carried out in America during the 1950s (Ludvigh & Miller 1958; Miller 1958; Miller & Ludvigh 1962). It was investigated with Landolt rings presented in the eight principal meridians, at angular velocities ranging from 10 to $170^{o}\ sec^{-1}$, for an observation period of 200 msec. The rings were viewed monocularly, and with the head restrained, at a distance of 4m. Subjects were three groups of naval personnel with uncorrected acuities of $\frac{20}{20}$ or better. Ludvigh & Miller found that dynamic acuity deteriorated with increase in target velocity. Their findings suggested that the dynamic resolution threshold (y) varies with the cube of the target velocity (x):

$$y = \alpha + \beta x^3$$

with the parameter α being a measure of the static acuity and β determining the level of dynamic acuity. Y is measured in minutes of arc and x in degrees per second.

This expression reduces to

$$y = \alpha \text{ when } x = o \text{ (i.e. the target is stationary)}$$

and the value of α is small when static acuity is good. At high target velocities (i.e.when x is large), the value of y is chiefly attributable to β. The value of β is large when y deteriorates rapidly with increase in x.

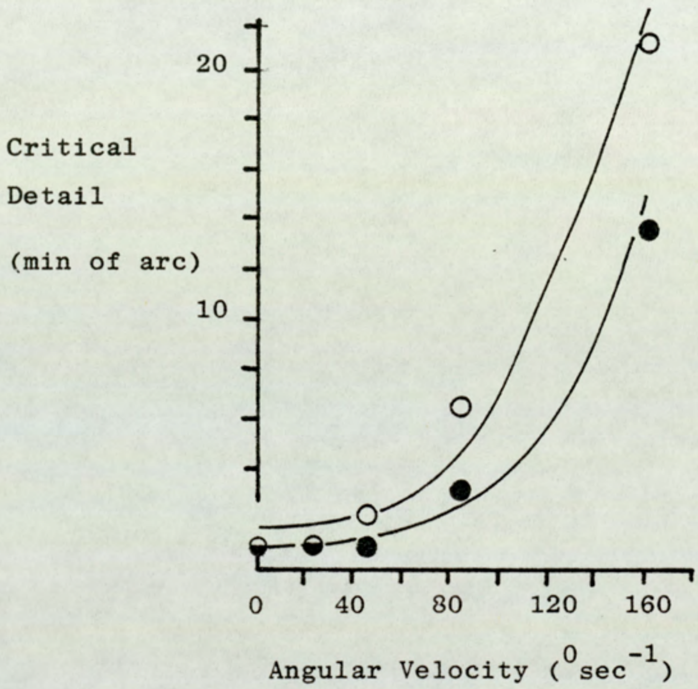


Fig. 11.1. Mean dynamic visual acuity thresholds for two groups of observers aged 20-30 (closed circles) and 40-50 years (open circles). (After Reading 1972a).

Miller & Ludvigh (1962) found mean values, for 18 subjects, of $\alpha = 2.29$ and $\beta = 3.46 \times 10^{-6}$. The absolute values of α and β will, however, depend upon factors such as the nature of the apparatus, procedure for threshold determination, type of test target and the characteristics of the sample.

The equation $y = \alpha + \beta x^3$ was found to be valid irrespective of whether the test object was moved in the horizontal or vertical planes and whether the relative movement was produced by motion of the test target or motion of the observer. The adequacy of this equation to describe the decrease in acuity with increase in target velocity was confirmed by Reading (1972a) (Fig. 11.1). Brown (1972b), however, considered that the relation between critical resolution and target velocity was approximately linear for velocities up to $90^{\circ}sec^{-1}$.

Ludvigh & Miller suggested that the static component α and dynamic component β were independent functions. They found that the correlation between α and β was not statistically significant. This was also demonstrated by Reading (1972a).

Ludvigh & Miller proposed that the function offered a means to compare, between individuals, the ability to resolve moving targets.

Ludvigh & Miller also reported that individuals with similar test chart acuities could differ "markedly and significantly" in dynamic acuity. This opinion was also held by Mayyasi, Beals, Templeton & Hale (1970). There is, however, a considerable divergence of opinion concerning the relationship between the measured static acuity and the individual dynamic acuity thresholds. Burg & Hulbert (1959) measured binocular dynamic acuity with chequerboards, identical to those of the Bausch & Lomb Ortho-Rater. The targets were presented at four angular velocities of 60, 90, 120 and $150^{\circ}sec^{-1}$ using the apparatus described by Hulbert, Burg, Knoll & Matthewson (1958). Dynamic acuity was measured on 120 subjects possessing uncorrected acuities of between $\frac{20}{15}$ and $\frac{20}{40}$. Two experimental conditions were employed, namely with and without head restraint. The target presentation time was not stated in the paper. Burg & Hulbert found the correlations between dynamic acuity at the four velocities and static acuity measured by an Ortho-Rater to be small, but statistically significant ($r = 0.17$ to $r = 0.31$; $p < 0.05$). The correlations decreased as target velocity increased and were generally smaller for the fixed head state than for the free rotation of the head. In a continuation of this work, Burg & Hulbert (1961) compared dynamic acuity with both the Ortho-Rater static acuity and the static acuity determined by the test apparatus. The test targets were presented for approximately (sic) 1 sec. at angular velocities ranging from 20 to 180° sec $^{-1}$. The sample comprised 236 subjects with corrected static acuities ranging from $\frac{20}{40}$ to $\frac{20}{13}$. Burg & Hulbert found that the correlation between static Ortho-Rater acuity and both the free head and fixed head dynamic acuities followed the same general pattern as their earlier study. In addition, they reported higher, and statistically more significant correlations between these dynamic acuities and the static acuity determined with the test apparatus.

The results of a similar study, carried out on 17,438 subjects aged between 16 and 92, were reported by Burg in 1966. Binocular static acuity was determined with both an Ortho-Rater and with the test apparatus. Dynamic acuity was assessed binocularly at four speeds of 60, 90, 120 and 150 sec^{-1}. The target presentation time was not stated, nor is it clear whether dynamic acuity was determined in the fixed or free head position. Burg found high correlations between the two types of static acuity and the dynamic acuity at all four target velocities. The correlations decreased as target velocity increased and were higher for the static acuity determined with the test apparatus than for the Ortho-Rater acuity. The values ranged from 0.71 at $60^{o}sec^{-1}$ to 0.45 at $150^{o}sec^{-1}$ and from 0.60 at $60^{o}sec^{-1}$ to 0.35 at $150^{o}sec^{-1}$ for the two methods respectively. Burg attributed the increase in magnitude of the correlations, compared with his earlier studies, to the use of a large and heterogenous sample.

Weissman & Freeburne (1965) presented a thorough statistical analysis of dynamic acuity at six angular velocities ranging from 20 to $180^{o}sec^{-1}$. The targets were Landolt rings, orientated in the four cardinal meridians, and presented for an observation time of 1 sec. The subjects were 30 female students and the dynamic acuity was determined binocularly with the head free to move. The correlations between static acuity, measured with their apparatus, and dynamic acuity decreased with increase in target velocity and, with the exception of the two fastest velocities (150 and $180^{o}sec^{-1}$ respectively), were statistically significant ($p < 0$. Further analysis revealed a statistically significant non-linear relationship ($p < 0.01$) between static acuity and dynamic acuity at each of the first four target velocities. In addition, a non linear association (statistically significant at the 0.05 level) was found between static acuity and each of the two fastest velocities. A simple mathematical relationship, e.g. a curvilinear expression, could not, however, be elicited for these latter two velocities.

A similar experiment was carried out by Reading (1972a). She utilized two experimental groups: the first comprising 10 subjects aged 18-31 years, and the second 6 subjects aged 42-50 years. Landolt ring targets were presented in the 8 principal meridians at angular velocities of 22, 43, 83 and $167^{o}sec^{-1}$. Reading found that with the younger age group the correlation coefficients between static acuity and dynamic acuity at each of the four target velocities were not statistically significant. In the older age group, however, one value (that of static acuity and acuity at $43^{o}sec^{-1}$) was significant at the 0.05 level. In addition, a test for nonlinearity failed to show a significant association between static and dynamic acuity. Reading concluded that there was no statistically significant relationship between static acuity and dynamic acuity threshold in either a linear or curvilinear fashion.

Dynamic acuity has been found to be higher in males than females (Burg & Hulbert 1961; Burg 1966). It improves with practise (Miller & Ludvigh 1962),with increase in target illumination (Miller & Ludvigh 1962) and with increase in target contrast (Mayyasi et al 1970; Brown 1972c). In addition,it has been shown to be better with binocular observation. Dynamic acuity, however, has been found to decline with age (Burg 1966; Reading 1972a).

A number of studies have utilized eye movement recording techniques to investigate the components of dynamic acuity.

Methling & Wernicke (1968) utilizing such techniques, concluded that image movement over the retina is the main cause of decreased visual acuity at angular velocities greater than $60^{o}sec^{-1}$. The reduction in acuity at target velocities of less than $50^{o}sec^{-1}$, they believed, was mainly due to imaging of the target outside the central region of the fovea.

Barmack (1970) also recorded eye movement responses during the measurement of dynamic acuity. The initial eye movement was found to be a saccade superimposed on a small pursuit movement. If the saccade elicited fixation of the target near the fovea, a pursuit movement was carried out which matched target velocity and so maintained fixation. The early pursuit movement was never greater than 1^{o} in size and was sometimes absent altogether. If the target was not fixated, another sequence of saccadic and pursuit eye movements was carried out. The amplitude, velocity and acceleration of the saccades was found to increase with increases in target velocity. Barmack noted that pursuit movements with peak velocities of between 50 and $90^{o}sec^{-1}$ could be attained after two or more saccades had been carried out. He suggested that dynamic acuity was probably determined by three factors - foveal acuity, parafoveal acuity, and oculomotor control.

Reading (1972b) recorded eye movement responses to Landolt ring targets moving at discrete angular velocities ranging from $20^{o}sec^{-1}$., to $167^{o}sec^{-1}$. At target velocities of $20^{o}sec^{-1}$ and $43^{o}sec^{-1}$, she noted the occurrence of a saccade, after an initial period of 200msec followed by an accurate and synchronous pursuit movement. The velocity of the target was matched with considerable precision at these velocities, resulting in a steady retinal image and high resolution. Increased saccadic movements, however, were found at a target velocity of $83^{o}sec^{-1}$ due to the failure of the initial saccade to achieve fixation. At $167^{o}sec^{-1}$ the eye movements had deteriorated into a series of saccades. Indeed, at velocities above $65\text{-}70^{o}sec^{-1}$ the saccadic system had replaced the pursuit system as the dominant mechanism. The mismatch of eye and target velocity at these velocities caused the visual acuity to deteriorate. Reading considered it unlikely that the deterioration in resolution with increase in target velocity was simply the result of insufficient eye movement velocity. She further suggested that the information required for accurate pursuit was derived firstly from a state of fixation, during which the target angular velocity is assessed, and secondly from a state of pursuit during which the difference between target and eye movement velocity is evaluated.

Brown (1972a) determined the threshold minimum angle of resolution (M.A.R.) for moving targets presented at specified eccentricities from the point of fixation. He found an approximately linear relationship at the fovea between threshold target size and target angular velocity. Resolution in the parafovea, however, was better for slowly moving targets than for stationary targets. Brown suggested that two mechanisms were responsible for the resolution of moving targets in the foveal region: one operating at velocities below $20^{o}sec^{-1}$ and the other at velocities greater than this value.

Brown (1972b) carried out an extensive study of eye movements recorded during the measurement of dynamic acuity. Landolt ring targets were presented at angular velocities ranging from 0 to $90^{o}sec^{-1}$. Brown found that two saccades were nearly always made at the slowest target velocity. As target velocity increased above $40^{o}sec^{-1}$, a marked increase occurred in the number of third saccades. The latencies of these saccades decreased with increase in target velocity. Increases in the velocity of the pursuit movements corresponding to the various saccades occurred with increases in target angular valocity. The third pursuit velocity was greater than the second which in turn was greater than the velocity of the first pursuit movement. The velocity error, defined as the difference between eye and target angular velocities during the last smooth pursuit movement, increased linearly with increase in target velocity. The position error, the mean position of the target image on the retina relative to the fovea during the last pursuit, increased in a similar manner. Brown hypothesized that the position and velocity errors of the retinal target image were the main factors in determining the resolution of moving targets. He used the data on the position and velocity errors in conjunction with his data on peripheral acuity for moving targets, to predict threshold M.A.R. as a function of target angular velocity (Brown 1972a; b). He then compared the predicted thresholds with those determined experimentally and found good agreement between the two sets of results. Brown concluded that position and velocity errors were the main determinants of dynamic acuity.

Brown (1972c) recorded eye movements during the assessment of dynamic acuity at four different levels of target contrast, 70.3, 51.2, 36.3 and 23.3% respectively. He pointed out that the absolute effect of contrast on eye movement control was masked by the compensatory increase in target size necessary with decrease in contrast level. This factor thus affected any comparison of eye movement data at individual contrast levels. Nevertheless, the results indicated that a reduction in energy input into the oculomotor system adversely influenced its response.

11.2 Rationale for the Study of DVA

An investigation of the dynamic acuity of partially seeing individuals was considered suited to the present study for a number of reasons.

Dynamic acuity has been shown to correlate more closely with car driving performance than other visual measures such as static acuity and visual field (Burg 1971). In addition Beals, Mayyasi, Templeton & Johnson (1971) suggested that dynamic acuity can be used to predict basket ball performance. This latter claim, however, was subsequently questioned by Dippner (1973). From these studies of normally sighted individuals,it would be reasonable to hypothesize that dynamic acuity among the partially sighted might correlate with a measure of performance such as job capability.

It has already been shown (Section 11.1) that saccadic and pursuit eye movements play an important part in determining dynamic acuity. Saccadic eye movements are controlled by the frontal cortex and the descending fronto mesencephalic pathways whilst pursuit movements are governed by the anterior occipital lobes and the occipitomesencephalic pathways (Gay, Newman, Keltner & Stroud (1974). Dynamic acuity is thus dependent upon widespread neural connections. Consequently,it can be hypothesized that such a function would vary considerably in a population such as the partially sighted where the integrity of these connections can reasonably be expected to be in doubt.

Mention has already been made to the lack of concensus over the relationship between testchart and dynamic acuity of normally sighted observers (Section 11.1).

If static acuity in normally sighted individuals is unrelated to dynamic acuity, then a similar relationship could be expected to apply to the partially sighted.

A number of other factors lend support to the case for an investigation of the dynamic acuity of partially seeing observers. Hood (1967) has shown that target slippage from the fovea in patients with central scotomata does not induce a saccade and the pursuit mechanism is able to operate without interruption. Consequently these patients can exhibit pursuit movements with velocities as high as $90^{o}sec^{-1}$, far exceeding those generally found in normal subjects. Indeed, this situation might actually favour those patients who utilize a parafoveal form of fixation. In contrast, Gay, Newmann, Keltner & Stroud (1974) report that patients with congenital nystagmus exhibit very poor pursuit eye movements. These patients consequently have great difficulty in sports such as basketball, table tennis and lawn tennis where smooth eye tracking is essential.

The aim of the experiment was considered to be twofold. The first phase was to develop an apparatus and experimental method capable of determining the dynamic visual acuity of partially seeing observers. The second phase of the work was to determine whether dynamic acuity, namely the level of the β coefficient, would provide an indication of job capability.

11.3 Rationale for design of apparatus and experimental method

The apparatus and experimental method were designed after an appraisal of the techniques described in the previous published studies of dynamic visual acuity. The apparatus was required to be portable and suitable for use in confined spaces whilst the experimental method had to permit the rapid and accurate assessment of dynamic acuity.

Various methods have been used to create relative motion between observer and test target. These have included physical movement of the object by mechanical methods (Warden & Brown 1944; Low 1947), movement of a projected image by motion of projector or background (Hulbert et al 1958; Burg 1965; Anderson, Black, Hale, Mayyasi & Reeves 1970) and movement, by optical means, of a virtual image (Ludvigh 1947; Ludvigh & Miller 1958) or a real image (Cutler & Ley 1963; Barmack 1970; Brown 1972abc). The method most suited to the requirements of the present study was considered to involve the use of a rotating mirror to reflect a transparency from a projector onto a curved screen (Peaston 1978). It was felt that the electronic circuit for such a method would be relatively easy to produce and that the use of a projector would ensure a compact presentation of the test types.

Dynamic visual acuity may be determined in one of two ways. The most frequently adopted and usual method is to present test targets moving at discrete angular velocities for a fixed period of time. The angular distance travelled by the target is consequently variable and is proportional to the angular velocity of the target. The alternative method is to present targets moving for a fixed angular distance. The time for observation of the target is thus variable and is proportional to the reciprocal of the target velocity. The measure of visual acuity derived by the first method is a function of target velocity alone, whilst that of the second is determined by the interaction of target velocity and exposure time. Miller & Ludvigh (1962) and Miller & Reeder (1965) suggest that this latter method approximates more closely to natural conditions in that the angular distance over which an object can be observed is seldom determined by velocity alone. It is suggested, however, that the first method provides a better measure of the functional capability of the eye (Miller & Ludvigh 1962). It was decided to adopt a constant observation time in order to permit a comparison of the results with those of the published studies.

Dynamic visual acuity has been determined for various observation times. These have varied from 180msec (Brown 1972a) to 1 sec (Burg & Hulbert 1961; Weissman & Freeburne 1965). In addition, Ludvigh & Miller (1958) and Cutler & Ley (1963) preceded the observation period with a "lead-in" period of 200 msec during which the target could be detected but not resolved. Miller & Reeder (1965) reported that an increase in lead-in time from 200msec to 400msec resulted in an improvement in D.V.A. A similar conclusion was noted by Elkin (1962). He investigated dynamic acuity with two lead-in periods of 200msec and 1 sec, and with two presentation times of 200 and 500msec. Dynamic acuity was best with the combination of the longest lead-in and presentation times, and worst with the shortest combinations. It was decided to adopt a presentation time of 1.5 sec. This value was chosen on the basis that the subjects involved would be partially sighted whereas the previous published work had involved normally sighted observers.

Dynamic visual acuity is generally determined for target velocities between 0 and $160^{o}sec^{-1}$ with the vast majority of the data points being below $100^{o}sec^{-1}$. It was proposed to assess D.V.A. at 6 discrete target velocities between 0 and $90^{o}sec^{-1}$. It was felt that such a range would permit an adequate investigation of D.V.A. and, at the same time, would be commensurate with the electronic and mechanical considerations of the envisaged apparatus for generating target motion.

A number of different test targets have been used to determine dynamic visual acuity. The Landolt ring, however, has proved to be the most popular target. Ludvigh & Miller (1958) and Reading (1972a) presented Landolt rings orientated in the 8 principal meridians. In contrast, Weissman & Freeburne (1965) used rings in the 4 cardinal positions. The oblique meridians were, however, preferred by Cutler & Ley. (1963) and Miller & Reeder (1965). They assumed that gaps in the cardinal meridians were unlikely to provide the same degree of difficulty as those in the oblique positions. Indeed, Methling & Wernicke (1968) and Bhatia (1974) noted that horizontal target motion differentially affected the visibility of landolt rings. They found that rings orientated in the vertical were less visible than those in the horizontal meridian. The oblique format was consequently adopted by Brown (1972abc). The results of Barnack (1970) and Mackworth & Kaplan (1970) suggest that this differential effect is also present with square-wave gratings.

Other types of targets have included chequer boards (Burg & Hulbert 1959; 1961; Burg 1965), horizontally and vertically orientated square wave gratings (Barnack 1970) and Snellen letters (Mayyasi et al 1970). It was felt that Landolt rings orientated in the 4 oblique meridians would be the most suitable type of test target. It was considered that such a target would be familiar to partially sighted youngsters, would permit ease of communication, and would be relatively easy to produce.

A geometrical progression in M.A.R. based upon $\sqrt{2}$ was felt to be the most suitable for the study. It was considered that this progression, which produced a doubling of M.A.R. every 2 increments of $\sqrt{2}$, would provide a reasonably sensitive scale commensurate with the desired minimum number of target presentations. The progression was centred around a M.A.R. of 10' as it was felt that it would be beneficial to incorporate into the scale a value equivalent to 6/60 . Consequently the values of M.A.R. ranged from 1.25' to 80.0' (Snellen equivalents of 6/7.5 to 6/480)in 12 steps.

Although as previously mentioned, contrast has been shown to influence absolute values of D.V.A., target contrast is seldom specified in the literature. It was felt that, for the present study, the Landolt rings should be of negative contrast to avoid undesired changes in adaptation level associated with the use of a projector. Particular values of target contrast could then be achieved by interposing neutral density filters in the projection beam.

The direction of target motion, movement in the horizontal plane from right to left, was dictated by the technical requirements of the pen-motor and the projector.

Dynamic visual acuity has been determined at various observation distances ranging, for example, from 0.94 m (Barnack 1970) to 4m (Ludvigh & Miller 1958). A distance of 1.5m was selected for the current investigation, as it represented the greatest distance commensurate with the available space in the rooms at the various schools. The field size for target observation was thus determined by the selection of this distance.

D.V.A. can be measured with the head restrained (Ludvigh & Miller 1958; Brown 1972abc) or with the head free to move (Cutler & Ley 1963 Burg 1965). It was decided to permit head movements since visually handicapped individuals often readily adopt head postures as a means of augmenting their residual vision. In addition, such an approach would also avoid possible subject discomfort arising from the prolonged use of a head-restraining apparatus. Although little or no head movement has been reported under these circumstances (Cutler & Ley 1963) it was recognised that the derived measurement of dynamic visual acuity would be a function not only of target velocity but also of head movements. It was also decided to determine D.V.A. binocularly since this pertained more closely to the natural situation.

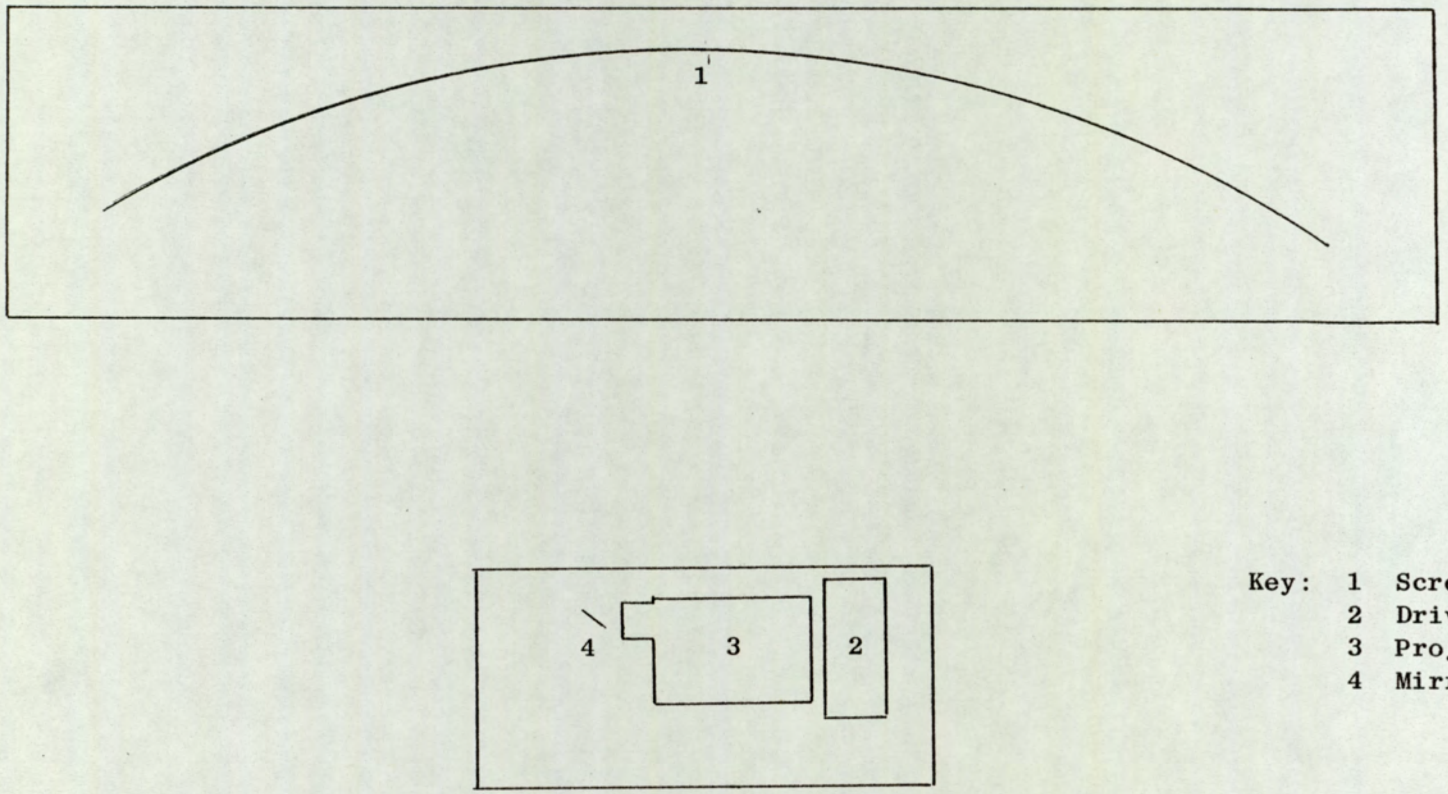
The most suitable method of threshold determination was considered to be a single presentation of targets, in ascending order of M.A.R. for each angular velocity. The criteria for threshold would be taken as the first of two successive correctly resolved targets. It was felt that such a procedure would result in threshold values free from the effects of any potential learning process. Miller & Ludvigh (1962) determined 20 successive thresholds for 200 observers at target velocities of $20^{o}sec^{-1}$ and $110^{o}sec^{-1}$. They found that the effect of practice was minimal at $20^{o}sec^{-1}$ but considerable at $110^{o}sec^{-1}$. They showed that resolution at $110^{o}sec^{-1}$ improved exponentially with the number of threshold determinations. A statistically significant difference in threshold value ($p < 0.01$) was present between the first and second presentations. Fifty per cent of the improvement due to practice had taken place by the end of the fourth presentation. Since the rings could be orientated in any one of 4 positions, the probability of obtaining a threshold value due to chance by the envisaged method was 1 in 16.

It has been shown by Miller & Ludvigh (1962) and Reading (1972a) that the effect of practice at one target velocity produces no significant improvement in target resolution at another velocity. Nevertheless, it was decided to randomize the order of target velocities in the current study.

11.4 Materials and methods

The apparatus consisted essentially of a screen and the equipment for generating target motion. It was set up as shown in Fig. 11.2. The screen, 40 cm in height, was curved with a radius of 1.50m and an arc length of 2.20 m. It was made from a sheet of 16 guage aluminium and was mounted on a 3/4" plywood baseboard. The curvature was maintained by appropriate positioning between pairs of brass studs fixed along a radius premarked on the baseboard. In order to facilitate transportation, the baseboard was made in two sections which were bolted together with wing nuts. The overall dimensions of the baseboard were 2.14m in length and o.6m in width.

The equipment for generating target movement consisted of a front surface silvered plano mirror, mounted on a pen-motor spindle and rotatable about the vertical axis, a Kodak carousel S-AV 2000 projector with a 150mm focal length lens, and a specially designed power unit (Peaston 1978). The entire apparatus was mounted on a baseboard and supported on a vertically adjustable instrument table. The projector was positioned such that its beam was directed onto the screen via the mirror which, in the stationary position, was at an angle of 45^{o} to both the projector and the screen. As the mirror constituted the exit pupil of the projection beam, its centre of rotation was placed as close as possible to the projection lens. The



Key: 1 Screen
2 Drive unit
3 Projector
4 Mirror/pen motor

.Fig. 11.2 Diagrammatic representation of the apparatus used to investigate dynamic visual acuity. (not to scale) distance from the front of the projector to the screen, via the mirror, was 1.50m. The projection system was thus positioned at the centre of curvature of the screen . The power unit was designed to rotate the mirror at discrete angular velocities over a constant time period. The various linear deflections of the mirror were achieved by applying differing current ramps to the motor. Voltage ramps were generated by charging a capacitor from various constant current sources. The presentation time was determined by the use of a summing amplifier in conjunction with the voltage ramps and fixed d.c. shifts. The resultant voltage ramp was fed into a power amplifier and thus converted into the appropriate current ramps. Linearity of the mirror deflection was ensured by using feedback techniques around the power amplifier ramp. The angular velocities of the mirror were determined by the speeds of the voltage ramps and corresponded to target velocities of 0, 26, 44, 62, 79 and 90^{o} sec^{-1} respectively.

The transparencies containing the Landolt rings were produced in a manner similar to that described in Chapter 8. The magnification at 1.50m. produced by the projector in conjunction with a 150 mm focal length lens, was determined from the information manual published by Kodak. The object sizes required to produce the desired range of M.A.R.'s at 1.5m were then calculated with the aid of a simple computer programme. The transparencies were commercially produced by an industrial photographer (Levin 1978) and the accuracy of manufacture assessed using the method described in chapter 8. The transparencies were divided into 4 groups arranged in ascending order of M.A.R. The orientation of the rings was distributed in a quasi-random manner throughout each series. The rings were arranged such that, within any one series, no two successive transparencies contained a Landolt ring with the same orientation. In addition, the arrangement was designed to ensure that all 4 orientations of the Landolt ring were represented, for a given M.A.R., across the 4 groups of transparencies.

The screen was diffusely illuminated by two appropriately positioned tungsten filament lamps. The screen luminance was 57 cdm^{-2} and the immediate surround luminance was 17 cdm^{-2}. Target contrast was thus

The apparatus became available in late April 1978. It was decided to forgo an investigation of normally sighted individuals in order to make the best possible use of the remaining part of the academic year at Exhall Grange School.

The experiment was carried out on a sample comprising 40 out of a total of 42 final year pupils from the 1977/78 academic year. The youngsters were randomly divided into 4 equal groups. The target velocities, for each threshold determination, were presented in ascending order to the individuals in Group 1, whilst those in Group 2 received a descending sequence. The velocities were presented in a quasi-random fashion to the individuals in Group 3, ie 44, 79, 0, 90, 26 and $62^{o}sec^{-1}$. This order was reversed for the subjects in Group 4. It was hoped that this procedure would allow for any possible influence of experience at a previous velocity on the threshold determined at an ensuing velocity. In addition, the threshold determination was repeated for the initial target velocity in all 4 groups at the end of the procedure. It was envisaged that a comparison of these two values would provide an indication of either the practise effect or the fatigue of the individual.

A well defined procedure was developed for the determination of dynamic acuity. The distance correction giving maximum distance visual acuity was placed in a trial frame and positioned on the subject. An addition of +0.50DS was added to the distance correction to allow for the viewing distance of 1.50m. The youngster was then moved forward and positioned at the instrument table. The individual was comfortably seated such that the head and mirror occupied the same lateral and vertical planes, the line of sight was perpendicular to the centre of the screen and the viewing distance was 1.50m. The projection system and observer were thus at the centre of curvature of the screen.

With the power unit in the "off" mode, a demonstration Landolt ring was projected onto the screen, directly in front of the subject. This ring subtended an M.A.R. of 54 minutes of arc and had the gap in the 6 o'clock position. The presence and position of the gap was demonstrated to the subject. The subject was told that the gap on subsequent rings would appear in either the top right, top left, bottom right or bottom left positions. The subject was instructed to identify the position of the gap on subsequent targets and to convey the information using similar terminology. A series of Landolt rings were then projected, in ascending order of M.A.R. onto the screen. The stationary threshold M.A.R. was determined in the prescribed manner.

The power unit was then switched to the "on" mode. This procedure removed the Landolt ring from the screen. The subject was shown the black cross on the right hand side of the screen and informed that the rings would appear to the left of the cross and would move at different speeds across the screen. The subject was instructed to identify in each case, the position of the gap. It was stressed that the cross served as an approximate indication of the initial position of the moving target and was not for constant fixation. In addition, the subject was informed that it was acceptable to utilize any lateral head movements, eye movements, or any process to assist vision. A practise session was then undertaken. Landolt rings, randomly orientated in the 4 cardinal meridians were presented in ascending order of angular velocity. The M.A.R. of the 6 rings, at 1.50m, ranged between 18' and 64'. The threshold M.A.R. using rings in the 4 oblique meridians, was then determined for each of the 6 angular velocities. The size of the initial target presented at each angular velocity was 2 M.A.R. increments below the previously determined static threshold of the individual. The youngsters were selected at random from the 4 experimental groups. The series of slides used for the determination of a particular angular velocity was varied randomly.

11.5 Results and further investigations

A graph of threshold M.A.R. versus target angular velocity was plotted for each subject immediately after the experiment. These graphs showed that a considerable scatter of results was present for all subjects and that the curve of best fit lay approximately parallel to the abscissa. It was concluded that, under the conditions of the experiment, visual acuity did not substantially deteriorate with increase in target angular velocity over the range 0 to $90^{o}sec^{-1}$.

It was therefore decided to reduce the presentation time to 600 msec as a means of producing a more pronounced deterioration in threshold at the faster target velocities. This second experiment was carried out in a similar manner on 12 of the original sample of 40 youngsters. The results were analysed after the experiment and showed similar patterns to those of the previous experiment: a considerable degree of scatter and a best fit curve parallel to the abscissa.

It was decided to reduce the presentation time to 300msec in a further attempt to produce a recognizable reduction in acuity with increase in target velocity. In addition, the number of threshold determinations carried out at each angular velocity was increased to 4 consecutive determinations comprising alternate presentations in ascending and descending order of target size. The criteria for threshold was to be taken as the smallest target, correctly identified on 3 or more of the 4 threshold determinations, preceeding a similar or better level of identification of the next larger target. The probability with this procedure of obtaining a threshold value due to chance was 1 in 4096. It was acknowledged that the use of 4 threshold determinations per target angular velocity would introduce a learning effect into the result such as that described by Miller & Ludvigh (1962) and mentioned earlier (Section 11.3). Nevertheless, it was hoped that this modified method would reduce some of the variance inherent in the previous experimental procedure.

Twenty-four youngsters from the original sample of 40 were involved in the 300msec trial. The subjects were divided, as before, into 4 equal groups. The presentation of the target velocities within each particular group was identical to that of the previous two experiments.

Owing to unforseen circumstances, the results from 9 youngsters were lost.* Data for the remaining 15 subjects are listed in Table 11.1 and presented graphically as the continuous line in Figs. 11. a to 11. q.

The overall pattern of the results in the experiment can be seen in these graphs. The scatter of the results was reduced by the revised method of threshold determination. Nevertheless, it was

*Documents containing raw data and other material were stolen in the Autumn of 1980.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	Stationary	0	26	44	62	79	90	Repeat
Group 1A								($0^{o}Sec^{-1}$)
M.C.	10	20	20	20	20	20	20	20
N.P.	10	20	20	20	20	20	20	20
K.I.	28.28	80	80	-	-	80	80	80
P.C.	2.5	20	10	20	20	20	28.28	7.07
Group 1B								($90^{o}Sec^{-1}$)
S.B.	5	10	7.07	14.14	14.14	14.14	10	10
H.M.	14.14	56.57	40	28.28	28.28	20	28.28	28.28
A.C.	7.07	10.0	10.0	7.07	10.0	14.14	14.14	7.07
J.B.	3.53	10.0	5.0	10.0	10.0	14.14	10.0	10.0
Group 2A								($44^{o}Sec^{-1}$)
W.P.	2.5	3.53	3.53	2.5	5	3.53	5	5
E.W.	10	14.14	10	14.14	14.14	14.14	10	14.14
D.S.	7.07	10	7.07	20	10	5	14.14	10
K.B.	56.57	80	56.57	80	56.57	56.57	56.57	56.57
Group 2B								($62^{o}Sec^{-1}$)
S.P.	7.07	10	10	10	10	14.14	14.14	10
S.G.	10	14.14	14.14	10	14.14	14.14	14.14	14.14
H.E.	10	14.14	14.14	14.14	14.14	14.14	20	14.14

Table 11.1 Results of Experiment 3. Threshold Values of M.A.R. for Landolt rings Presented at 6 Different Target Velocities

Overleaf ... Fig. 11.3 Minimum angle of resolution as a function of target angular velocity (Ordinate: ranked M.A.R. - which corresponds to a logarathmic scale. Abscissa: target angular velocity ^{o} sec $^{-1}$).

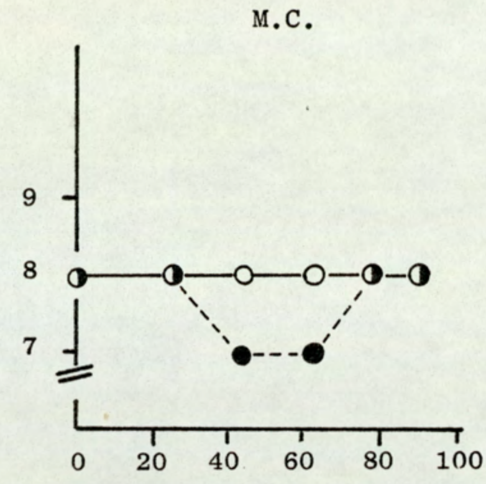


Fig. 11. 3a

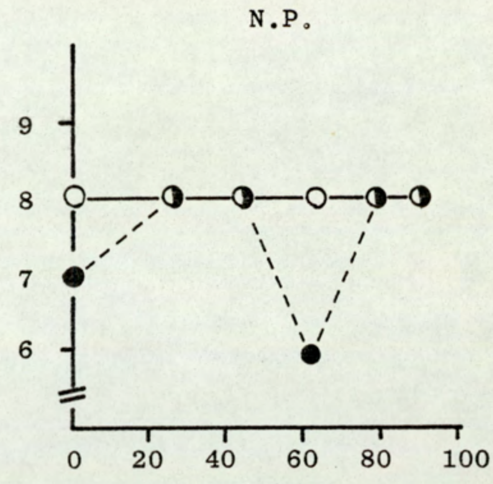


Fig. 11.3b.

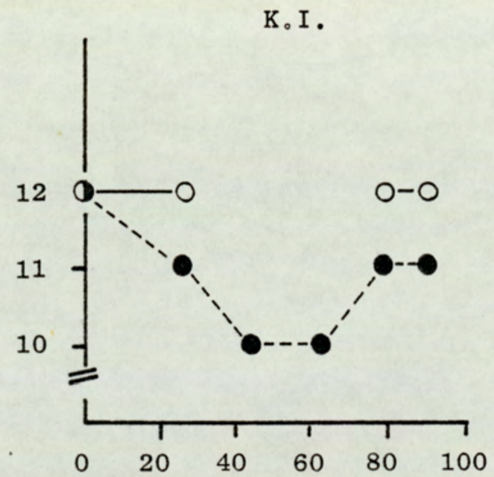


Fig. 11. 3c.

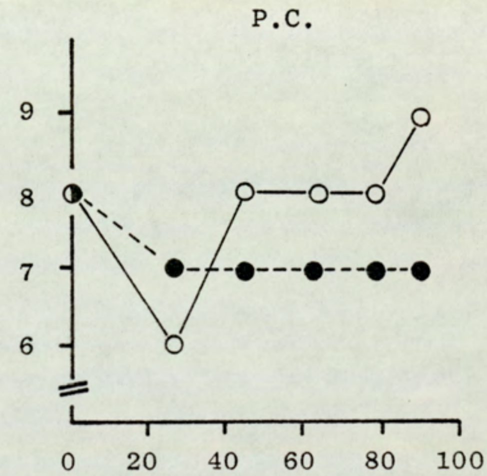


Fig. 11.3d.

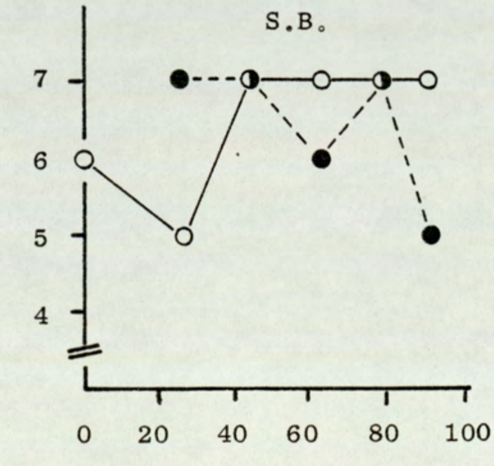


Fig. 11.3e.

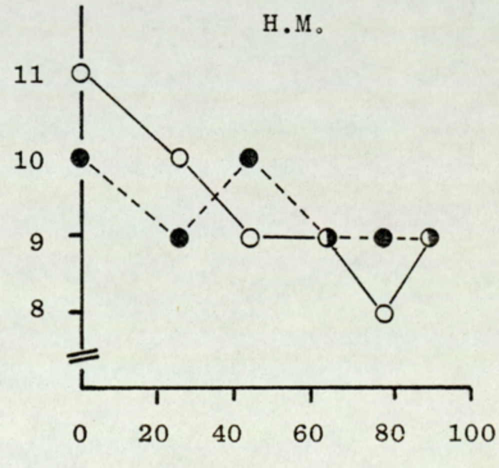


Fig. 11.3f.

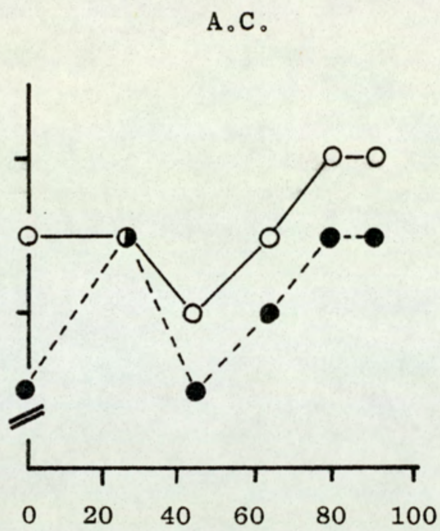


Fig. 11.3g.

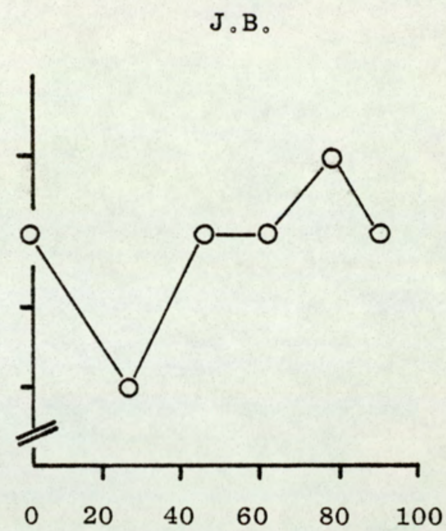


Fig. 11.3h.

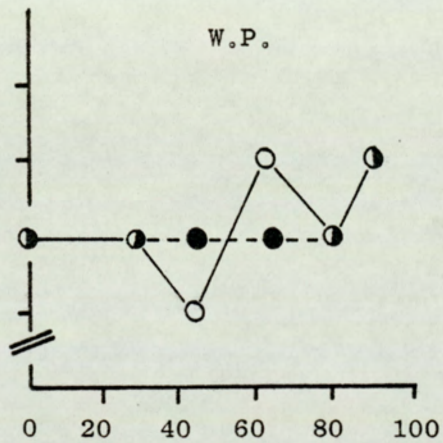


Fig. 11.3i.

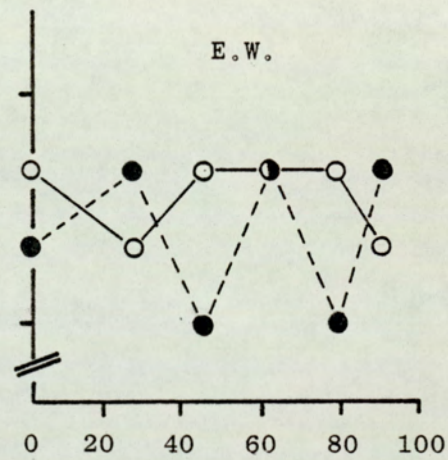


Fig. 11.3j.

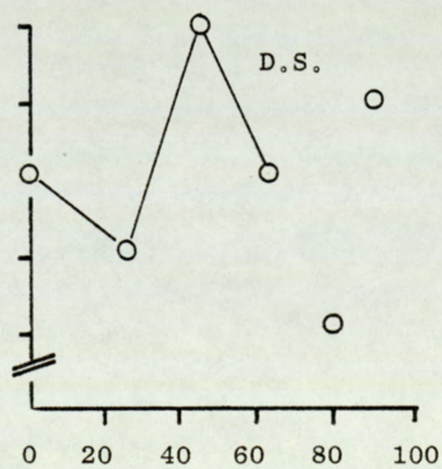


Fig. 11.3k

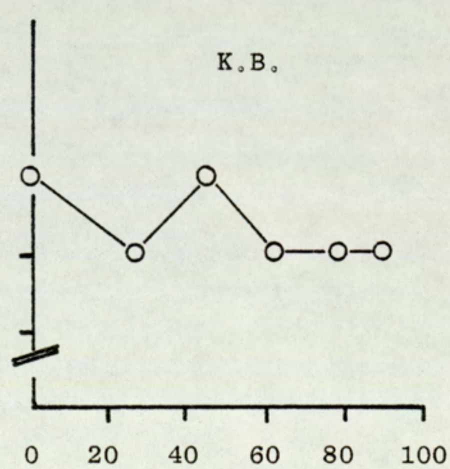


Fig. 11.3l.

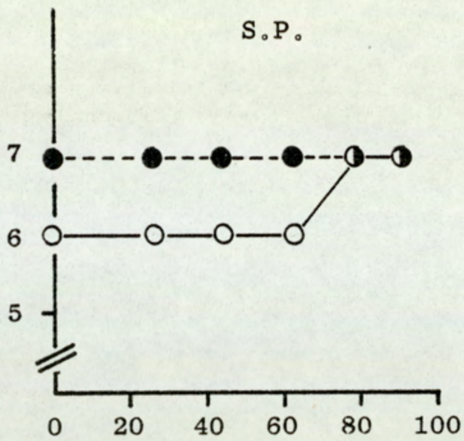


Fig. 11.3m.

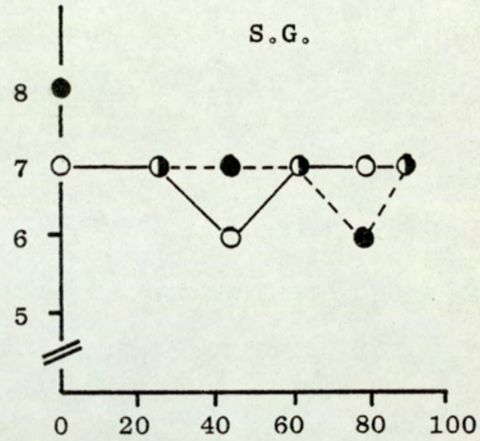


Fig. 11.3n.

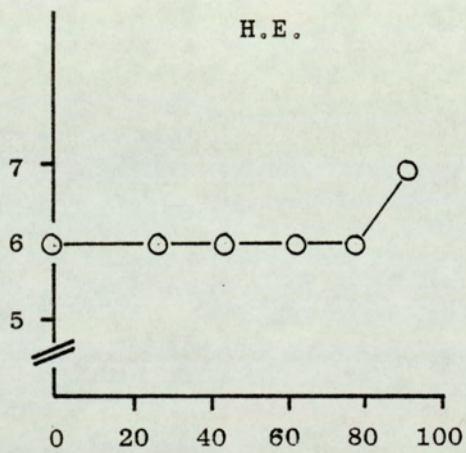


Fig. 11.3p.

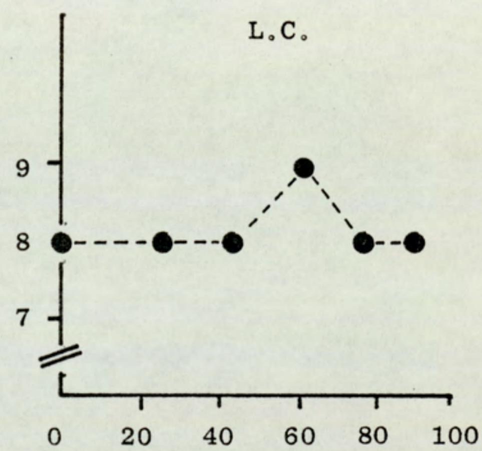


Fig. 11.3q.

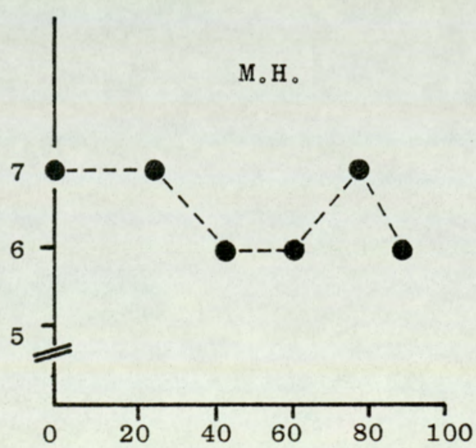


Fig. 11.3r.

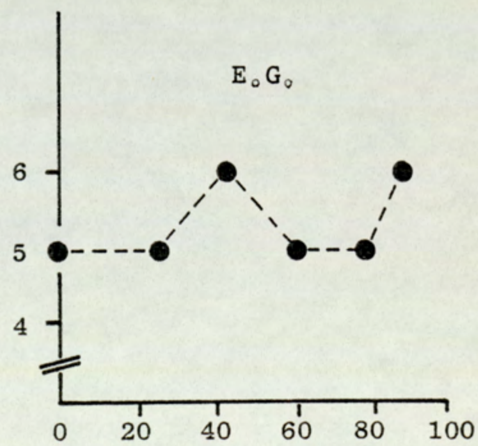


Fig. 11.3s

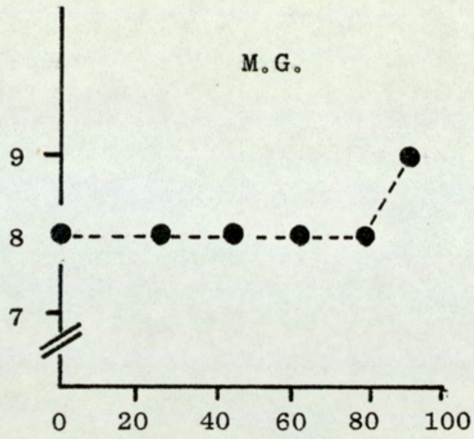


Fig. 11.3t.

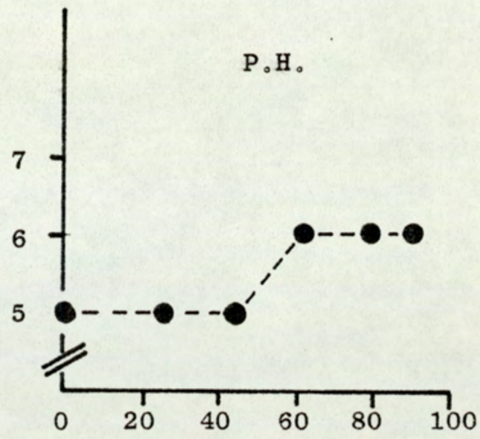


Fig. 11.3u.

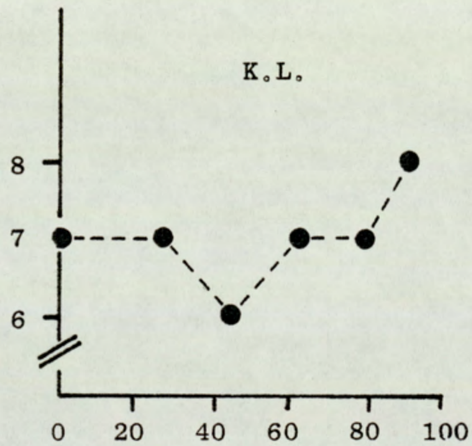


Fig. 11.3v

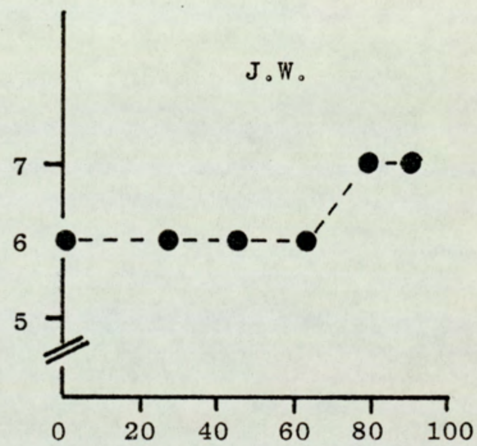


Fig. 11.3w.

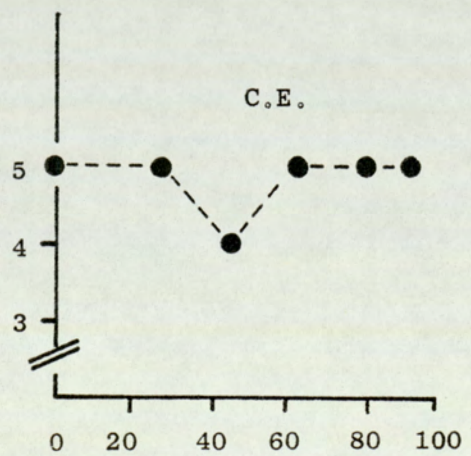


Fig. 11.3x

still evident in many cases (for example, subjects D.S. S.B. J.B. and W.P.). It was seen that, for the majority of individuals, the curve of best fit still remained parallel to the abscissa (Subjects M.C. N.P. E.W. K.B. and S.G.). The threshold acuity for some youngsters did, however, seem to worsen with increase in angular velocity of the target (subjects P.C. A.C. S.P. and H.E.).

The stationary threshold, determined without restriction of time, was found to be better than that determined with the presentation time of 300msec in each of the 15 subjects. This difference was statistically significant ($t = -3.175, df = 14, p<0.005$).

This result differs from that found with the normally sighted where acuity is only influenced by exposure times of less than approximately 100msec (Graham & Cook 1937). It is in accord, however, with the opinion that the partially sighted take longer than their sighted peers to carry out particular tasks.

Statistical analysis showed that there was no difference between the threshold determined at the initial angular velocity and that determined for the same velocity on completion of the experiment ($t = 1.86, df = 14, p<0.1$).

The results of the experiment were considered to be of sufficient merit to warrant a study of reliability. Consequently, the experiment was carried out, in exactly the same manner, after an interval of 7 days, on 19 of the 24 youngsters. The data for all 19 subjects are listed in Table 11.2 and shown graphically as the broken line in Fig.11.4a to 11.4x.

A similar pattern appeared to be present in the results for the repeat experiment. Some subjects exhibited considerable scatter in their results (subjects K.I. S.B. E.W. K.L. and S.G.), others showed a curve parallel to the abscissa (subjects M.C. N.P. P.C. L.C. and

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	Stationary	0	26	44	62	79	90	Repeat
Group 1A								($0^{o}Sec^{-1}$)
M.C.	10	20	20	14.14	14.14	20	20	10
N.P.	10	14.14	20	20	10	20	20	20
K.I.	28.28	80	56.57	40	40	56.57	56.57	80
P.C.	10	20	14.14	14.14	14.14	14.14	14.14	14.14
L.C.	20	20	20	20	28.28	20	20	20
Group 1B								($90^{o}Sec^{-1}$)
S.B.	5	5	14.14	14.14	10	14.14	7.07	14.14
H.M.	20	40	28.28	40	28.28	28.28	28.28	40
M.H.	10	14.14	14.14	10	10	14.14	14.14	14.14
E.G.	7.07	7.07	7.07	10	7.07	7.07	10	10
A.C.	7.07	5	10	5	7.07	10	10	14.14
Group 2A								($44^{o}Sec^{-1}$)
W.P.	2.5	3.53	3.53	3.53	3.53	3.53	5	5
M.G.	14.14	20	20	20	20	20	28.28	20
P.H.	2.5	7.07	7.07	7.07	10	10	10	7.07
E.W.	14.14	10	14.14	7.07	14.14	7.07	14.14	14.14
Group 2B								($62^{o}Sec^{-1}$)
S.P.	10	14.14	14.14	14.14	14.14	14.14	14.14	10
K.L.	5	14.14	14.14	10	14.14	14.14	20	14.14
J.W.	5	10	10	10	10	14.14	14.14	10
S.G.	7.07	20	14.14	14.14	14.14	10	14.14	10
C.E.	3.53	7.07	7.07	5	7.07	7.07	7.07	5

Table 11.2 Results of Experiment 3 - Repeat
Threshold values of M.A.R. for
Landolt rings presented at 6 different
target velocities

S.P.) and others a deterioration in threshold with increased target velocity (subjects A.C. W.P. M.G. P.H. and J.W.).

The difference between the two types of stationary thereshold in this group of youngsters was also found to be statistically significant ($t = -2.64$ $df = 14$ $p<0.01$). The magnitude of the significance, however, was less than that determined from the surviving data on 15 individuals involved in the initial experiment. The reason for the difference in magnitude of the two significance levels is not clear. It could possibly be attributed to the overall variance inherent in the experiment or to a practice effect. The latter explanation would seem to be reasonable in that the 19 individuals would all have had experience of the task during the initial running of the experiment.

The lack of statistical significance between thresholds for the initial velocity and for the same velocity at the end of the experiment was maintained for this group ($t = -0.506$, $df = 13$, $p<0.9$).

A comparison of the findings from the initial and repeat experiments unfortunately showed that a considerable within group variance was present in the results. Some individuals exhibited scatter in their results from only one of the experiments whilst others showed scatter in those from both the test and retest experiments. The results for some youngsters did, however, demonstrate a reasonable degree of repeatability. These various effects can be seen in the graphs of 11 youngsters for whom data is available (Figs. 11.4a to 11.4n).

Several conclusions were drawn from these two experiments. It was felt that a substantial amount of experimental error resulted both from the apparatus and also from the method of threshold determination. It was suspected, in particular, that the lack of control over head movements in the anterior-posterior plane accounted for much of the variance. It was also acknowledged that the technique had failed to produce the requisite deterioration in acuity with increase in target angular velocity.

The second phase of the development work on the dynamic acuity task was carried out using final year pupils from the 1978/79 academic year at Exhall Grange School.

A number of modifications were made to both the apparatus and experimental method as a result of the experience gained during the previous experiment.

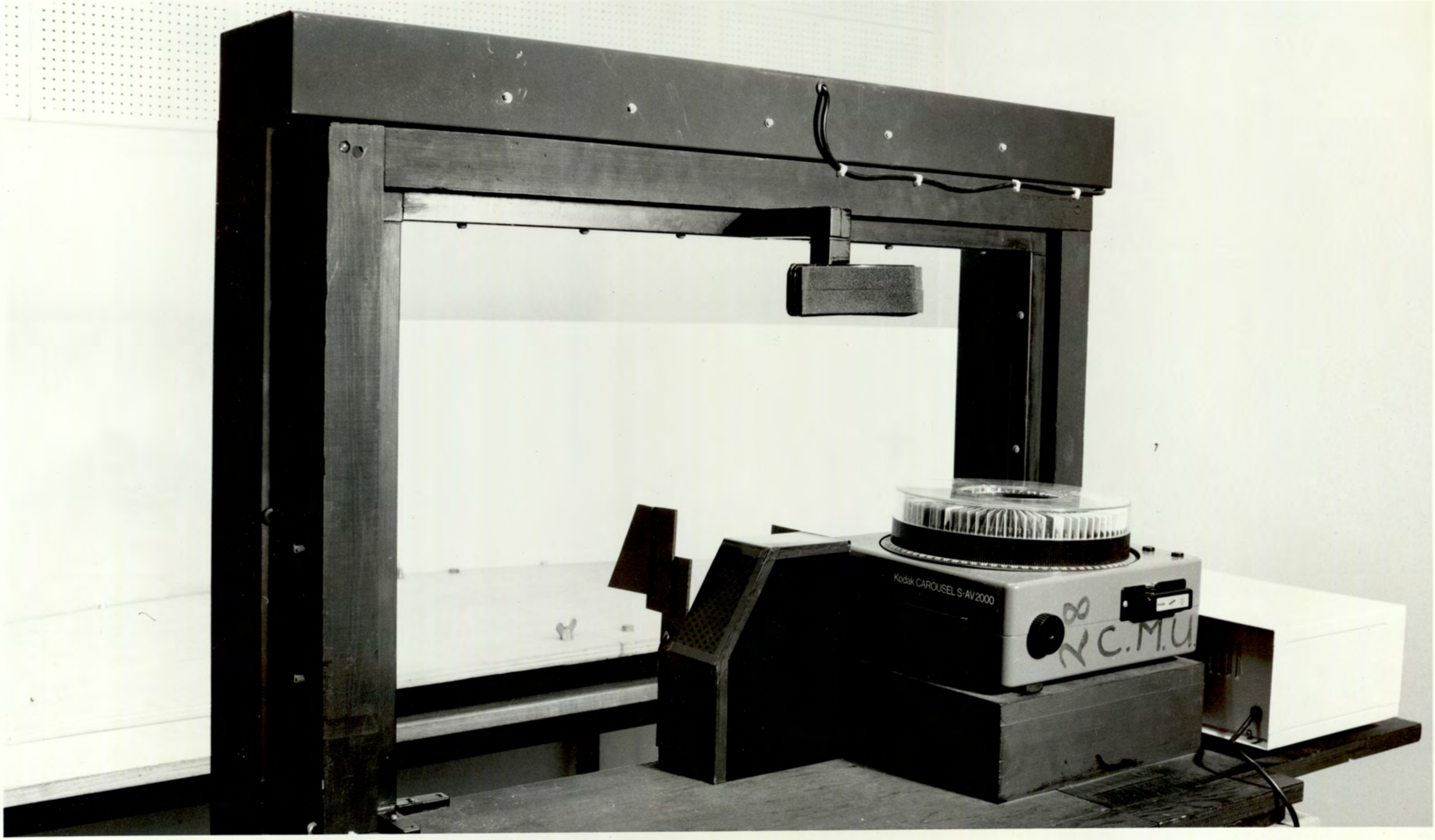
In order to facilitate a constant experimental environment, a light source was incorporated into the apparatus. This consisted of 3 fluorescent tubes, each 2ft in length, mounted on a specially devised aluminium reflector and supported on a framework consisting of $1\frac{3}{4}$" soft wood and dexon speed frame. The light source provided a screen luminance of $92 \pm 7 cdm^{-2}$.

A headrest was also constructed and was attached to the framework. The head rest permitted lateral and vertical head movements, but restricted head movements in the anterior-posterior plane. The viewing distance was maintained at 1.50m. (Plates 11.1 and 11.2).

The indicator cross used to denote the initial position of the targets was changed from a black to a yellow colour in order to reduce the possibility of after images.

It was decided to reduce the target contrast with the aim of producing a more apparent deterioration in target resolution with increase in target velocity. The effect of such a reduction in target contrast is well illustrated by the results of Brown (1972c) (Fig.11.4). The reduction of target contrast in the present study was achieved by inserting neutral density filters in between the projection beam and

Overleaf . ... Plate 11.1. The apparatus used for the dynamic visual acuity investigation of youngsters from the 1978/79 and 1979/80 academic years.


Kodak CAROUSEL S-AV 2000
C.M.U.

Overleaf ... Plate 11.2. Close - up view of the pen - motor and mirror.


Kodak CAROUSEL S-AV2000

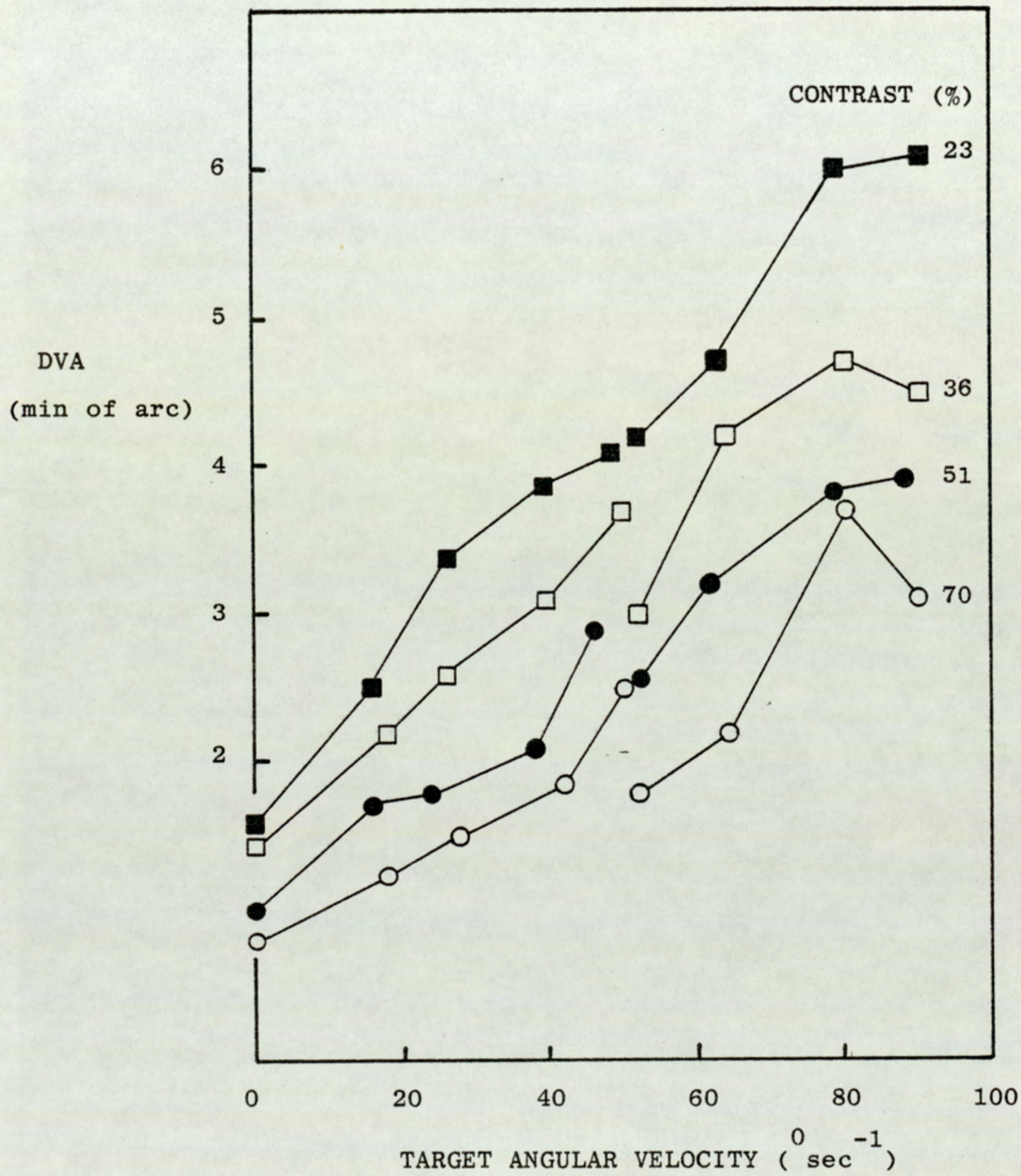


Fig. 11.4. Mean DVA as a function of target angular velocity at 4 contrast levels. (After Brown 1972c).

the rotating mirror. The filters were protected by glass plates and held in place by a black perspex support which also served to shield spurious reflections from the projection beam. Appropriate neutral density filters were selected to provide two contrast levels of 24.0% and 5.0% respectively.

It was decided to omit the measurement of static acuity determined without time restriction, and also the repeat threshold measurement carried out at the initial target velocity. These measurements were discontinued in order to reduce the time length of the experiment which had previously been of the order of 20 minutes. It was felt that this omission was necessary not only to reduce subject fatigue, but also to minimise the length of time away from the classroom.

The opportunity was also taken to alter the sequence of presentation of the target velocities. It was decided to avoid grouping the subjects and to present the target velocities in 4 distinct and consecutive series, namely in ascending, randomized, descending and reverse randomized orders of velocity. Threshold acuity at a particular angular velocity was to be determined once during each series. The mode of target presentation was identical to that of the previous experiment; namely, 4 series of targets presented in alternate ascending and descending order of target size.

The combination of both the target and the velocity presentations resulted in a well defined procedure for the determination of threshold acuity at each particular angular velocity. Threshold acuity was first determined with a series of targets in ascending order of size and with the target velocities also in ascending sequence. It was then determined with a descending series of target sizes and with the randomized order of velocities. The third threshold determination utilized an ascending order of target sizes and the descending velocity sequence. The final determination was carried out with a descending series of target sizes and with the reversed randomized order of target velocities. This procedure is summarized in Table 11.3

The criteria for threshold at each of the 4 determinations varied with the mode of target presentation. In the ascending target size presentation, it was taken as the smallest of the first two successively correctly identified targets whilst that for the descending target series was the smallest of the last two correctly recognised targets. The threshold target size for the 4 determinations combined was taken as the smallest target, correctly identified on at least 3 of the 4 threshold determinations, proceeding a similar or better level of identification of the next larger target.

The modified procedure was incorporated into the next experiment (the fourth of the series) which was carried out on a sample of 10 final year pupils from the 1978/79 academic year at Exhall Grange School. Dynamic acuity was determined at both levels of contrast in the same experimental session. Half of the sample were assessed first with the higher contrast targets and then with the targets of the lower contrast level. This order was reversed for the remaining 5 subjects.

Unfortunately, due to the circumstances described earlier (footnote page 234) the results for the 24% contrast level are not available. Five results do, however, remain for the lower contrast level. These are presented in Table 11.4.

A noticable deterioration in acuity with increase in target velocity was, for the first time, observed in the results obtained at the 5% contrast level. The results at the higher contrast level, however, failed to show such a deterioration in acuity. In addition, the results at both contrast levels showed a definite reduction in the

THRESHOLD DETERMINATION	TARGET SIZE SEQUENCE	TARGET VELOCITY SEQUENCE ($^{o}Sec^{-1}$)
FIRST	ASCENDING	0, 26, 44, 62, 79, 90
SECOND	DESCENDING	26, 90, 62, 0, 44, 79
THIRD	ASCENDING	90, 79, 62, 44, 26, 0
FOURTH	DESCENDING	79, 44, 0, 62, 90, 26

Table 11.3 Sequence of target size and velocity presentation for each of four threshold determinations

INITIAL
ASSESSMENT

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subject	0	26	44	62	79	90
R.M.	20	28.28	28.28	20	28.28	28.28
C.P.	5	5	7.07	10	10	10
M.P.	28.28	20	20	28.28	28.28	40
S.P.	28.28	40	40	28.28	40	56.57
M.Q.	10	14.14	10	14.14	20	20

REPEAT
ASSESSMENT

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subject	0	26	44	62	79	90
R.M.	20	20	28.28	28.28	40	40
C.P.	5	7.07	5	10	10	10
M.P.	28.28	20	20	20	28.28	40
S.P.	40	40	28.28	40	80	80
M.Q.	7.07	10	14.14	14.14	14.14	20

Table 11.4 Remaining results for Experiment 4
Threshold values of M.A.R. for Landolt rings presented at 6 different target velocities.

scatter which had been present in previous experiments.

Consequently, it was decided to repeat the experiment at both contrast levels on all 10 observers. This was carried out after an interval of one day. A similar pattern was found in the results from the repeat investigation; a reduction in the spread of results and, at the lowest contrast level, an apparent deterioration in acuity with increased target velocity. Indeed, the results showed a good degree of test - retest reliability between the two investigations. Some indication of the degree of reliability can be seen from the magnitude of the Pearson correlation coefficient calculated from the remaining results at the lowest contrast level for all 5 observers. ($r = 0.871$, $df = 28$, $t = 9.38$, $p<0.001$).

It was acknowledged that the criteria for threshold acuity adopted in the initial four experiments had not included an indication of the range of values from which any particular threshold value was determined. Consequently, it was decided to modify the criteria for threshold. The threshold value at each angular velocity was to be taken as the mean of the 4 individual threshold evaluations. The range of results associated with each mean value could then be represented by the standard deviation or by the standard error of the mean. An opportunity was also taken at this juncture to increase the number of threshold determinations carried out at each angular velocity, from 4 to 8 presentations. This was incorporated into the routine in an attempt to further refine the accuracy of the threshold measurement at each target velocity.

It was acknowledged, however, that an increase in the required number of observations might lead to a more pronounced fatique effect influencing the nature of the results.

The experiment incorporating these modifications was carried out with the 24% contrast targets on a sample of 7 youngsters. The mean threshold acuity at each angular velocity is given in Table 11.5a.*

The results showed that in 6 of the subjects, the acuity did not substantially alter with increase of target angular velocity. The acuity of one youngster (subject G.D.) did, however, deteriorate rapidly as target velocity was increased. Indeed, the threshold acuity of this youngster at the fastest two velocities was poorer than that of the stationary velocity by a factor of between 1½ and 2.

A curve of the form $y = \alpha + \beta x^3$ (Section 11.1) was fitted to the data of each individual by the method of least squares (Pollard 1977). The resulting values of the coefficients α and β are listed in Table 11.6a.

The value of β i.e. that governing the rate of increase in the threshold y, varied for 6 of the youngsters between -0.90×10^{-6} and 2.67×10^{-6} whilst for the seventh youngster (subject G.D.) it was 15.30×10^{-6}. A negative value of β was found for 4 subjects suggesting a supposed improvement in dynamic acuity with increase in target velocity.

The results of an F test (Pollard 1977), however, showed that the β coefficient for 6 of the subjects did not differ significantly from zero. In contrast, the β coefficient for one youngster (subject J.S.) was significant at the 0.05 level ($\beta = 2.87 \times 10^{-6}$, $F = 8.05$ $df = 1, 4.$ $p<0.05$). The value of F for each observer is also listed in Table 11.6a.

The experiment was repeated in exactly the same manner after an interval of 1 day. The mean threshold values are listed in Table 11.5b

*Due to circumstances described earlier, the standard deviations associated with each mean are not available.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	0	26	44	62	79	90
G.C.	6.29	4.78	5.52	4.52	3.71	5.59
J.Sy	32.25	31.94	28.71	35.18	26.34	35.18
A.S.	19.35	18.10	15.82	16.06	17.59	17.59
P.O.	5.15	4.17	5.06	5.67	3.15	4.76
D.Pe	7.51	6.29	6.40	6.73	6.22	6.92
J.Sk	21.49	19.87	21.34	21.64	21.79	23.10
G.D.	26.64	31.33	38.71	35.60	51.84	35.60

Table 11.5a Results of Experiment 5. Mean Threshold values of M.A.R. for Landolt rings presented at six different target velocities.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	0	26	44	62	79	90
G.C.	4.21	4.78	4.60	5.35	4.45	4.71
J.Sy	28.08	37.68	27.67	32.67	31.64	34.75
A.S.	14.57	12.59	14.57	13.32	14.57	14.57
P.O.	4.32	4.32	3.74	4.27	4.97	4.98
D.Pe	7.36	6.14	6.22	5.59	7.10	6.84
J.Sk	22.59	18.53	17.59	16.06	15.30	16.03
G.D.	28.26	27.07	28.93	29.44	41.21	42.85

Table 11.5b Results of Experiment 5 - Repeat. Threshold values of M.A.R. for Landolt rings presented at six different target velocities.

SUBJECT	α	$\beta x10^{-6}$	F	SIGNIFICANCE LEVEL
E.C.	5.30	-0.90	0.360	N.S.
J.Sy	31.22	1.46	0.060	N.S.
A.S.	17.56	-0.55	0.062	N.S.
P.O.	4.90	-0.94	0.427	N.S.
D.Pe	6.72	-0.16	0.036	N.S.
J.Sk	20.79	2.87	8.046	$P<0.05$
G.D.	32.63	15.30	1.526	N.S.

Table 11.6a Experiment 5. Computed values of α and β and results of F test of statistical significance.

SUBJECT	α	$\beta x 10^{-6}$	F	SIGNIFICANCE LEVEL
G.C.	4.65	0.13	0.042	N.S.
J.Sy	31.12	3.68	0.341	N.S.
A.S.	13.72	1.18	0.763	N.S.
P.O.	4.10	1.30	7.627	N.S.
D.Pe	6.49	0.54	0.235	N.S.
J.Sk .	19.35	-6.39	3.880	N.S.
G.D.	26.93	23.15	46.222	$P<0.01$

Table 11. 6b Experiment 5 - Repeat. Computed values of α and β and results of F test of statistical significance

and the computed values of α and β in Table 11.6b. A similar pattern was noted in the results of the repeat experiment. Five youngsters showed no appreciable increase in threshold acuity at the faster target velocities, the value of β ranging from 0.13×10^{-6} to 3.68×10^{-6}. The acuity of subject G.D. again deteriorated rapidly as the target velocity was increased. The results of one youngster (J.Sk) showed a considerable discrepancy between the two assessments; the value of β being 2.87×10^{-6} at the initial examination and -6.92×10^{-6} at the repeat investigation. The F test revealed that 6 of the 7 β coefficients were not significantly different from zero. The β coefficient for subject G.D. was, however, found to be significantly different in this respect. ($\beta = 23.15 \times 10^{-6}$. $F = 46.22$ $df = 1,4$. $p<0.01$).

A Pearson correlation coefficient, for all 7 subjects, was calculated for the initial and repeat values of α and for those of β. The magnitude of the coefficients and the level of statistical significance both for the coefficient α ($r = 0.986$, $df = 5$, $t = 13.22$, $p<0.01$) and β ($r = 0.874$, $df = 5$, $t = 4.02$, $p<0.05$) indicated that the experimental method yielded repeatable values of α and β.

Two possible suggestions were put forward for the lack of statistical significance of the β coefficients. The first, more obvsious explanation, was that the values of β were indeed not significantly different from zero. The resulting inference from this suggestion was that the model of dynamic acuity developed for the normally sighted was not applicable to the partially sighted.

The second argument contended that the variance inherent in the technique of threshold measurement prevented the accurate expression of the true curvilinear repression characteristics between x and y. It was hypothesized that the spread of results was such that it caused the curve of best fit to be placed almost parallel to the abscissa. Evidence for this hypothesis lay in the individual test - retest correlation coefficients calculated from the raw eata (Table 11.7). These correlations were small and did not significantly differ from zero indicating that considerable unexplained variance was present in the data for each youngster. The variation in the magnitude of F for the test and retest β coefficients of subjects J.Sk and G.D. further illustrated the obvious experimental error inherent in the method. It was felt that the magnitude and significance of the overall correlation for the test - retest β coefficients presented a distorted picture in that it merely described the degree of reliability of the unrepresentative test and retest assessments of β.

It was recognized, however, that these arguments were only founded on the results from 5 partially sighted observers. It was therefore considered necessary to continue the experiment on a further sample of 10 youngsters. In addition, it was also decided to investigate dynamic acuity at the lower contrast level using a second sample of 10 youngsters. A control experiment of normally sighted observers was also carried out at this stage.

The results for the continuation of the 24% contrast level experiment, carried out on the further sample of 10 partially seeing youngsters, are listed in Table 11.8a. The computed values of α andβ for each subject are listed in Table 11.9a. The value of β ranged from -0.63×10^{-6} to 1.90×10^{-6} in 6 of the 10 subjects. Two youngsters (A.M. and G.S.) showed a slight deterioration in threshold: the acuity at the fastest two velocities being poorer than the stationary acuity, by a factor of approximately one third. Negative β coefficients were observed in 4 subjects; 2 of whom (J.N. and D.L.)

TEST - RETEST RELIABILITY
COEFFICIENTS (Pearson r)

G.C.	-0.385
J.Sy	+0.382
A.S.	-0.569
D.P.	+0.42
J.Sk	-0.360
G.D.	0.622

Table 11.7 Experiment 5. Individual test - retest coefficients (Pearson r) calculated from the raw scores of 7 youngsters

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	0	26	44	62	79	90
M.J.	8.90	6.77	6.77	7.39	7.65	7.02
M.T.	8.06	14.72	6.92	9.68	10.30	10.82
T.M.	11.92	12.07	15.67	16.12	16.19	15.15
V.T.	11.03	10.67	11.19	11.19	12.22	12.07
D.P.	21.64	17.80	18.53	19.14	18.84	20.30
M.S.	11.77	14.20	11.70	11.86	13.53	11.55
N.P.	8.17	6.92	6.92	7.80	9.41	7.28
J.N.	22.16	21.34	16.34	18.41	17.07	18.84
G.S.	12.07	11.55	11.40	13.32	15.09	15.09
D.L.	15.30	14.72	24.87	16.49	12.65	14.42

Table 11.8a Experiment 6. - 24% Contrast
Mean threshold values of M.A.R.
for Landolt rings presented at
6 different target velocities.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	0	26	44	62	79	90
M.J.	7.76	6.81	6.48	7.54	7.28	6.66
M.T.	10.04	14.57	11.19	11.19	9.94	10.52
T.M.	11.55	14.57	15.82	13.32	17.22	16.91
V.T.	12.07	10.52	11.55	12.59	13.10	12.59
D.P.	17.07	19.87	17.80	18.84	16.55	16.85

Table 11.8b Experiment 6 - 24% Contrast - Repeat
Mean threshold values of M.A.R. for
Landolt rings presented at six different
target velocities.

SUBJECT	α	$\beta x10^{-6}$	F	SIGNIFICANCE LEVEL
M.J.	7.56	-0.57		N.S.
M.Tu	9.87	0.83	0.033	N.S.
A.M.	13.48	3.98	2.108	N.S.
V.T.	10.90	1.90	19.319	P<0.025
D.Po	19.22	0.59	0.064	N.S.
M.S.	12.60	-0.63	0.182	N.S.
N.P.	7.51	0.93	0. 61	N.S.
J.N.	19.89	-3.30	0.874	N.S.
G.S.	11.68	5.40	29.478	P<0.01
D.L.	17.97	-6.0	0.796	N.S.

Table 11.9a Experiment 6. 24% Contrast
Computed values of α and β and results of F test of statistical significance

SUBJECT	α	$\beta x10^{-6}$	F	SIGNIFICANCE LEVEL
M.J.	7.19	-0.39	0.205	N.S.
M.Tu	10.54	-0.12	0.016	N.S.
A.M.	13.50	5.35	4.197	N.S.
V.T.	11.50	2.18	3.665	N.S.
D.Po	18.48	-2.48	1.867	N.S.

Table 11.9b Experiment 6. 24% Contrast - Repeat.
Computed values of α and β and results of F test of statistical significance.

showed an apparent improvement in threshold at the faster velocities.

The value of β was significantly different from zero in only two of the 10 youngsters being ($\beta = 1.90 \times 10^{-6}$. df = 1,4. $p<0.025$ for subject V.T. and $\beta = 5.40 \times 10^{-6}$. df = 1,4. $p<0.01$ for subject G.S.).

The procedure was repeated one day later on 5 subjects chosen at random from the sample of 10 youngsters. These results are also listed in Table 11.8b. The β values (Table 11.9b) generally showed a similar pattern to those of the initial assessment. A slight deterioration in threshold was again noted in the results of subject A.M. ($\beta = 5.35 \times 10^{-6}$). A discrepancy was present in the results for the subject D.Po., the value of β being 0.59×10^{-6} at the initial assessment and -2.48×10^{-6} at the repeat investigation. The F test revealed that all 5 β coefficients were not significantly different from zero. The magnitude and statistical significance of the Pearson correlation coefficients for all 5 subjects for both α ($r=0.992$ df=3, $t=13.61$, $p<0.01$) and β ($r=0.879$, df=3, $t=3.19$, $p<0.05$) confirmedthe repeatable nature of the assessment procedure used to determine α and β. The individual correlation coefficients (Table 11.10)caclculated from the mean threshold values were significantly different from zero in only two of the 5 cases (subjects M.J. $r = 0.855$ df = 4, $t = 3.29$, $p<0.05$ and V.T. $r = 0.820$, df = 4, $t = 5.73$, $p<0.05$).

The mean values for the low contrast (5%) investigation are listed in Table 11.11a The computed values of α and β are listed in Table 11.12a. Negative values of β were obtained from two subjects. The results from the majority of the youngsters, however, showed a noticable deterioration in acuity at the faster target velocities. In particular, the acuity of subjects R.E. and P.B. deteriorated markedly as target velocity was increased, the value of β being 25.21

Subject	Pearson r
M.J.	0.855
M.T.	0.744
T.M.	0.603
V.T.	0.820
D.P.	-0.602

Table 11.10 Experiment 6 - 24% contrast. Individual test - retest coefficients (Pearson r) calculated from the raw scores of 5 youngsters.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subject	0	26	44	62	79	90
R.E.	30.18	24.14	26.64	28.71	39.74	44.14
V.W.	26.77	20.91	16.34	21.34	24.57	24.14
P.K.	5.96	5.77	5.15	6.03	6.66	5.33
M.F.	12.95	11.18	11.44	12.95	13.82	12.07
S.R.	21.03	18.62	19.05	28.71	29.26	19.51
P.B.	10.82	14.20	10.15	14.78	21.12	19.35
J.H.	18.53	18.53	20.30	20.30	20.60	20.60
D.S.	8.79	10.93	11.19	12.95	10.52	8.90
N.J.	24.87	18.62	19.05	28.71	29.26	19.51
K.B.	20.30	20.90	18.84	16.86	19.05	23.71

Table 11.11a Experiment 6 - 5% Contrast
Mean threshold values of M.A.R.
for Landolt rings presented at
six different target velocities.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subject	0	26	44	62	79	90
R.E.	23.10	24.14	26.64	30.17	32.67	34.57
V.W.	17.37	16.55	17.07	18.53	20.30	25.17
P.K.	4.63	5.07	5.07	4.63	6.48	4.89
M.F.	11.44	11.81	11.55	12.28	13.90	14.31
S.R.	23.62	26.34	22.67	21.64	19.34	16.64

Table 11.11b Experiment 6 - 5% Contrast - Repeat
Mean threshold values of M.A.R. for
Landolt rings presented at six different
target velocities.

SUBJECT	α	$\beta x10^{-6}$	F	SIGNIFICANCE LEVEL
R.E.	25.69	25.21	29.564	P<0.01
V.W.	21.36	3.77	0.405	N.S.
P.K.	5.78	0.13	0.019	N.S.
M.F.	12.11	1.12	0.473	N.S.
S.R.	19.33	-2.53	0.607	N.S.
P.B.	11.69	12.97	11.441	P<0.05
J.H.	19.14	2.55	5.122	N.S.
D.S.	10.90	-1.34	0.274	N.S.
N.J.	22.75	2.23	0.072	N.S.
K.B.	19.04	3.46	0.957	N.S.

Table 11.12a Experiment 6. 5% Contrast. Computed values of α and β and results of F test of statistical significance

SUBJECT	α	β	F	SIGNIFICANCE LEVEL
R.E.	24.58	15.22	46.000	P<0.01
V.W.	16.41	10.57	48.216	P<0.01
P.K.	4.90	0.85	0.605	N.S.
M.F.	11.47	4.14	82.183	N.S.
S.R.	24.55	-10.92	35.332	P<0.01

Table 11.12b Experiment 6. 5% Contrast - Repeat. Computed values of α and β and results of F test of statistical significance.

x 10^{-6} and 12.97 x 10^{-6} respectively. These values were found to be significantly different from zero (β = 25.21 x 10^{-6}, F = 29.56, d,f = 1,4 p<0.01 and β = 12.97, F = 11.44 d,f = 1,4 p<0.05 respectively). The F values for the remaining β coefficients were not statistically significant. The curves for subjects R.E. and P.B. are shown in Figs. 11.5 and 11.6.

The procedure was repeated one day later on 5 individuals selected at random from the sample. The result of these youngsters (Tables 11.11b and 11.12b) compared reasonably well with those from the initial assessment. Analysis with the F test showed that 3 coefficients were significantly different from zero, with that of subject R.E. being maintained for both the test and retest situation. The emergence of an additional 2 significant coefficients at the retest situation tended to support the argument that the lack of statistical significance for the β coefficients at the test situation was due to the variance present in the experimental method. It also implied that this variance could be reduced with additional experience of the task. The findings for subject S.R., however, indicated that the acuity of this youngster apparently improved with increase in target speed. The retest curve for subject R.E. is shown as the broken line in Fig.11.5.

The product moment correlation for the coefficient α (r = 0.904 p<0.05) indicated the repeatable nature of this measurement. A high correlation was also obtained for the β coefficient (r = 0.769); this value, however, was not statistically significant (df = 3, t = 2.08, p < 0.1).

The individual test retest correlations calculated from the mean threshold values (Table 11.13) were found to take on a wide range of values. The value for subject R.E. was statistically significant (r = 0.840 df = 4 p<0.05) while those for the remaining 4 youngsters

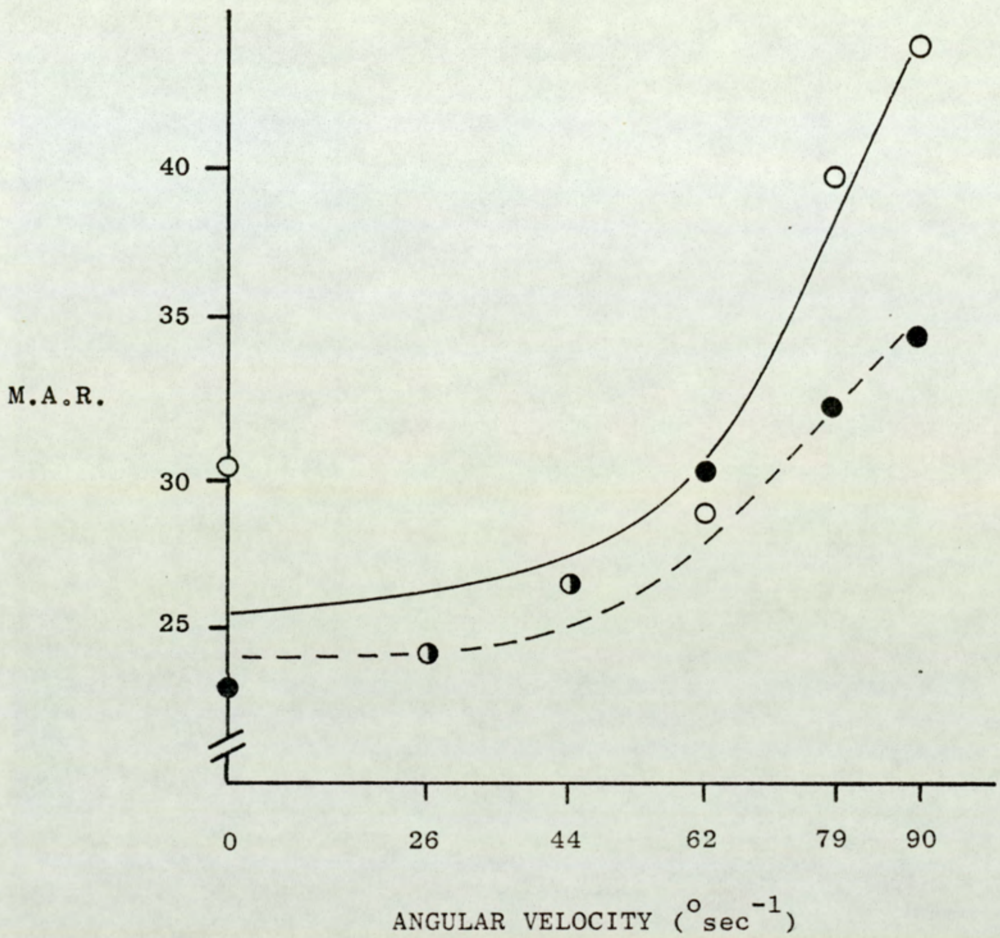


Fig. 11.5. Minimum angle of resolution as a function of target angular velocity. 5% contrast determination, Subject R.E. The test curve is shown as the solid line and the retest curve as the broken line.

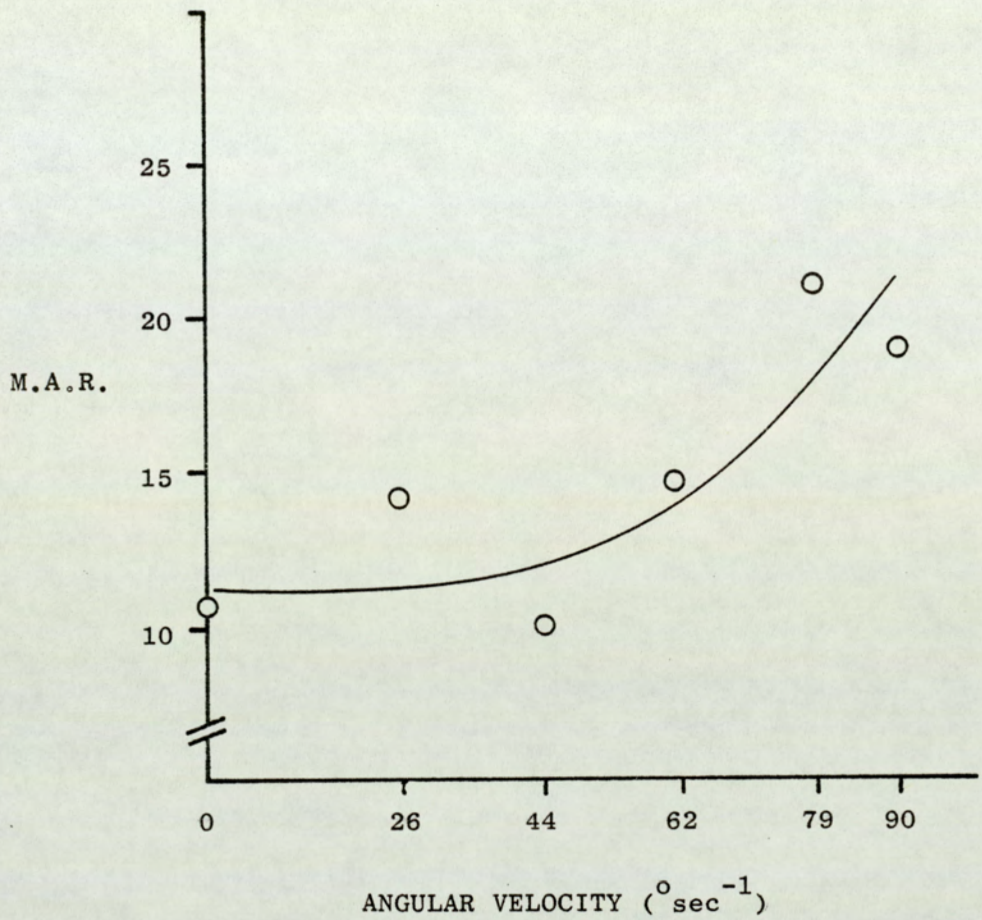


Fig. 11.6. Minimum angle of resolution as a function of target angular velocity. 5% contrast determination, Subject P.B.

Subject	Pearson r
R.E.	0.840
V.W.	0.378
P.K.	0.600
M.F.	0.386
S.R.	- 0.303

Table 11.13 Experiment 6 - 5% contrast. Individual test - retest coefficients (Pearson r) calculated from the raw scores of 5 youngsters.

were small and not significant. This latter finding is also commensurate with the presence of a learning factor.

Dynamic acuity was subsequently assessed at each contrast level using two separate groups of 10 final year pupils from the 1980/81 academic year at Exhall Grange School.

The mean threshold acuities and the accompanying standard errors of the mean for the low contrast determination are listed in Table 11.14a. The values of the respective α and β coefficients are given in Table 11.15a. Two subjects (A.W. and M.Ta.) showed marked loss of acuity at the higher target velocities, the value for β being 10.34×10^{-6} and 14.11×10^{-6} respectively. The remaining 8 subjects showed little or no appreciable decrease in acuity, β ranging from -1.99×10^{-6} to 3.25×10^{-6}.

The F test, however, revealed that only one β coefficient (subject A.W.) was significantly different from zero. In addition, the F value of subject A.H. just failed to meet this criteria. The curve for subject A.W. is shown in Fig.11.7.

The procedure was similarly repeated one day later on 8 of the 10 youngsters. The repeat results listed in Tables 11.14b and 11.15b compared very favourably with those from the initial assessment. High values of β (13.77×10^{-6} and 14.98×10^{-6} respectively) were again obtained from the results of subjects A.W. and M.Ta. The values of β in the remaining 6 subjects ranged from -1.47×10^{-6} to 4.73×10^{-6}.

The coefficient for subject A.W. remained statistically significant whilst those of 3 further youngsters (subjects M.B., M.T. and C.S.) were also found to be significant. This finding is in accord with earlier hypothesis that the variance associated with the measurement technique could be reduced as a result of practise. The retest curve

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subject	0	26	44	62	79	90
A.W.	8.28	6.92	10.04	12.22	15.09	14.57
	1.96	1.56	3.11	2.80	3.35	3.81
P.M.	23.53	23.10	22.07	24.14	23.10	24.14
	7.25	4.28	3.83	4.42	4.28	4.42
M.H.	22.59	17.59	19.78	16.34	20.30	19.57
	9.40	5.67	4.90	3.01	3.82	4.40
M.B.	17.07	17.59	21.76	17.80	16.55	19.57
	6.19	7.79	7.65	3.03	3.92	4.40
S.B.	18.84	19.27	20.30	19.27	19.35	22.37
	7.18	2.07	3.82	2.07	6.57	5.23
M.T.	29.14	26.64	25.60	26.64	39.75	34.14
	7.61	6.78	7.11	6.78	11.71	12.39
C.S.	18.32	18.10	18.83	17.89	19.57	18.10
	5.54	7.34	4.79	6.96	4.40	5.03
M.M.	9.27	8.53	8.79	7.54	8.90	10.15
	1.36	1.57	2.83	1.67	1.52	1.91
A.P.	13.90	14.27	15.60	13.53	12.28	13.68
	5.40	4.95	5.99	5.78	3.63	4.65
A.H.	9.68	10.88	10.52	11.03	10.67	12.59
	5.01	3.82	1.46	1.92	2.40	2.14

Table 11.14a Experiment 7 - 5% Contrast
Mean threshold M.A.R. values and accompanying standard error of the mean for Landolt ring targets presented at six different target velocities.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subject	0	26	44	62	79	90
A.W.	8.53	8.17	9.94	11.03	16.34	17.80
	1.57	1.52	2.93	1.92	3.03	3.03
P.M.	29.14	24.87	24.87	24.57	26.64	25.0
	7.62	8.02	8.02	10.49	6.78	9.26
M.H.	22.07	2030	22.37	23.10	21.34	23.41
	3.83	3.82	5.28	4.28	4.74	5.55
M.B.	17.28	18.01	18.53	17.07	19.57	21.34
	3.95	5.03	2.71	3.13	4.40	4.74
S.B.	20.60	17.80	20.30	21.03	22.67	22.37
	5.38	3.03	3.82	2.93	6.39	5.28
M.T.	28.41	25.91	26.03	25.17	35.78	36.21
	8.81	7.83	9.08	4.28	13.92	10.06
C.S.	12.59	12.59	12.59	13.32	14.21	15.15
	2.14	2.14	2.14	3.39	4.40	5.52
M.M.	8.53	6.77	8.53	6.92	8.17	7.18
	3.10	2.19	1.57	1.55	1.52	1.35

Table 11.14b Experiment 7 - 5% Contrast - Repeat
Mean threshold values of M.A.R. and accompanying standard error of the mean for Landolt ring targets presented at six different target velocities.

SUBJECTS	α	$\beta x10^{-6}$	F	SIGNIFICANCE LEVEL
A.W.	8.49	10.34	19.353	P<0.025
P.M.	22.97	1.34	1.388	N.S.
M.H.	19.42	-0.23	0.004	N.S.
M.B.	18.34	0.19	0.003	N.S.
S.B.	19.05	3.25	4.642	N.S.
M.Ta	26.64	14.11	5.039	N.S.
C.S.	18.37	0.37	0.126	N.S.
M.M.	8.48	1.46	1.319	N.S.
A.P.	14.39	-1.99	1.661	N.S.
A.H.	10.22	2.61	7.197	N.S.

Table 11.15a Experiment 7. 5% Contrast. Computed values of α and β and results of F test of statistical significance.

SUBJECTS	α	$\beta x10^{-6}$	F	SIGNIFICANCE LEVEL
A.W.	8.38	13.77	129.436	P<0.001
P.M.	26.23	-1.47	0.251	N.S.
M.H.	21.61	1.88	1.205	N.S.
M.B.	17.40	4.73	12.035	P<0.05
S.B.	19.57	4.71	6.699	N.S.
M.Ta	25.68	14.98	11.922	P<0.05
C.S.	12.47	3.61	397.205	P<0.001
M.M.	7.83	-0.59	0.185	N.S.

Table 11.15b Experiment 7. 5% Contrast - Repeat Computed values of α and β and results of F test of statistical significance

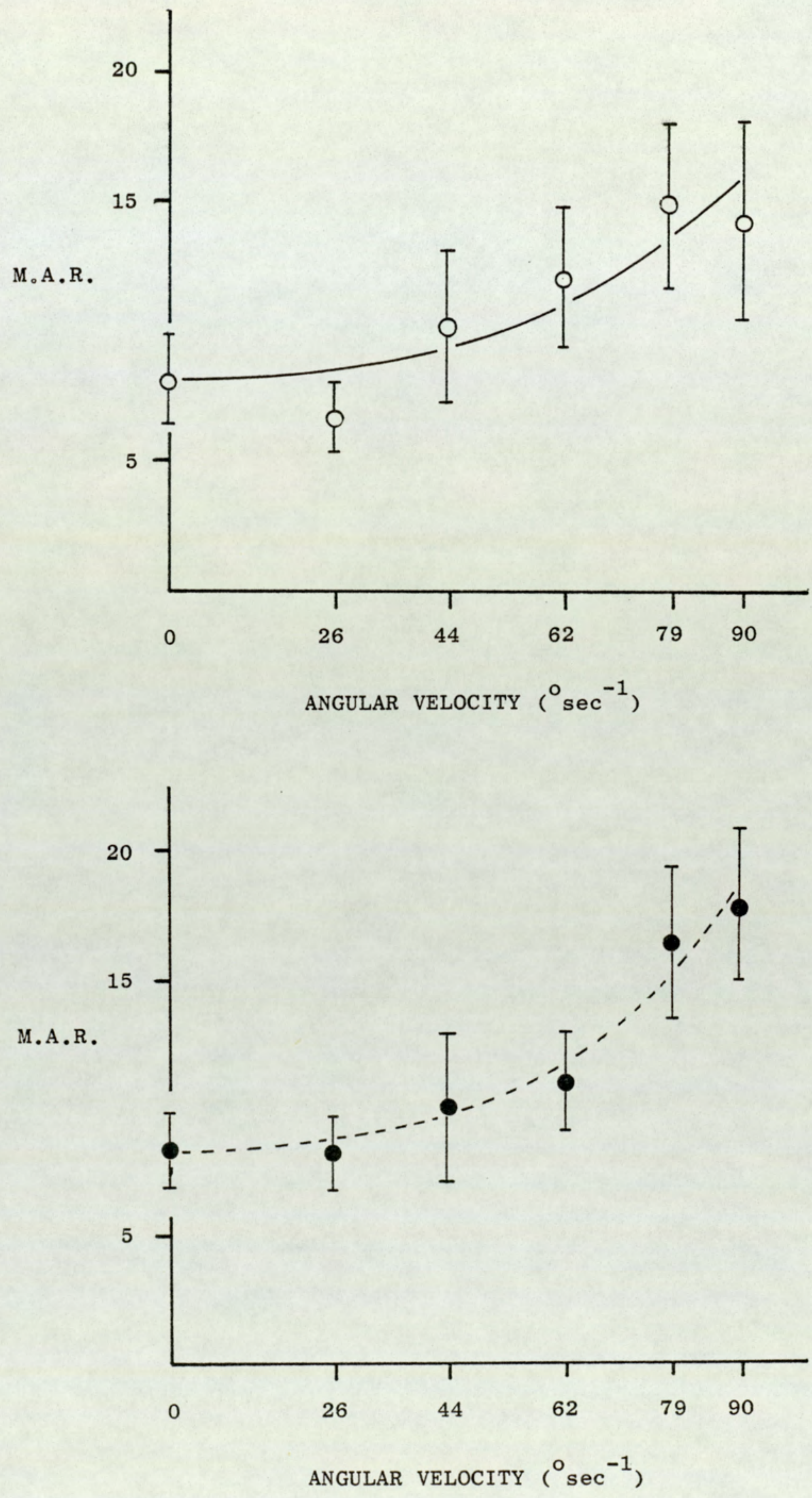


Fig. 11.7. Minimum angle of resolution as a function of target angular velocity. 5% contrast determination, Subject A.W. (Top - test curve and bottom - retest curve. The bar indicates the standard error of the mean).

for subject A.W. is shown as the broken line in Fig.11.7. The magnitude and significance levels for the α coefficient ($r = 0.928$ df = 6 $t = 6.10$ $p<0.01$) and the β coefficient ($r = 0.904$ df = 6 $t = 5.18$ $p<0.01$ once again indicated that the experimental procedure yielded repeatable assessments of α and β. The test - retest correlations calculated from the raw data again indicated the degree of variance present for each observer. The values of the correlations (Table 11.16) ranged from $r = 0.938$ for subject A.W. to $r = -0.02$ for subject M.H.

A similar pattern was evident in the results from the second 24% contrast assessment. The mean threshold acuities and standard errors of the mean are given in Table 11.17a and the resulting values of α and β in Table 11.18a. The magnitude of β for the majority of the sample (7 subjects) ranged from 0.82×10^{-6} to 5.77×10^{-6}. The acuity of subject L.K., however, showed a decrease at the fastest target velocities by a factor of approximately 2; the value of β being 27.55×10^{-6}. In one case (subject T.P.), the range of target sizes was insufficient to permit an assessment of the dynamic acuity. Five of the 9 β coefficients (subjects L.K., R.S., L.T., T.M. and A.S.) were found to be significant different from zero. The curves for 3 of the 5 youngsters are shown in Figs.11.8 to 11.10.

The individual mean and standard error of the means are given in Table 11.17b and the values for α and β in Table 11.18b. A comparison of the test - retest data revealed that the statistical significance of the β coefficient was maintained for two of the four cases (subjects R.S. and L.T.) and was not quite significant in the remaining 2 youngsters (L.K. $F = 6.69$ df 1,4 $p< 0.5$ T.M. F 5.72 df 1,4 $p< 0.5$ The retest curves for these 4 youngsters are shown as the broken line in Figs. 11.12 to 11.15. The β coefficient for one individual (subject C.S.) became significant (F = df 1,4 $p<0.05$) at the retest situation.

Subject	Pearson r
A.W.	0.938
P.M.	0.030
M.H.	- 0.020
M.B.	0.277
S.B.	0.404
M.T.	0.932
C.S.	0.122
M.M.	0.275

Table 11.16 Experiment 7 - 5% contrast. Individual test - retest coefficients (Pearson r) calculated from the raw scores of the 8 youngsters.

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	0	26	44	62	79	90
C.W.	61.21	58.09	58.28	48.28	49.75	54.50
	17.00	20.08	15.23	8.86	16.04	5.86
R.B.	26.34	29.14	29.14	25.82	28.41	33.10
	9.64	7.62	7.61	10.46	8.81	7.85
L.K.	25.60	32.67	29.57	36.03	44.14	47.43
	10.38	14.43	9.29	7.67	16.95	13.13
R.S.	12.07	12.285	13.32	12.80	14.05	16.55
	2.21	3.63	3.39	3.56	4.14	3.93
C.S.	14.20	11.40	12.07	12.59	17.07	13.84
	4.40	3.96	2.21	2.14	3.13	3.11
L.T.	15.60	15.09	15.61	15.39	17.59	18.32
	5.99	3.35	2.71	5.41	5.67	5.54
T.M.	4.52	4.71	5.20	5.07	5.52	5.52
	1.26	1.20	2.38	0.96	0.96	0.96
M.W.	35.17	40.18	33.93	38.59	38.41	41.21
	11.34	19.59	13.58	16.42	15.11	21.42
A.S.	6.14	5.85	5.85	5.96	6.29	6.55
	1.82	1.38	1.38	2.01	1.07	0.96

Table 11.17a Experiment 7. 24% Contrast
Mean threshold values of M.A.R. and accompanying standard error of the mean for Landolt rings presented at six different target velocities

ANGULAR VELOCITY ($^{o}Sec^{-1}$)

Subjects	0	26	44	62	79	90
C.W.	57.07	54.14	52.43	62.43	52.43	59.50
	19.80	17.52	7.67	7.67	7.67	8.28
R.B.	25.60	28.71	23.41	24.57	23.41	26.21
	7.11	5.40	5.55	7.27	5.55	3.83
L.K.	17.37	32.98	42.24	33.10	50.0	50.61
	5.14	16.47	13.73	7.85	18.52	79.68
R.S.	10.67	9.42	10.52	12.07	11.70	13.10
	2.37	2.40	1.46	2.21	2.77	1.92
C.S.	11.34	11.03	10.67	10.30	13.32	15.09
	3.19	1.92	2.37	2.69	3.39	3.35
L.T.	15.09	14.35	15.82	16.34	18.10	17.07
	3.35	2.70	3.73	3.03	5.03	3.13
T.M.	4.52	4.14	4.97	4.32	4.82	5.59
	1.26	0.98	1.47	0.99	0.52	1.32
M.W.	42.07	37.55	28.11	36.34	42.68	39.75
	24.61	17.40	13.52	13.29	20.80	11.71

Table 11.17b Experiment 7. 24% Contrast - Repeat Mean threshold values of M.A.R. and accompanying standard error of the mean for Landolt rings presented at six different target velocities.

Subject	α	$\beta x 10^{-6}$	F	Significance level
C.W.	57.58	9.84	1.859	N.S.
R.B.	27.16	5.77	2.968	N.S.
L.K.	28.73	27.55	43.978	P<0.01
R.S.	12.14	5.26	28.228	P<0.01
C.S.	12.57	3.68	1.581	N.S.
L.T.	15.14	4.32	33.919	P<0.01
T.M.	4.77	1.21	11.700	P<0.05
M.W.	36.40	5.81	2.281	N.S.
A.S.	5.89	0.82	11.843	P<0.05

Table 11.18a Experiment 7 - 24 Contrast
Computed values of α and β and results of F test of statistical significance.

Subjects	α	$\beta x 10^{-6}$	F	Significance level
C.W.	53.65	3.91	0.698	N.S.
R.B.	25.66	-1.33	0.156	N.S.
L.K.	28.87	33.95	6.689	N.S.
R.S.	10.23	3.88	13.014	P<0.025
C.S.	10.49	5.64	15.230	P<0.025
L.T.	15.13	3.83	8.911	P<0.05
T.M.	4.37	1.36	5.716	N.S.
M.W.	36.10	6.32	0.553	N.S.

Table 11.18b Experiment 7 - 24% Contrast
Computed values of $\alpha$and β
and results of F test of significance.

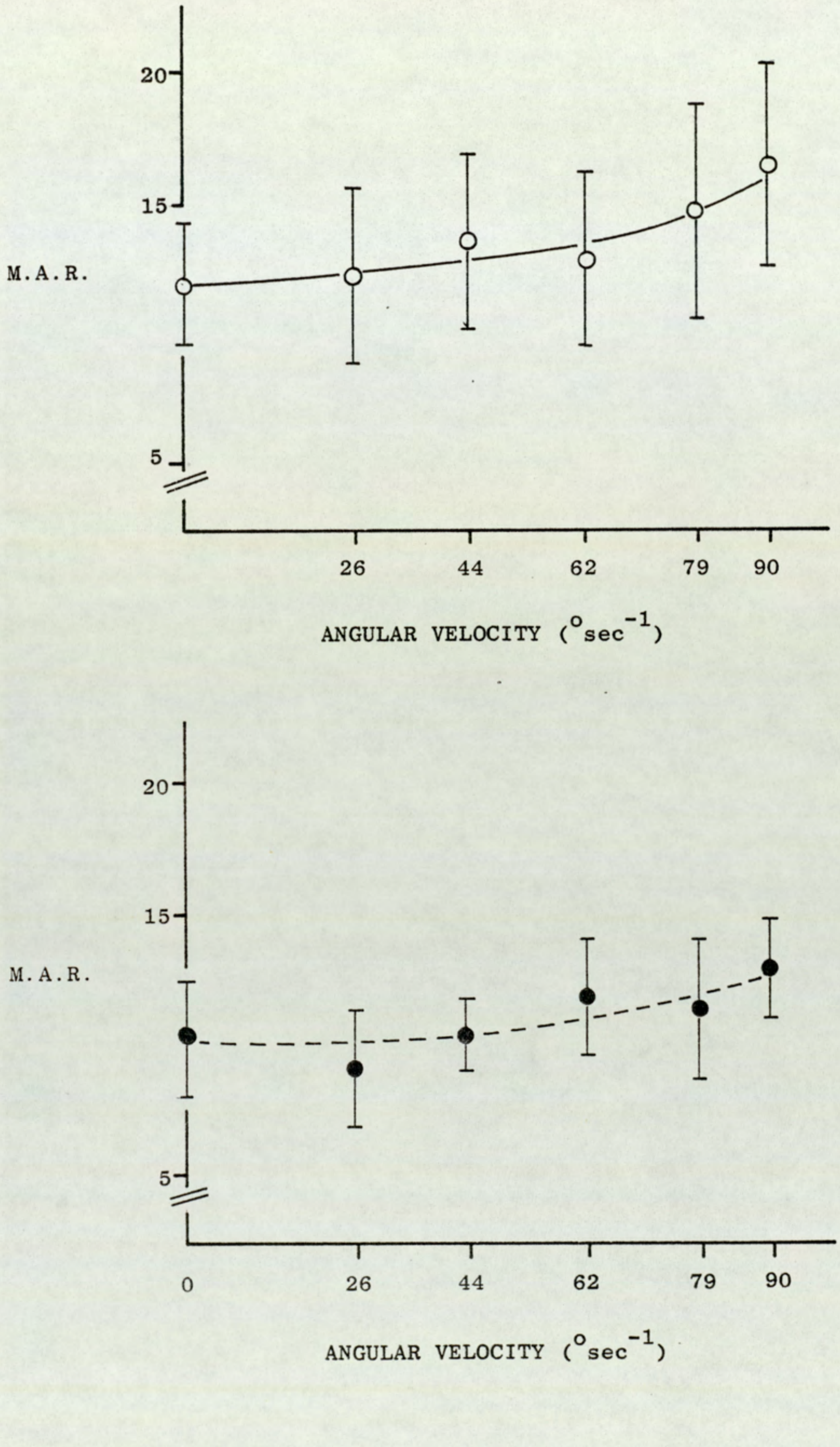


Fig. 11.8. Minimum angle of resolution as a function of target angular velocity. 24% contrast determination, Subject R.S. (Top - test curve and bottom - retest curve. The bar indicates the standard error of the mean).

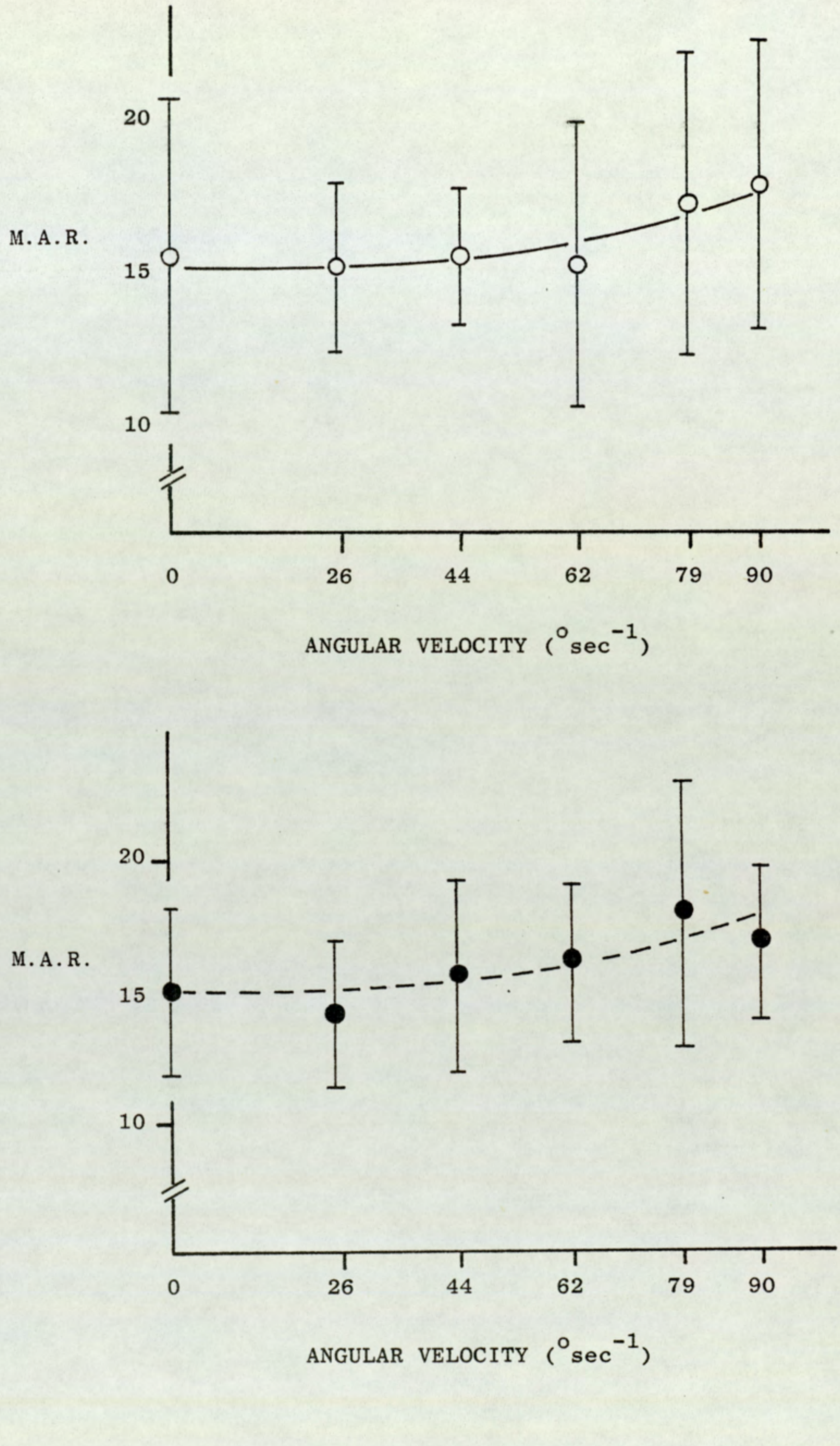


Fig. 11.9 Minimum angle of resolution as a function of target angular velocity. 24% contrast determination Subject L.T. (Top - test curve and bottom - retest curve. The bar indicates the standard error of the mean).

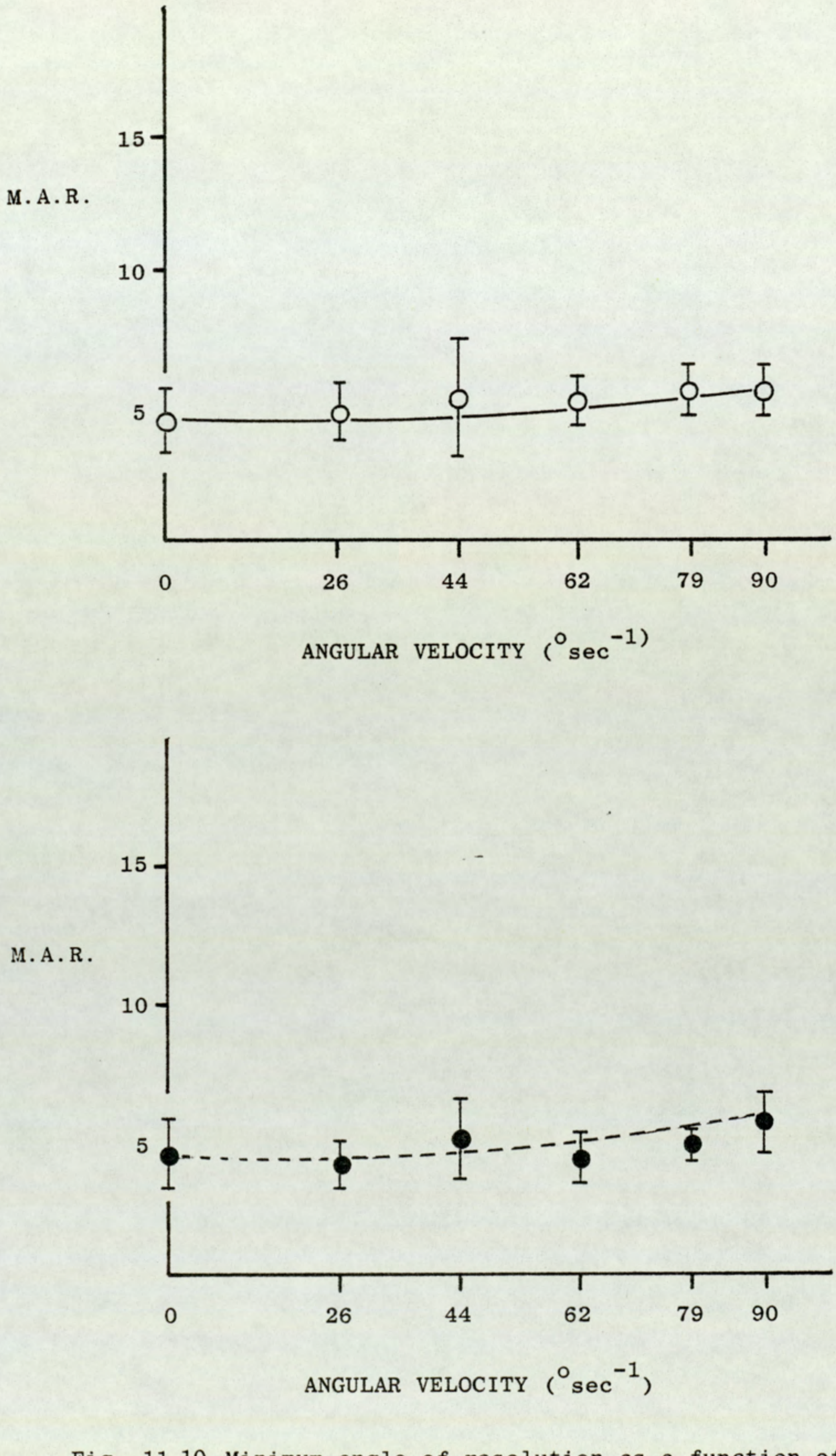


Fig. 11.10 Minimum angle of resolution as a function of target angular velocity. 24% contrast determination, Subject T.M. (Top - test curve and bottom - retest curve. The bar indicates the standard error of the mean).

The individual correlations calculated from the raw data, also reflect this general trend of statistically significant tesr - retest data, the values being greaterthan 0.70 in 4 of the 8 cases. The Pearson product moment correlation coefficients for both α ($r = 0.997$, $df = 6$, $t = 31.55$, $p<0.001$) and β ($r = 0.838$, $df = 6$, $t = 3.76$, $p<0.01$) were again high an statistically significant.

The study using a group of normally sighted observers was undertaken purely to confirm that the apparatus and procedure yielded statistically significant values of α and β. The subjects were 10 postgraduate university students. All subjects had monocular and binocular distance visual acuities of better than or equal to 6/5. The experiment was carried out with the low contrast targets at a viewing distance of 2m. This distance was chosen to overcome the technical difficulties of providing target sizes small enough for use with normally sighted observers. The smaalest available target size was governed by the resolution capabilities of the projection system and subtended an M.A.R. of 1.25' at the viewing distance of 1.50m utiized for the investigation of partially sighted youngsters. This target size, although more than adequate for use with partially sighted youngsters, was well within the resolving power of normally sighted individuals. Two methods wereconsidered for reducing the target sizes; the use of an alternative projection lens and the use of an increased viewing distance. The latter method was adopted as it permitted a greater reduction in M.A.R. A viewing distance of 2m. was chosen since it was the maximum commensurate with the field of

Subject	Pearson r
C.W.	0.396
R.B.	0.254
L.K.	0.836
R.S.	0.788
C.S.	0.571
L.T.	0.809
T.M.	0.730
M.W.	0.453

Table 11.19 Experiment 7. - 24% contrast. Individual test - retest coefficients (Pearson r) calculated from the raw scores of the 8 youngsters

view governed by the illumination system. The M.A.R.'s subtended by the targets at 2m. are given in Table 11.20. It was considered that the smaller targets used in conjunction with the 5% contrast level would provide an adequate stimulus for the normally sighted observers. The modified values of the target angular velocities are shown in Table 11.20. It was recognized that the use of a longer viewing distance would result in a slight change in velocity due to the obliquity of viewing at the edge of the field. Calculations, however, showed that the maximum possible error was less than 2%.

The analysis showed that statistically significant values of α and β were obtained from all 10 observers. The mean values are given in Table 11.21 and the results of the statistical analysis in Table 11.22a. These findings confirmed that the apparatus and procedure yielded valid measurements of dynamic acuity.

The assessment was repeated one day later on 4 of the 10 subjects. The results from all 4 observers were again statistically significant (Tables 11.21 and 11.22b). In all 4 cases. the retest value of β was found to be smaller than that obtained at the test situation. This finding suggests that a learning factor was also present in the results for the normally sighted observers. The correlations, based on the raw data of each individual, varied between $r = 0.862$ for subject M.R. and $r = 0.946$ for subject C.D.

11.6 Conclusions

The results from the various experiments illustrate the difficulty in obtaining sophisticated visual measurements from

TARGET SIZE (minutes of arc)	ANGULAR VELOCITY ($^{o}sec^{-1}$)
0.94	0
1.33	19.5
1.87	33.0
2.65	46.5
3.75	59.25
5.30	67.5
7.50	
10.60	
15.00	
21.21	
30.00	
42.43	
60.00	

Table 11.20 Modified values of target size and target angular velocity resulting from the use of a 2m. viewing distance.

Initial Subject	ANGULAR VELOCTY ($^{0}sec^{-1}$) 0	19.5	33	46.5	59.25	67.5
J.W.	2.73	3.20	2.97	3.72	4.00	4.67
	0.25	0.41	0.25	0.39	1.41	0.53
M.C	3.27	4.86	4.86	5.00	5.78	6.13
	0.44	0.52	0.52	0.45	0.72	0.40
L.J.	2.65	2.27	3.25	4.16	4.51	4.33
	0.24	0.29	0.38	0.54	0.62	0.38
M.R.	1.27	1.75	1.69	2.30	2.40	2.40
	0.13	0.18	0.19	0.25	0.22	0.26
J.L.	1.72	1.62	2.15	2.40	2.90	3.40
	0.14	0.23	0.21	0.23	0.26	0.33
C.D.	2.02	2.55	3.04	3.54	4.76	5.07
	0.23	0.25	0.41	0.38	0.52	0.53
J.B.	1.62	1.91	2.17	2.34	2.65	2.90
	0.13	0.19	0.14	0.29	0.21	0.25
L.C.	3.16	2.96	3.39	3.53	4.33	5.00
	0.38	0.25	0.33	0.32	0.28	0.45
A.E.	2.40	2.26	2.59	3.16	3.26	3.86
	0.23	0.14	0.21	0.38	0.34	0.36
J.N	2.57	2.40	2.93	2.83	3.67	4.67
	0.31	0.23	0.40	0.22	0.29	0.54
TOTAL	2.34	2.58	2.90	3.30	3.83	4.24
	0.23	0.33	0.31	0.31	0.37	0.40
Repeat						
L.J.	2.12	2.30	2.55	3.40	3.04	3.59
M.R.	1.62	1.87	1.64	1.91	2.30	2.44
J.L.	1.37	1.52	1.87	2.09	2.90	2.71
C.D.	1.90	2.05	2.65	3.15	3.29	4.31
Total	1.75	1.93	2.18	2.64	2.88	3.26.
	0.11	0.68	0.17	0.26	0.15	0.15

Table 11.21 Experiment 8 - 5% contrast Mean threshold values of M.A.R. and accompanying standard error of the mean for Landolt rings presented at 6 different target velocities - Normal observers.

SUBJECTS	α	$\beta \times 10^{-6}$	F	SIGNIFICANCE LEVEL
J.W.	2.93	5.63	54.52	$p<0.005$
M.C.	4.25	6.70	9.40	$p<0.05$
L.J.	3.76	8.60	10.18	$p<0.05$
M.R.	2.16	4.23	9.88	$p<0.05$
J.L.	2.35	7.28	112.40	$p<0.001$
C.D.	3.27	12.62	58.04	$p<0.005$
J.B.	2.49	4.77	34.91	$p<0.005$
L.C.	3.04	6.23	178.63	$p<0.001$
A.E.	2.40	4.77	54.86	$p<0.005$
J.N.	2.45	6.66	61.09	$p<0.005$
Overall	2.92	6.74	83.35	$p<0.001$

Table 11.21a Computed values of α and β and results of F test of statistical significance. Low contrast - 10 normally sighted observers.

SUBJECTS	α	$\beta \times 10^{-6}$	F	SIGNIFICANCE LEVEL
L.J.	3.17	5.54	10.93	$p<0.05$
M.R.	2.24	3.44	35.80	$p<0.005$
J.L.	2.09	6.16	23.33	$p<0.01$
C.D.	2.84	9.20	44.95	$p<0.005$
Overall	2.59	6.08	60.58	$p<0.005$

Table 11.21b Computed values of α and β and results of F test of statistical significance. Low contrast - 10 normally sighted observers.

the partially sighted. Nevertheless, the apparatus and final experimental procedure has yielded valid measurements of dynamic acuity from a number of partially sighted observers. It is clear, however, that further modifications in the experimental technique will be necessary before valid data can be obtained in all cases. One possible procedure might involve an increased number of threshold determinations at a fewer number of target veolcities.

12 DYNAMIC ROTATING TEST

Preliminary work was carried out towards the end of the study on the design of a second performance task involving the resolution of moving detail. It was decided that this test should employ targets moving in a circular direction. It was felt that such a performance task would not only involve the saccadic and persuit eye movement systems, but also assess the integrity of extra ocular muscle functioning. It was decided that the target velocity for the test should be such as to comfortably permit the detection of detail in moving targets. It was felt that this approach might lead to a more relevant measure of visual ability than one employing a velocity which pushed the partially sighted to the limits of their visual capability. A suitable velocity was considered to be approximately $30^{o}sec^{-1}$.

The choice of both the target and the method of target presentation was influenced by the fact that a series of Landolt rings, in a geometric progression based on $\sqrt{2}$, were readily available in transparency form from the dynamic acuity investigation. It was felt that since these had proved satisfactory for the dynamic acuity study they would be adequate for use in the second test.

Two basic methods of operation were considered to be appropriate. The first technique, a self paced method of presentation, involved scoring the test in terms of the time taken to obtain a correct response. The second method, the forced paced type of presentation, required the test to be scored in terms of adequacy of response over a constant period of time. It was felt that both these methods of assessment warranted investigation.

It was proposed that a series of Landolt rings should be presented both at a size corresponding to the static threshold of the individual and at one interval of $\sqrt{2}$ above this threshold. It was felt that larger targets would be too easily seen whilst those below threshold would not be resolved.

The choice of viewing distance for the test was closely associated with the diameter of the target field. In addition, it was also governed by the limited size of the rooms available at the various schools for the partially sighted. It was envisaged that a field size of 30° and a viewing distance of 1.0 or 1.5m would be adequate for the purposes of the test.

An apparatus for generating target motion, employing both mechanical and electronic principles, was constructed by Instelec Ltd., Birmingham. The apparatus was designed so as to provide the facility for adjustment of the presentation time and the target velocity. In addition, target presentation could be initiated and terminated at any point on the circle.

Field trials of the test were, however, not undertaken owing to involvement in other aspects of visual ability. The work has, nevertheless, reached a stage whereby considerable progress has been made towards the development of a second performance task based on the dynamic aspect of vision. A logical first step in any continuation of the present study would, therefore, involve field trials of this test. Indeed, it is felt that information concerning the detection and resolution of moving detail is essential in the evaluation of visual ability.

13 POSTAL QUESTIONNAIRE

The reason for using a postal questionnaire in the current study has been described previously (Section 5). It was shown that its purpose was twofold; namely to determine the level of occupational success and to elicit factors influencing a successful employment of the partially sighted school leaver.

13.1 Previous Studies

The use of a postal questionnaire as a research tool is extensively documented. Notable monographs include those of Berdie & Anderson (1974); Cochrane (1973); Oppenheim (1966). Its application has, in the main, been directed to the normally sighted. This technique, dependant as it is on the ability to read print, would appear to be contra-indicated when the subjects involved are partially sighted. Nevertheless, it has been used previously with varying degrees of success.

Clayton (1973) utilized a postal questionnaire to ascertain the occupation and employment success of 343 former pupils of Maryland School for the Blind. Forty-four per cent of the sample completed and returned the questionnaire within a period of 45 days from the date of posting.

Gould & Silver (1974) briefly reported the use of a questionnaire to assess the educational and social background of 56 children attending the L.V.A. clinic at Moorfields Eye Hospital, London. The questionnaire also sought information on the benefits accruing from the use of the L.V.A. obtained at the clinic. It was completed, wherever possible, by the children and was augmented by the parents. Fifty questionnaires were returned. It is not clear from the report, however, whether Gould & Silver circulated the questionnaire by post or handed it out during attendance at the clinic.

Green (1976) utilized a postal questionnaire to determine the occupational experiences of 280 partially sighted youngsters. The questionnaire was 32 pages in length, was printed in uppercase typeface equivalent to N14, and incorporated various coloured pages to facilitate identification of particular sections. The majority of the questions were devised such that the answer could be indicated by the marking of an appropriate box. Green received 95 completed questionnaires - a response rate of 34%.

13.2 Design of Questionnaire

Two distinct phases of development were involved in the design of the questionnaire. The first stage consisted of semi-structured interviews with partially sighted youngsters already in employment. These were carried out in order to define the more likely contributors to occupational success. The second stage comprised the formulation of appropriate questions, the construction of a prototype questionnaire and a subsequent pilot study to assess the feasability of the design.

Two types of question were prepared for the semi-structured interviews. Some were designed to obtain specific answers whilst others were constructed to produce open ended responses. The work of Green (1976) served as a guide to the more salient areas for discussion. Green had compiled a list of factors considered likely to influence the first employment of the partially sighted school leaver and a further list of factors believed to affect the overall employment success in the immediate post school years. The interview sought information on the biographical, work behaviour and motivational aspects of the individual. Questions covered such topics as the type of job, the method of obtaining the employment, the career guidance, the visual, physical and mental demands of the work and the opinion on achievement, future prospects and job satisfaction. The interview was structured such that the more sensitive questions were posed towards the end of the discussion. The questions were prepared on a specially printed sheet (Appendix A) to facilitate recording of the responses.

It was decided to conduct the semi-structured interviews on a sample of 8 partially sighted youngsters. It was felt that this number was the maximum commensurate with the constraints of time and available manpower.

The records of approximately 1370 former pupils of Exhall Grange School, Coventry, were examined in order to acquire a list of potential subjects for the interviews. This search was supplemented by an inspection of 35 records of patients attending the Low Vision Clinic, University of Aston in Birmingham. The prospective interviewees were selected for certain common characteristics; residential locality within a reasonable travelling distance of the University of Aston, age, ocular disorder and, whenever possible, intelligence quotient. The resulting list comprised 22 former pupils of Exhall Grange School, Coventry, and one former pupil of George Auden School, Birmingham.

Twelve potential subjects were selected from the former Exhall Grange pupils. The youngsters were chosen so as to provide a sample with a mean age of approximately 20 years.(Table 13.1).

Subject	Sex	Age	Ocular Disorder	IQ	Reply to Initial letter	Reply to Follow up Letter	Occupational Status
1	F	17.9	"High" Myopia	-	Positive	-	College
2	M	18.7	Partial Albinism Nystagmus	121	Positive	-	Employed/College
3	M	18.2	Cataract,Buphthalmos, Microphthalmos	-	Positive	-	Unemployed
4	M	19.4	Congenital (?) Idiopathic Nystagmus	-	-	Negative	-
5	M	20.6	Albinism	-	Changed address	-	-
6	M	20.3	Congenital (?) Idiopathic Nystagmus	106	Positive	-	Employed
7	M	20.2	Optic Atrophy "High" Myopia	106	-	-	-
8	F	20.4	Cataract, Aphakia	124	Positive	-	Residential home
9	M	20.6	Microphthalmos; Subluxated lenses	113	-	-	-
10	F	21.7	Cataracts Microphthalmos	130	Positive	-	University
11	F	20.5	Albinism	127	-	-	-
12	M	21.7	Cataracts Nystagmus	106	-	Positive	Employed

Table 13.1 CHARACTERISTICS OF THE FIRST SAMPLE OF PROSPECTIVE INTERVEIWEES

A letter requesting an interview was sent to the 12 subjects. It was written in an informal style, stated the purpose of the study and stressed the potential role for the partially sighted youngster. The letter contained a reply slip to be used in conjunction with a prepaid envelope. Six subjects replied favourably to this letter. A Follow-up letter was sent to the remaining six subjects. This second letter reiterated the information contained in the first letter and, in addition, stated that much had already been learnt from interviews with other former pupils of Exhall Grange School. Two subjects replied to the second letter, one responding favourably, the other unfavourably. The mean age of the seven respondents was 19.9 years ant the standard deviation 1.6 years. The mean I.Q. available for only five of the respondents, was 117.4 with a standard deviation of 10.9. The types of I.Q. were, however, unknown. The high value of the mean I.Q. may have been as a result of using former pupils of Exhall Grange School, this school having a grammar school stream.

Interviews were carried out with these seven respondents. It was found that the youngsters represented a spectrum of post-school opportunities; employment, further education or training and employment. Unfortunately, only four of the seven youngsters had had experience of occupational situations. Three respondents were undertaking higher education. It was decided therefore to seek interviews with the remaining eleven subjects. (Table 13.2). The mean age of this latter group of subjects was 21.8 years with a standard deviation of 1.1 years. An intelligence quotient was available for only one of these youngsters. It was hoped that the higher mean age of the second sample would result in a greater proportion of respondents

Subject	Sex	Age	Ocular Disorder	IQ	Reply to Initial letter	Occupational Status
13	F	20.2	Albinism	-	Positive	Employed
14	M	19.8	Partial Albinism Nystagmus	-	Positive	Employed
15	M	21.6	Congenital(?) Idiopathic Nystagmus	-	Positive	Employed
16	F	21.4	Cataract - Aphakia Nystagmus	-	Positive	University
17	F	21.8	Cataract - Aphakia	-	Positive	Unemployed
18	M	21.1	Albinism	-	Positive	University
19	M	22.4	Albinism	119	-	-
20	M	22.7	Albinism	-	-	-
21	F	22.5	Cataract - Aphakia	-	Positive	Employed
22	M	23.2	Cataract, Nystagmus Microcornea	-	Positive	Employed
23	M	23.2	Partial Albinism Nystagmus	-	Positive	Employed

Table 13.2 CHARACTERISTICS OF THE SECOND SAMPLE OF PROSPECTIVE INTERVIEWEES

with experience of employment.

Nine subjects responded to the initial request for co-operation and interviews were carried out with seven of these youngsters. It was considered impractical to interview the remaining two respondents: one had returned to the University of Bath and the other was employed in Leeds. The mean age of the seven interviewees was 21.7 years with a standard deviation of 1.3 years. Five subjects were in employment, one was at university and one was unemployed. The follow-up of the remaining two subjects was not carried out as it was felt that an adequate response had been achieved as a result of the first letter.

The interviews lasted between 45 minutes and $1\frac{1}{2}$ hours and, with the subjects' permission, were tape recorded to facilitate subsequent analysis. All thirteen subjects, without exception, were found to be extremely co-operative.

The interviews revealed that some individuals experienced little difficulty in obtaining employment whilst others repeatedly failed at the interview or job application stage. This suggested the existence of a possible interview/job application "hurdle" as a cause of failure to secure a job. Analysis of the interviews suggested certain criteria for overcoming this hurdle. These included a realistic self appraisal of capability, an ability to adjust to the normally sighted environment, and the possession of academic qualifications and other normal attributes. The analysis also tended to suggest that the number of attempts to overcome the hurdle was dependent upon the effort and drive of the particular partially sighted individual. Indeed, it was found that some individuals had stuck obstinately to the task of finding employment and had eventually obtained their desired job. In contrast, others had become rapidly disillusioned and had undertaken employment in occupations well below their capability or had completely given up the search for employment.

It was realised that having obtained a job, the resulting success in employment was a complex phenomenon dependent upon many factors; some visual and others psychological and sociological in origin.

The analysis of the interviews has been summarised in diagramatic form in Fig. 13.1.

The most serious limitation associated with the use of a questionnaire is the problem of a low response rate. A poor return poses a particular difficulty in that the individuals who respond may not be representative of the sample chosen for the survey. Consequently, the results from such a return cannot be considered, with any certainty, to be typical of the population under study. The problem of possible differences between respondents and non respondents can only be satisfactorily resolved by the acquisition of a high return. Unfortunately the "usual" response rate amongst the normally sighted, estimated between 0 and 70%, is often insufficient to adequately overcome this difficulty (Ferber 1948; Goode & Hatt 1952). Furthermore, this problem could be expected to be more pronounced with the partially sighted, particularly bearing in mind that a visual medium is used to obtain data. Indeed, the response from two postal surveys of the visually handicapped, 44% and 34% respectively, lends support to this opinion (Clayton 1973; Green 1976).

VISUAL
PSYCHOLOGICAL
SOCIOLOGICAL

$\left.\begin{array}{l}\text{VISUAL}\\ \text{PSYCHOLOGICAL}\\ \text{SOCIOLOGICAL}\end{array}\right\}$ VARIABLES

DRIVE
EFFORT

APPLICATION/
INTERVIEW HURDLE ⟶ JOB ⟶ DEGREE OF SUCCESS IN EMPLOYMENT

CRITICAL FOR OVERCOMING HURDLE

1. POSITIVE ATTITUDE TOWARDS IMPAIRMENT
2. ADJUSTMENT TO NORMAL ENVIRONMENT
3. REALISTIC SELF APPRAISAL
4. HANDLING OF VISUAL ISSUES RAISED AT INTERVIEW
5. QUALIFICATIONS
6. OTHER NORMAL ATTRIBUTES

Fig. 13.1 Schematic representation of results from the semi-structured interviews.

Considerable research has been undertaken with the normally sighted to improve the level of response. Indeed, a well established set of procedures has been developed to facilitate this end. This includes an appropriately designed questionnaire, the use of a covering letter, and a well defined series of postal procedures for stimulating response. Considerable attention was paid to these aspects in order to reduce the probability of a poor response rate.

The design of a questionnaire has an important bearing on response rate. The particular design for the present study was achieved after considerable discussion amongst the research workers involved in the project. It incorporated many of the features devised for use with the normally sighted and others specifically evolved to assist those possessing residual vision.

The most suitable format for the questionnaire was considered to be a division into four parts: a compulsory first section on biographical aspects followed by sections on employment, unemployment and further education or training, corresponding to the appropriate post school status of the recipient.

Four different types of question format were used. The majority of the questions were devised such that the answer could be indicated by the marking of an appropriate box. These were either of the "Yes/No" format or the multiple choice type. Other questions were of the "complete-the-sentence" variety. A few were open-ended and required a more extensive written response. These were kept to a minimum, however, as it has been suggested that the inclusion of such items adversely affects response rate for both the normally sighted (Robin 1965) and partially sighted (Green 1976).

Considerable attention was paid to the layout and spacing of the questionnaire as it was felt that this would be an important factor in determining response. Indeed, Berdie & Anderson (1974) and Robin (1965) consider that questionnaires to the normally sighted which possess much "white space" are likely to achieve a higher response than those which contain crowded pages. In addition, Marshall (1975), in discussing the selection of reading material for visually handicapped children, has pointed out the need to avoid long lines of print, inadequate spaces between lines and cramped margins.

The questions were ordered into logically coherent groups and were arranged, wherever possible, to provide a continuity in the required response option (Levine & Gordon 1958; Freed 1964). The computer coding was placed away from the conventional position alongside the answer spaces so as to avoid confusing the potential respondents.

The most suitable typeface and typesize for the questionnaire was considered to be uppercase I.B.M. Bookface with 10 pitch spacing (Marshall 1976a).

The identification of the various sections was facilitated by a series of black spots, 8 mm in diameter, situated in the top right hand corner of each page. The use of selectively coloured pages had been ruled out at an early stage as a large number of the recipients were known to be colour defective.

The questionnaire, including the instructions, was 25 pages in length. The excessive length resulted primarily from the need to send all four sections of the questionnaire to each youngster. It has been shown that questionnaire length does not adversely affect response rate amongst the normally sighted (Berdie 1973; Champion & Sear 1969). It was therefore hoped that this finding would also apply to the partially sighted.

The questionnaire was produced by means of a Rank-Xerox 9200 photocopying process. This method was selected to achieve the recommended criteria for partially sighted children of high contrast print and good quality paper with a non-glare finish (Marshall 1975; 1976a). This technique also resulted in a high quality appearance for the questionnaire. This was of importance as appearance is generally considered to influence response rate (Leslie 1970; Nixon 1954). The instructions for completion occupied two pages and were attached to the questionnaire to avoid possible loss by the recipients.

The inital three questions of the first section requested information on previous special schooling and details of academic qualifications. These questions were selected to provide an interesting but non-threatening start to the questionnaire. It has been shown that both dull and threatening introductory questions can adversely affect response rate (Levine & Gordon 1958; Moser & Kalton 1971; Robin 1965). The ensuing six questions sought the status of registration, the family incidence of the particular ocular disorder and information on the possession and use of spectacles and low vision aids. Questions 9 and 11 were designed to determine the attendance, before and after leaving school respectively, on courses providing experience of the occupational environment. Question 10 served as a cross check on the choice of the appropriate section on post school status.

The remaining questions in the section were included to investigate the hypothesized job application/interview "hurdle". Questions 13 to 22 were designed to assess self appraisal of the visual handicap and the degree of adjustment to the normally sighted environment. These were followed by a series of ten questions devised to examine the rationale behind the job selection and application, and the performance during interview. Questions 33 to 46 comprised the Need for Achievement scale of the Edwards' Personal Preference Schedule (E.P.P.S.) developed by Edwards (1959). This particular achievement scale was selected as it has been shown to possess good internal consistency, validity and stability across time. (Edwards 1959; Scott & Johnson 1972). In addition, it has been widely used in psychological research (Finemann 1977). The remaining 13 questions were taken from a scale devised by Rotter (1966) to measure internal/external locus of control. Internal locus of control can be defined as the belief that the outcome of an event involving the individual can be influenced by the actions of that individual. In contrast, external locus of control describes the belief that such an outcome results primarily from forces beyond the influence of that individual. A reduced version of the scale was used as it was felt that the complete scale, comprising 23 questions and 6 dummy questions, was too long for inclusion in the questionnaire.

Minor modifications were made to the wording of certain questions in order to render the scales more appropriate for use with partially sighted youngsters. A pilot study to assess the suitability of the scales was then carried out on a sample of 13 final year pupils from the secondary modern stream of Exhall Grange School. The mean I.Q., available for nine of these pupils, was 97.2 with a standard deviation of 8.0. As a result of the pilot study a number of additional minor alterations were made to question wording and layout. The scales were preceded by a brief explanation of the purpose of the questions.

It was decided that the future leavers in the study would complete the Edwards and Rotter scales during the appropriate final term of schooling. It was felt that this approach would not only facilitate administration of the entire Rotter Scale, but also would permit a reduction in the length of the questionnaire. In addition, it was decided to use this opportunity to administer a second Need for Achievement Scale (Lynn 1969) to the future leavers.

The employment section sought information on the present and previous occupations and on the history of other job applications. Certain questions were specifically included to elicit occupational success whilst others were designed to ascertain particular aspects of employment.

The concept of occupational success has received much attention over the years (Dorcas & Jones 1950; Crites 1969; Super 1957; Campbell, Dinnette Lawler & Weick 1970; Warr & Wall 1975).

The occupational success of an individual can be measured by the employer or superior in terms of objective criteria such as productivity and efficiency relative to other employees. It can also be assessed by the individual in terms of subjective aspects such as job satisfaction.

The use of an employer based objective definition of occupational success had been ruled out at an early stage of the study due to a lack of finance and available manpower. In addition it is known that partially sighted youngsters often do not reveal their handicap to employers. Indeed, this opinion was reinforced during the semi-structured interviews. Consequently, it was envisaged that some youngsters would not give permission for a contact with their employer. It was agreed, nevertheless, that the definition of occupational success obtained from the youngsters should include some form of objective assessment. The most suitable definition was considered to be in terms of job tenure and job satisfaction. A four point rating scale of occupational success was put forward (Fig.13.2). Individuals in employment would be grouped into three categories: those with high job tenure and high job satisfaction, those with either low tenure and high satisfaction or high tenure and low satisfaction, and those with low tenure and low satisfaction. The fourth category would contain those individuals who had been unable to obtain employment in the period since leaving school.

It was decided to consider job tenure as the total time in employment, irrespective of the number of jobs held during this period. The use of a ratio to define job tenure:

$$\frac{\text{time in employment}}{\text{time available for employment}}$$

was necessitated by the fact that youngsters leave school at three distinct times in the year: the end of the Spring term, Spring Bank Holiday, and the end of the Summer term.

The assessment of job satisfaction however, was restricted to the current employment due to the problems in accuracy of information

"EMPLOYMENT SUCCESS"

ORIGINAL INTENDED DEFINITION:

EMPLOYED?

NO

O

YES

TENURE

		HI	LO
SATISFACTION	HI	3	2
	LO	2	1

Fig. 13.2 Proposed rating scale for occupational success

recall and the need to keep questionnaire length to a minimum.

It was recognised that the proposed rating scale would fail to adequately cater for the small proportion of youngsters previously employed, but unemployed at the time of receipt of the questionnaire. In addition, the scale did not take into consideration aspects such as the desire of the youngsters to seek employment and the influence of holidays and periods in hospital on the time available for employment. Despite these drawbacks, it was felt that the scale provided a useful measure of job tenure.

The numerator for the tenure ratio was calculated from information supplied in response to questions on the length of previous employments and the commencement of the current employment. The denominator was calculated from data obtained by questions in the compulsory first section. The level of job satisfaction was ascertained by ten questions requiring a response on a 3 point scale. These questions covered such aspects as the employee's opinion of the job, the attitude towards employer and fellow employees and the level of fulfilment derived from the work.

The questions on general aspects of employment sought information, for example, on the type of job, the origin of the idea for the job and the method of contact with the prospective employer.

Unemployed youngsters were required to complete the section entitled "Out of Work." The questions in this section were structured to provide information on the previous occupations and job applications.

The section on further education and training was designed to obtain data on the type of educational establishment attended, the course of study, and the reason for continuing in education.

It has been shown that the use of a carefully worded covering letter is essential in all postal questionnaire surveys (Berdie & Anderson 1974). The letter utilized in the present study was the result of considerable deliberation. It briefly explained the purpose and aim of the research, mentioned the role of the D.H.S.S. and outlined the necessary instructions for completion. It also stressed the confidentiality of any response and requested a prompt return using the prepaid envelope. The letter to those who had previously participated in the research (Appendix B Fig.1) additionally reminded the subject of the previous contact. In contrast the letter to those with no prior knowledge of the study included the name of the former school and headmaster in an attempt to both personalise the approach and underline the importance of the work (Appendix B Fig 2). Some letters to both groups of individuals (see later) contained an additional sentence which offered the reward of £1.00 for a prompt reply.

The letter was short and to the point (Goode and Hatt 1962) and did not exceed one page in length (Berdie & Anderson 1974). It was printed in uppercase I.B.M. Bookface typeface on headed University of Aston notepaper. Each letter was further personalised after the salutation by the writing in of the first name of the recipient. The effect of such personalisation on response rate, however, is unclear and may depend upon the nature of the sample under survey. In addition, Andreasen (1970), points out that personalisation may conflict with the desire of the recipient to remain anonymous. The use of firstnames had been adopted at the examination stage and this policy was continued for the circulation of the questionnaire. The influence of the handwritten signature on response rate is also uncertain (Kawash & Aleamoni 1971; Linskey 1965). Nevertheless, it was decided to individually sign each letter with the first name and surname signature of one of the research workers.

The questionnaire and covering letter was piloted on four of the youngsters who had previously taken part in the semi-structured interviews. The questionnaire was completed by each individual in the presence of one of the research workers. Five youngsters were originally contacted by letter or telephone.

The fifth individual, however, replied too late for inclusion in the study. As a result of the pilot study, various minor alterations were made to question wording and layout. The questionnaire was then submitted for approval to the D.H.S.S. in London. Consequently, a number of further minor modifications were carried out.

13.3 Postal Procedures

A variety of procedures have been developed for increasing the response rate of postal questionnaires. These include the use of incentives, the pre contact of the recipients and the use of carefully timed follow-up letters to stimulate response.

The most common incentive, the prepayment of subjects has been shown to produce large increases in the response rate (Armstrong 1975). The promise of a reward, involving payment only to respondents, does not influence response to the same extent. It can, however, be more cost efficient (Cox 1975). The provision of goods such as pencils and coffee has also been used as an incentive to respond (Purcel, Nelson & Wheeler 1971). It was decided to conduct a pilot experiment to determine whether the offer of a financial incentive would produce an increase in response from the sample under study.

Contact with the sample prior to circulation of the questionnaire can also increase response rate (Linskey 1975). Such approaches are usually made by telephone, letter or personal call and serve to introduce the researchers, discuss the purpose of the study and request co operation in completing the questionnaire. It was decided to investigate whether a higher response rate would be obtained from the individuals who had previously participated in the study.

The sample comprised 89 partially sighted youngsters who had left school during the 1976/77 academic year. Thirty-five of these youngsters were former pupils of Exhall Grange School, Coventry. They had all been examined during the previous year as part of the research and were fully conversant with the study. The remaining 54 youngsters had not previously taken part in the research and were unaware of the study. This latter group of youngsters were former pupils of George Auden School, Birmingham, Nansen School, London, Joseph Clarke School, London and Temple Bank School, Bradford.

The subjects who had previously taken part in the research were divided into two groups (Groups 1A and 1B). Each group was matched by sex and where available, by I.Q. The youngsters with no prior knowledge of the study were similarly divided into two groups (Groups 2A and 2B). These groups were additionally matched for the previous school attended. The modal distance acuity in each of the four groups was in the 6/60 - 6/36 range. Youngsters in Groups 1A and 2A were offered the sum of £1.00 as an incentive to reply. The allocation of subjects to the four groups of the experimental design is shown in Table 13.3.

The timing of the issue of the questionnaire relative to the particular circumstances of the sample has been shown by Robin (1965) to have an important bearing on response rate. The questionnaire was circulated on 14.6.78. This date was primarily chosen to provide the maximum periof for assessment of occupational success commensurate with the academic year at colleges of further education. It was considered important that individuals who had entered three term courses of further education or training, on leaving school, should fill in the education section of the questionnaire. A later circulation of the questionnaire would have resulted in youngsters, temporarily without work on completion of further education, filling in the unemployed part of the questionnaire. The date was additionally chosen to avoid college exams. A Wednesday,in particular, was selected to ensure that the questionnaire, posted at second class rates, would be delivered for the weekend. It was hoped that the receipt of the questionnaire at such a time would facilitate completion.

The address label on the outgoing envelope was typewritten. Computer printed labels were avoided as it has been suggested that these are likely to offend recipients concerned with individuality (Berdie & Anderson 1974).

Hand stamped postage was used on both the outgoing and return envelopes as it has been shown that this form of stamp is the most effective in producing high response rates (Champion & Sear 1969; Martin & McConnell 1970).

	RECEIVING INCENTIVE	NOT RECEIVING INCENTIVE
PREVIOUSLY EXAMINED	GROUP 1A (N = 17)	GROUP 1B (N = 18)
NOT PREVIOUSLY EXAMINED	GROUP 2A (N = 27)	GROUP 2B (N = 27)

Table. 13.3 THE FOUR GROUPS OF THE FIRST EXPERIMENTAL DESIGN

The level of response to a questionnaire can be increased by the use of carefully timed follow-up letters which encourage non-respondents to reply. (Scott 1961; Dillman 1968; Robin 1965). The follow-up letters were designed such that the content of successive letters progressively changed emphasis from the importance of the research to the importance of the subject returning the completed questionnaire (Robin 1965). The first follow-up letter, (Appendix B Fig.3) mentioned the receipt of many questionnaires, urged the recipient to respond and stressed the importance of every reply. The second letter,(Appendix B Fig. 4) noted the lack of response from the individual and drew attention to the inclusion of a duplicate questionnaire and prepaid envelope to offset the possible loss of original copies. The third follow-up letter reiterated the value of each completed questionnaire, encouraged the youngster to respond and stressed the inclusion of a further copy of the questionnaire and an additional prepaid envelope (Appendix B Fig. 5)

The exact timing for the issue of these letters is determined with the aid of a graph of response, as a cumulative frequency, against the number of days from the issue of the questionnaire. As the curve assymptotes, the first follow-up letter is sent to the non-respondents. This letter produces an increase in response and the process is then repeated for the second and then the third follow-up letters.

The first and second follow-up letters were posted 9 and 19 days respectively after the circulation of the questionnaire. The third follow-up letter was considered unnecessary because a high return had already been achieved by the end of the second follow-up.

13.4 Results and Analysis

Seventy-eight completed questionnaires were received out of a possible 89, resulting in a response rate of 87.6%. The response curve is shown in Fig. 13.3 Four questionnaires from Groups 2A and 2B were returned uncompleted; in the period since the collection of the clinical material, 3 of the 4 subjects had left their recorded address and one had become totally blind. These 4 questionnaires have consequently been omitted from the analysis.

The response of the individuals in each of the four experimental groups was considered in terms of three time periods T_1 T_2 T_3: which corresponded to the time of the first follow-up letter, second follow-up letter, land final response. The results are listed in Table 13.4. Statistical analysis was performed with a Chi Square Test for two independent samples; where the sample size was insufficient for this analysis, Fisher's Exact Probability Test was used (Siegal 1956).

The statistical analysis showed that the financial incentive offered in the study did not significantly increase the response from the subjects, irrespective of whether they had previously been examined (Groups 1A/1B) or had not been examined (Groups 2A/2B).

Analysis further showed that of the individuals receiving the offer of an incentive (Groups 1A/2A) those who had been examined (Group 1A) responded significantly better up to the first time period ($P < 0.05$) than those who had not been examined (Group 2A). This difference was also maintained for the second time period. In contrast, analysis of the groups not receiving an incentive (Groups 1B/2B) showed that there was no significant difference in response between those who had been examined (Group 1B) and those who had not been examined (Group 2B)

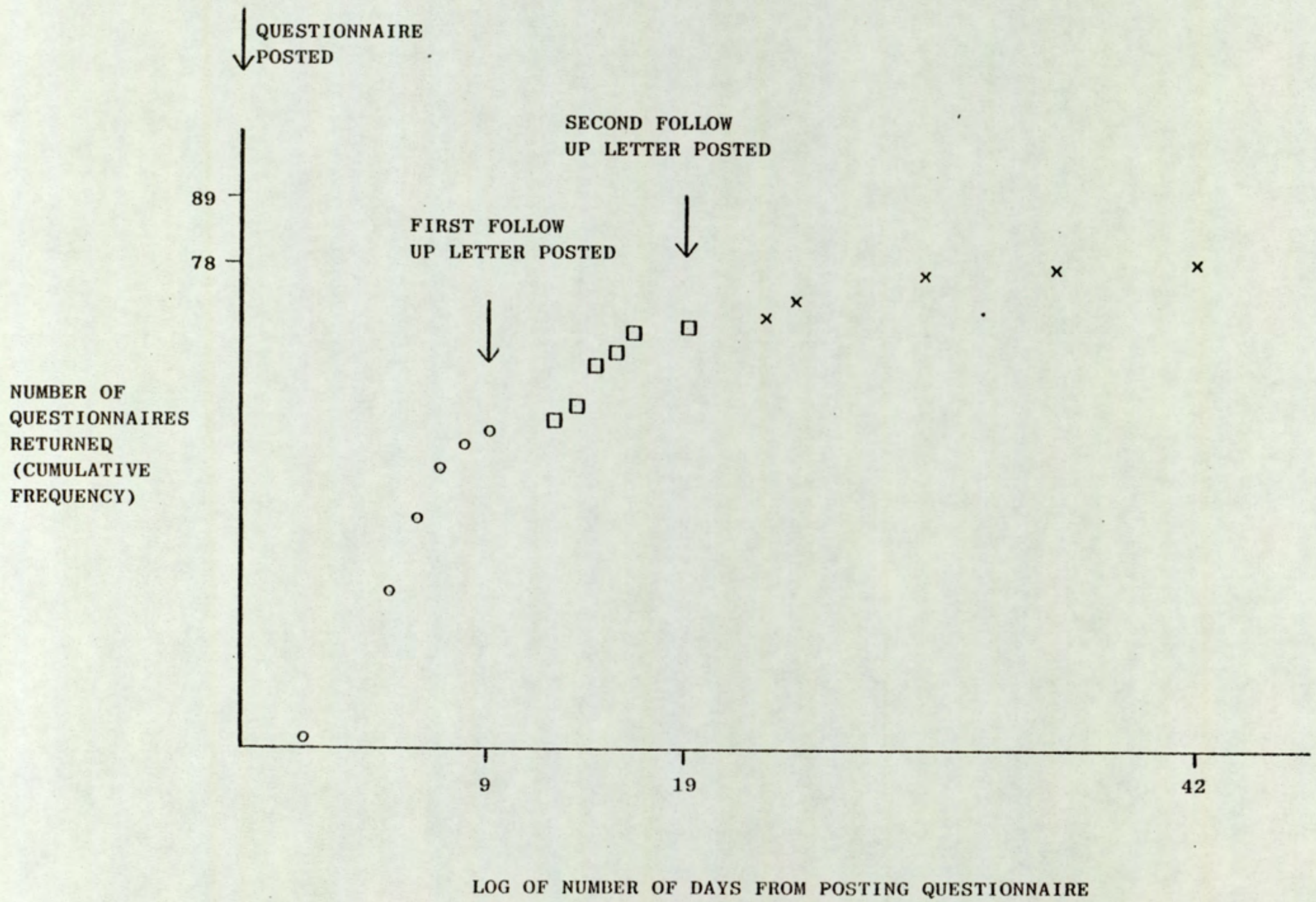


Fig. 13.3 Response curve for the questionnaire sent to the leavers from the 1976/77 academic year.

GROUP	TOTAL NUMBER OF USABLE REPLIES	REPLIES RECEIVED AT TIME PERIODS T_1	T_2	T_3
1A	17	15 (88.2%)	17 (100%)	17 (100%)
1B	18	12 (66.7%)	15 (83.3%)	17 (94.4%)
2A	26	15 (57.7%)	20 (76.9%)	23 (88.5%)
2B	24	10 (41.7%)	16 (66.7%)	21 (87.5%)
TOTAL	85	52 (61.2%)	68 (80.0%)	78 (91.2%)

TABLE 13.4 NUMBER OF USABLE REPLIES RECEIVED FROM THE FOUR GROUPS OVER THREE TIME PERIODS

These results suggest that the combination of the two factors of prior participation and financial incentive may have enhanced response rate. Further evidence for this hypothesis can be seen in the results from Groups 1A and 2B. Those individuals who had been examined and who received financial incentive (Group 1A) responded significantly better than those who had neither financial incentive nor prior knowledge of the study (Group 2B) during the first ($P<0.005$) and second ($P<0.025$) time periods.

No significant difference in response was found between those receiving an incentive (Group 2A) and those who had been examined (Group 1B).

The various differences in response were not significant by the final time period. Indeed, a return of 87.5% was achieved from the individuals in Group 2B who were neither examined nor given an incentive to reply. This result implies that a high return could perhaps have been achieved without either incentive or prior examination. Nevertheless, it is clear that the interaction of financial incentive and previous examination expedited the speed of return of the questionnaire. Such a finding was of value: a fast rate of return reduces the administrative inconvenience and cost in sending follow-up letters.

The overall return of 87.6% was very high compared with the usual response rates to postal questionnaires in normal populations. Goode & Hatt (1952), for example, consider the "usual" number of returns to be between 0 and 50%. The unusually high return can be attributed to at least two factors. The concerted application of a similar set of procedures has been shown by Dillman (1972) to yield postal response rates of 70-75% in large general population samples.

In addition, other studies have shown that strong interest in a topic under investigation can increase response rates. Boek & Lade (1963), for example, attributed their unusually high response rate of 86% to the interest of the respondents in the subject matter of the questionnaire. Despite the doubtless difficulty experienced by many partially sighted individuals in completing a lengthy and complex questionnaire, their interest in the subject matter probably encouraged them to persevere.

The most important conclusion from the returns of the questionnaire was that a high response rate could be achieved from the leavers in the remaining two academic years of the study.

The results from this pilot investigation indicated that it was unnecessary to offer an incentive to future leavers from Exhall Grange School. The findings did, however, suggest that the rate of return of the questionnaire might be improved by the offer of an incentive to those who had no prior involvement in the study. Indeed, the results showed that the statistical significance of the difference in response between those who had received an incentive and had been examined (Group 1A) and those who were neither examined nor offered an incentive (Group 1B) was $P < 0.005$ at T_1 and $P < 0.025$ at T_2. The offer of an incentive to those who had not received an examination (Group 2A), however, reduced the significance level of the difference in response, when compared with Group 1A, to $P < 0.05$ at T_1 and $P < 0.05$ at T_2. It was realised that the questionnaire would be sent to an additional category of individuals in the remaining two years of the study. This group comprised individuals, in addition to those from Exhall Grange School, who were to be examined as part of the investigation of visual ability. It was envisaged that these youngsters were unlikely to be examined as frequently as their peers from Exhall Grange School. Consequently, it was felt that the offer of an incentive to this group might facilitate response to the questionnaire.

The majority of the questionnaire had been completed in a satisfactory manner. Occasionally, however, a respondent who had completed either the employed or the unemployed sections had written the information in the wrong answer space. It was considered acceptable to transcribe such information to the appropriate space and computor code. A few individuals, having just finished a course of further education or training lasting three terms, had filled in the unemployed section of the questionnaire. It was considered reasonable to recategorize these individuals as belonging to the further education and training section. In addition, several individuals attending adult training on day centres had completed the unemployed section while others had answered the questions in the further education and training section. It was decided to place all these individuals in the unemployed category. It was felt that, despite these minor defects, the general format of the questionnaire was acceptable.

The layout and wording of one question (question 23) gave rise to misinterpretation by a considerable number of respondents. Although the question was structured to produce three answers, many respondents had only given one answer. It was consequently decided to restructure this question.

Analysis of the ten questions designed to assess the level of satisfaction with various aspects of the job, showed that the questions had failed to adequately discriminate between individuals in employment. Indeed, most youngsters appeared to be satisfied with all but one of the various aspects of their job. The one question which seemed to adequately distinguish between the various employments was that assessing the opportunity for promotion and future prospects. The distribution of the answers to each of the ten questions is shown in Fig. 13.4. The weakness of the questions in this area was of particular concern as it directly affected the envisaged definition of occupational success. As an alternative to these questions, the use of a 5 point scale - very satisfied through to very dissatisfied - was considered. It was felt, however, that use of such a scale would result in inadequate numbers within each category, thus necessitating amalgamation of categories for the purpose of analysis with a consequent lack of discrimination.

In contrast to job satisfaction, tenure of employment did appear to provide a measure which discriminated between those in employment. The distribution of employment tenure is shown in Fig. 13.5.

As a result of the findings, it was decided to define occupational success solely in terms of employment tenure. It was acknowledged that such a definition excluded any measure of the attitude of the individuals towards the job itself.

The alteration in the definition of occupational success enforced some changes in the content of the questionnaire which was to be sent to the future leavers. In particular the satisfaction questions were omitted and replaced by one question which assessed overall job satisfaction on a five point scale. Further modifications were also made in the computer coding of the questions which defined tenure.

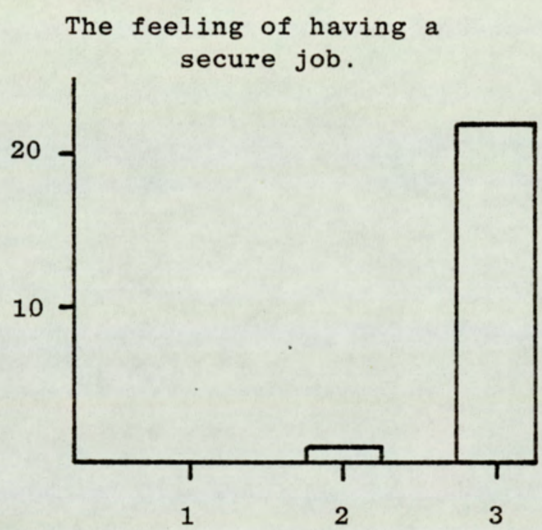
A number of additional questions were also included in the modified questionnaire. The D.H.S.S., after receiving the draft questionnaire, had requested the inclusion of two questions designed to elicit the affect of the family background and attitude towards the search for employment. This request had arrived too late for

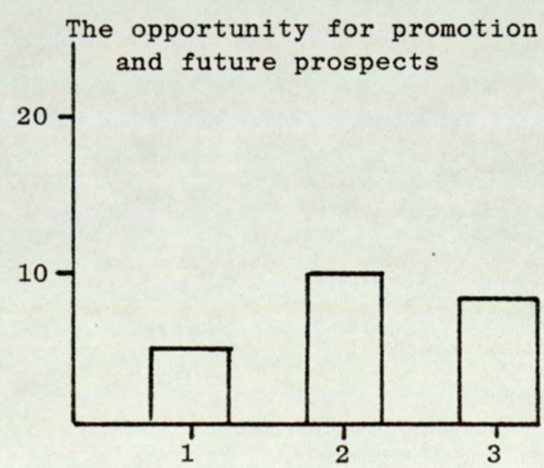
Fig. 13.4 Level of satisfaction with 10 aspects of the current employment.

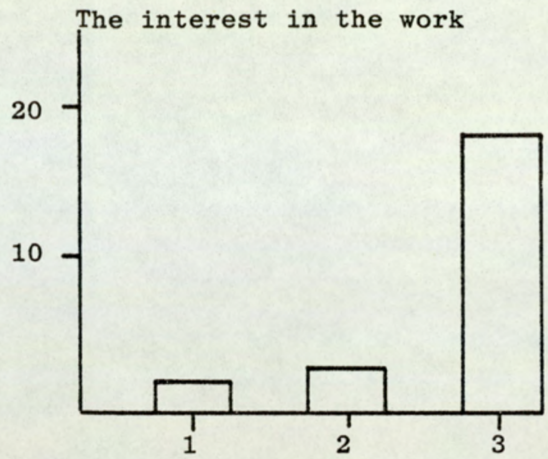
(1 = dissatisfied

2 = neither satisfied nor dissatisfied

3 = satisfied)






The interest in the work
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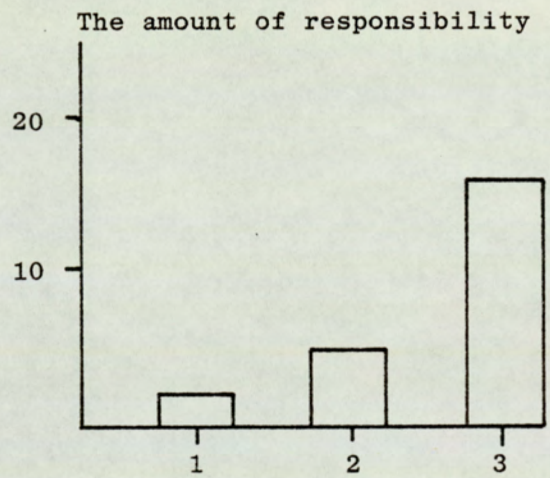
2
3


The amount of responsibility
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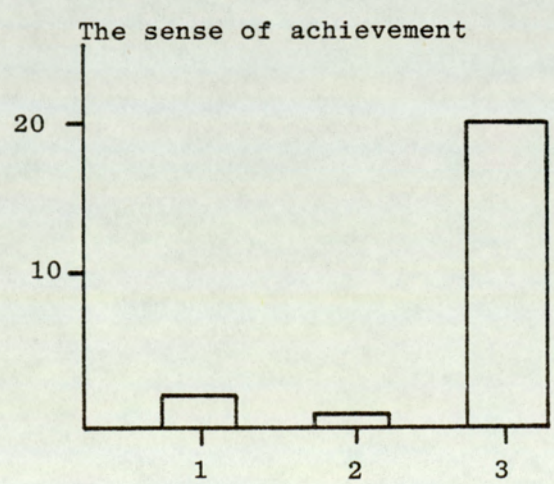
The sense of achievement
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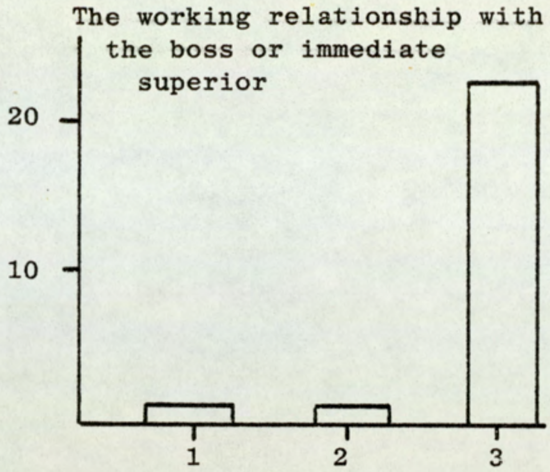
The working relationship with the boss or immediate superior
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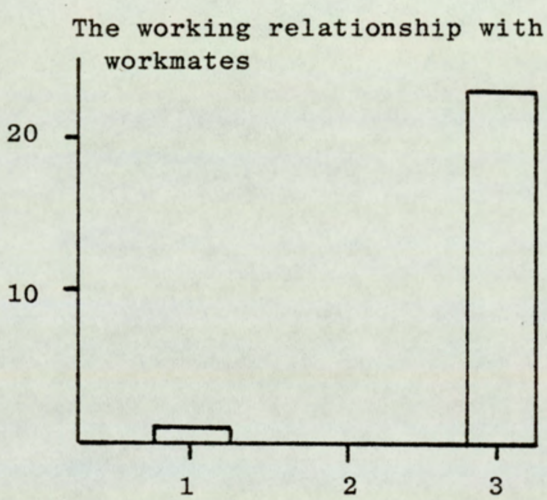
The working relationship with workmates
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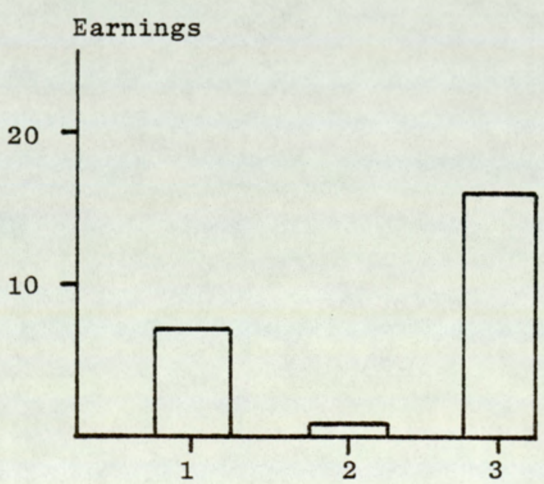
Earnings
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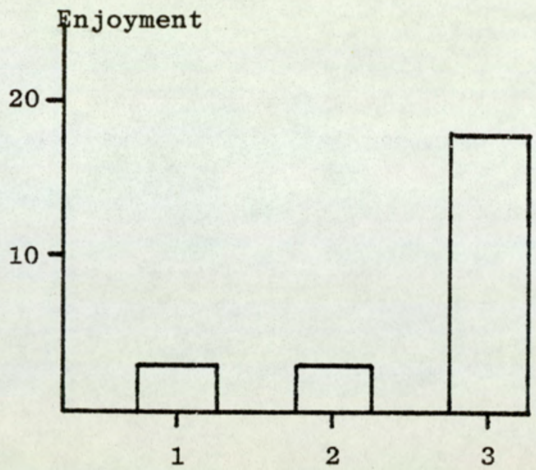
Enjoyment
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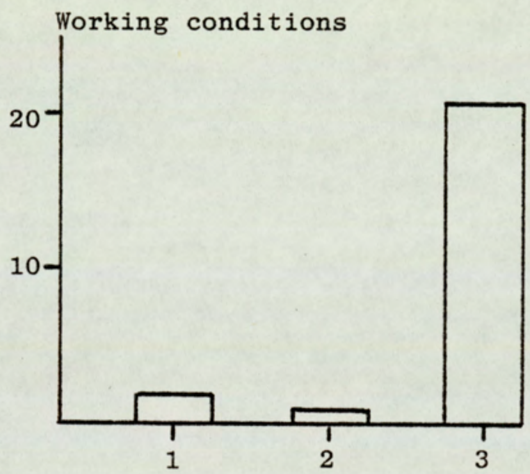

Working conditions
20
10
1
2
3

Fig. 13.5. Distribution of employment tenure among the respondents to the first questionnaire

inclusion in the first questionnaire. It had been decided, however, to incorporate these questions in the ensuing questionnaire. The questions were included in both the employment section and the unemployment section. Additional questions were included at various stages of the questionnaire to ascertain whether the particular employment was part of the Government Youth Opportunities Programme. The revised questionnaire is shown in Appendix B. Fig 6.

The questionnaire to the school leaver from the academic year 1977/78, was posted on 21.6.79. This was one week later than had previously been planned and, indeed was one week later than in the previous year. This was due to postal difficulties resulting from a letter bomb campaign affecting Birmingham during the second week of June 1979.

The sample comprised 65 individuals who had been examined previously as part of the study and 52 individuals who had not previously participated. Those who had been examined consisted of 34 former pupils of Exhall Grange School (Group 3A) and 31 former pupils of Joseph Clarke, Derby, Holmrook and West of England Schools (Group 3B). Those with whom contact had not previously been made (Group 3C) comprised 48 former pupils of John Aird, East Anglian, Temple Bank, Nansen, New River, Shawgrove and St Vincent's Schools, and four former pupils of Derby and Holmrook Schools.

The psychological scales of Edwards (1959); Rotter (1966) and Lynn (1969) had been administered to 89 of the 117 individuals, during the summer term of 1978, either by one of the research workers or by teachers at the various schools. These youngsters were sent the shortened version of the questionnaire. The remaining 28 individuals, approximately equally distributed among the three groups, received the questionnaire which contained the complete Edwards scale and the reduced Rotter scale.

The shortened questionnaire included an additional sentence in the instructions. This drew attention to the gap in question numbering between the end of the first section and the start of the second section.

Those individuals who had been examined on one occasion (Group 3B) and those who had not previously participated in the visual ability experiments (Group 3C) were offered the sum of £1 to respond, irrespective of questionnaire length. The allocation of subjects to the 3 groups of the second experimental design is shown in Table 13.5.

The response curve for the questionnaire is shown in Fig. 13.6. The first follow-up letter was posted 14 days after the issue of the questionnaire. A return of 62.4% had been achieved by this date (T_1). The second follow-up letter was posted 13 days after the first follow-up letter; 84 questionnaires had been received at this time (T_2). A third follow-up letter was posted at T_3, 13 days after the second follow-up letter. The response at the time of posting of this letter was 78.6%.

A total of 94 completed questionnaires were received by T_4 from a total of 117 giving a final response rate of 80.3%.

The results for the three experimental groups at each of the four time periods are listed in Table 13.6. Three letters were received from parents; two of these explained that the particular youngster was educationally subnormal (E.S.N.) and so unable to complete the questionnaire. The third letter stated that the parent did not wish his daughter to participate in the study. An additional 6 questionnaires were returned uncompleted, the subjects having moved from their recorded addresses. A total of 9 questionnaires were therefore omitted from the analysis.

GROUP	N	EXAMINED	RECEIVING INCENTIVE
3A	34	Frequently	No
3B	31	Occasionally	Yes
3C	52	No	Yes
TOTAL	117		

Table 13.5 THE THREE GROUPS OF THE SECOND EXPERIMENTAL DESIGN

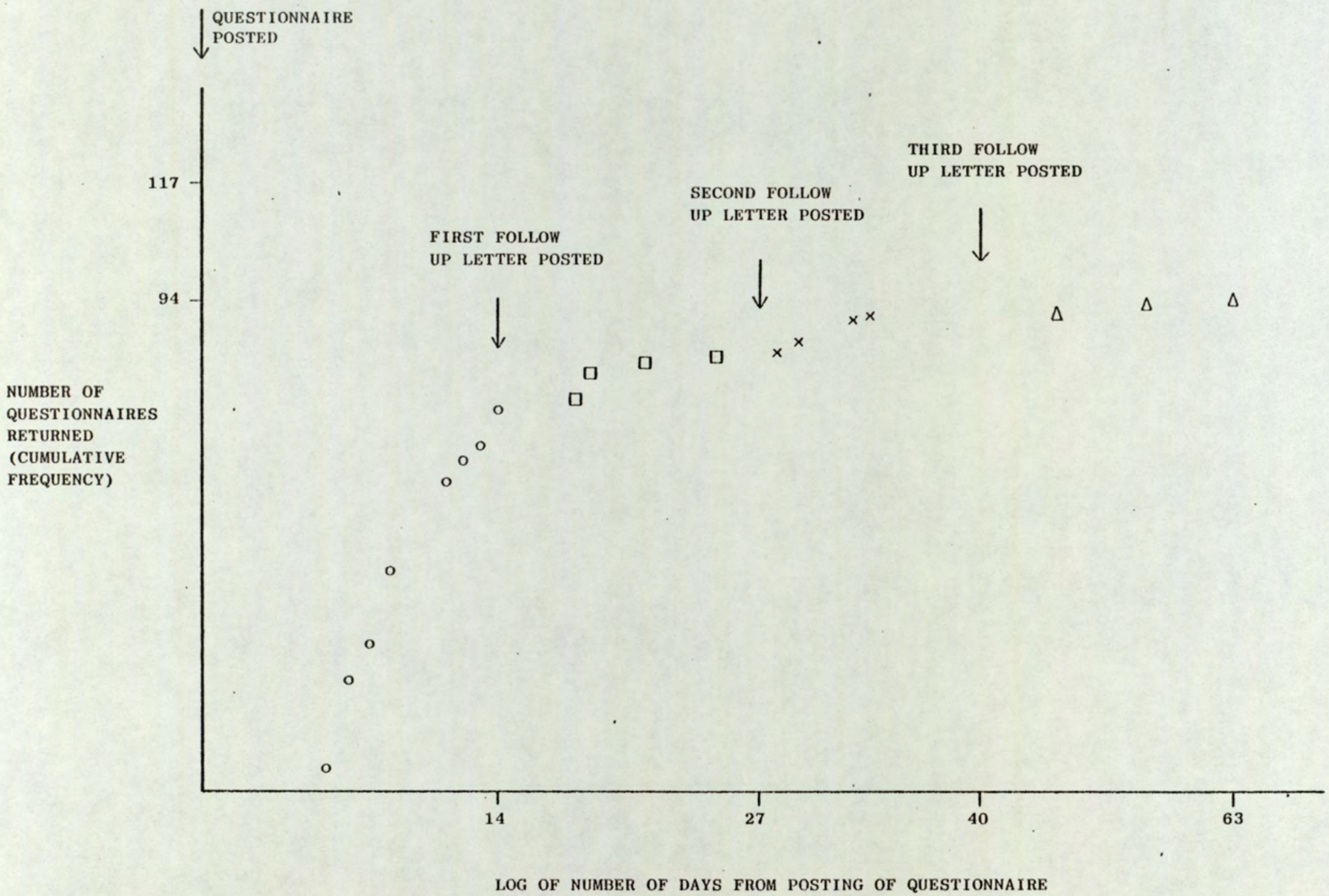


Fig. 13.6 Response curve for the questionnaire to the leavers from the 1977/78 academic year

GROUP	TOTAL NUMBER OF USABLE REPLIES	REPLIES RECEIVED FROM THE THREE GROUPS OVER FOUR TIME PERIODS			
		T_1	T_2	T_3	T_4
3A	34	22 (64.7%)	28 (82.3%)	30 (88.2%)	31 (91.2%)
3B	30	24 (80.0%)	25 (83.3%)	28 (93.3%)	28 (93.3%)
3C	44	27 (61.4%)	31 (70.4%)	34 (77.3%)	35 (79.5%)
TOTAL	108	73 (67.6%)	84 (77.8%)	92 (85.2%)	94 (87.0%)

Table 13.6 NUMBER OF USABLE REPLIES RECEIVED FROM THE THREE OVER FOUR TIME PERIODS.

A Chi Square Test for two independent samples revealed that the differences in response rate between the three experimental groups were not statistically significant for any of the four time periods.

The overall response 80.3% was, once again, extremely high. The return, however, was less than that of the first sample 87.6%. It was suggested that the reduction in response may have been due to the postal chaos resulting from the bombing campaign.

The questionnaire to leavers from the third academic year (1978/79) was posted on 11.6.80. This date corresponded to that of the posting of the questionnaire to the first academic year (1976/77).

The sample consisted of 94 individuals who had been previously examined; 46 were former pupils of Exhall Grange School (Group 4A) and 48 of Joseph Clarke, Derby, Holbrook and West of England Schools (Group 4B). In addition, it contained 55 individuals who had not been examined as part of the study (Group 4C). Fifty-one of these 55 youngsters were former pupils of John Aird, Temple Bank, East Anglian, Nansen, Shawgrove and St Vincent's Schools; the remaining four were former pupils of Joseph Clarke, Derby, and West of England Schools.

The psychological scales, due to the lack of available time, had only been administered to 40 individuals. These youngsters thus received the shortened questionnaire whilst the remainder received the more lengthy version.

Those individuals who had not previously been involved in the study or with whom contact was limited (Groups 4B and 4C) were offered the sum of £1.00 as an incentive to reply. The allocation of subjects to the various groups is shown in Table 13.7.

GROUP	N	EXAMINED	RECEIVING INCENTIVE
4A	46	Frequently	No
4B	48	Occasionally	Yes
4C	55	No	Yes
Total	149		

Table 13.7 The three groups of the third Experimental Design

The first follow-up letter was posted 9 days after the posting of the questionnaire (T_1). A response of 49.7% (74 questionnaires) had been received by this date. The second follow-up letter was posted one week after the first such letter (T_2) and after an additional response of 20.8%, the third letter was posted one week after the second letter (T_3). A response of 81.9% had been achieved by this date. A total of 132 completed questionnaires were finally received representing a return of 88.6%. The response curve is shown in Fig.13.7.

The response rate was thus the highest of the three academic years and was also achieved on the largest sample of youngsters.

A letter was received from one youngster in Group 4 indicating an unwillingness to participate in the study. An additional four questionnaires were returned due to the youngster having changed address, and these have been omitted from the analysis in Table 13.8

The overall response from the three years was 304 completed questionnaires out of a total of 355, a response rate of 85.3%. Many youngsters included letters in their questionnaires. These letters were all answered by return of post.

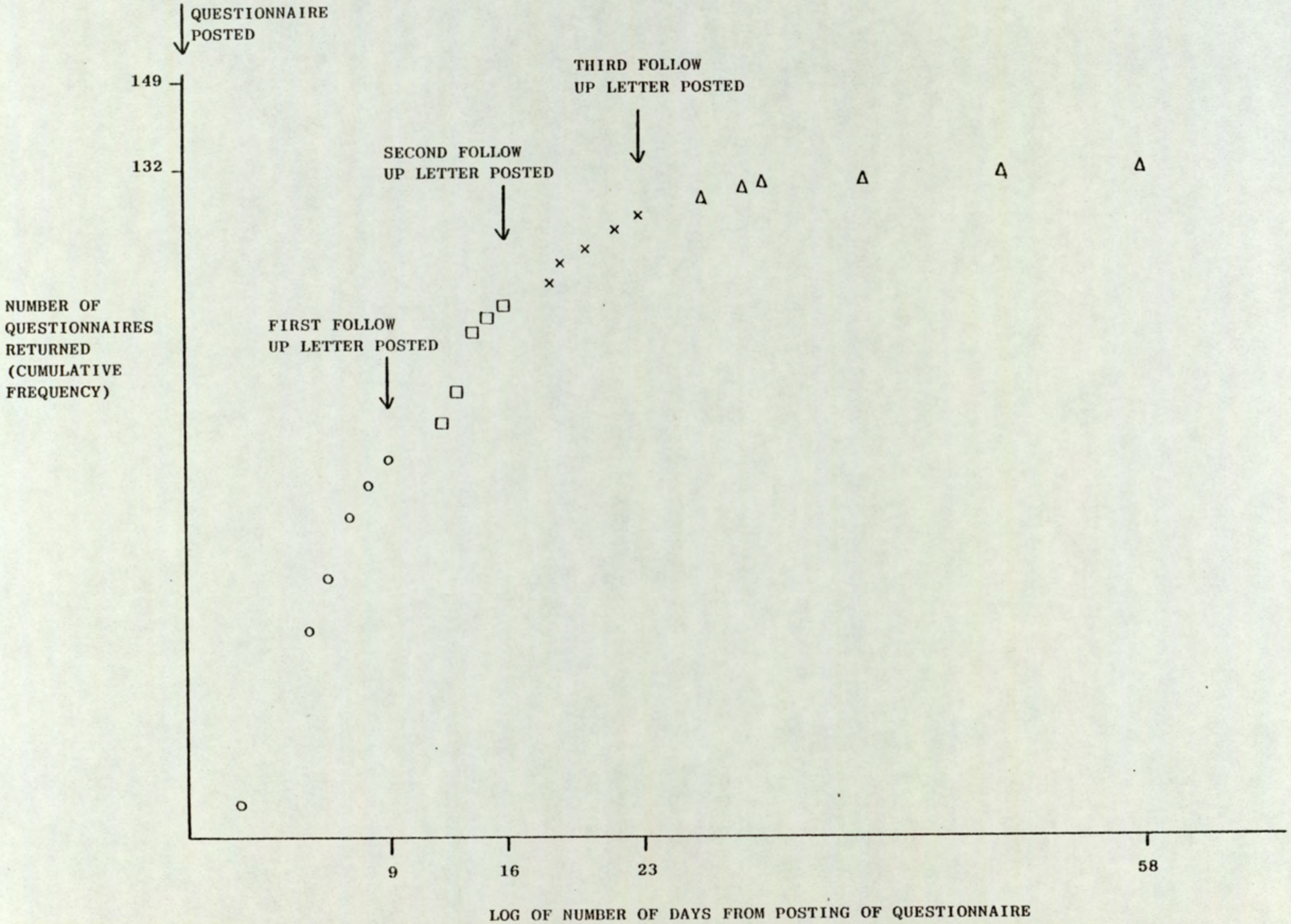


Fig. 13.7 Response curve for the questionnaire to the leavers from

GROUP	TOTAL NUMBER OF USABLE REPLIES	REPLIES RECEIVED FROM THE THREE GROUPS OVER FOUR TIME PERIODS			
		T_1	T_2	T_3	T_4
4A	46	27 (58.7%)	36 (78.3%)	41 (89.1%)	43 (93.5%)
4B	47	20 (42.6%)	33 (70.2%)	39 (83.0%)	43 (91.5%)
4C	51	27 (52.9%)	36 (70.6%)	42 (82.3%)	46 (90.2%)
TOTAL	144	74	105	122	132

Table 13.8 Number of replies received from the three groups over four time periods.

14. HYPOTHESES AND STATEMENTS

It was decided that the analysis should investigate certain specific factors considered likely to be involved in determining the level of occupational success. These various hypotheses were based on, for example, the work of Green (1976), conclusions from the semi-structured interviews and on opinions of those with considerable experience of the visually handicapped. The following hypotheses and statements were formulated during the study:

1. The sex of the youngster influences the level of occupational success.

2. The degree of employment success increases with increase in age.

3. The youngsters' place of abode influences the level of occupational success.

4. The type of previous special school for the visually handicapped, i.e. either day or boarding, influences the level of occupational success.

5. The duration of education in special schools for the visually handicapped influences the level of occupational success.

6. The possession of academic qualifications influences the degree of employment success.

7. The level of occupational success is related to the degree of achievement motivation.

8. The degree of employment success is related to the locus of control (Section 13), success increasing with increase in internal/decrease in external score.

9. The youngsters' attitude to visual impairment influences the level of occupational success.

10. The degree of adaptation to the normally sighted environment influences the level of employment success.

11. The capacity to make a realistic self-appraisal of ability influences the degree of employment success.

12. The handling of the visual issues at job interview influences the level of occupational success.

13. Parental encouragement influences the level of occupational success.

14. The degree of employment success is related to the type of primary ocular disorder.

15. The presence of unemployed members of the family adversely affects the youngsters' level of occupational success.

16. Occupational success is related to distance visual acuity.

17. Occupational success is related to near visual acuity.

18. The integrity of the visual field influences the level of occupational success.

19. Employment success is related to the integrity of the colour sense.

20. Dynamic acuity influences the level of occupational success.

15. RESULTS ANALYSIS AND DISCUSSION

15.1 Characteristics of the sample

The sample for the study consisted of 355 final year school leavers from the 3 consecutive academic years 1976/77, 1977/78 and 1978/79.

The leavers were former pupils from 13 different schools for the partially sighted. The youngsters were not, however, drawn from all 13 schools in each of the 3 academic years. Approximately one third of the youngsters in the sample were former pupils of Exhall Grange School. The high proportion of youngsters from this school was due to two factors: the large number of pupils being educated at the school and the involvement of youngsters from all 3 final year groups. The distribution of the youngsters among the various schools is shown in Table 15.1.

One hundred and ninety-five youngsters (49.3%) were examined by a research worker on at least one occasion during the appropriate final year of schooling. Of the 355 youngsters, 209 (58.9%) were male and 146 female (41.6%). The male to female ratio was thus 1.43:1.

The mean age at the time of receipt of the questionnaire, based on 353 youngsters, was 17.60 years with a standard deviation of 1.06 years.

The address used for correspondence with each youngster, in the vast majority of cases also the place of residence, was found to be widely distributed throughout Great Britain. The geographical distribution is shown in Table 15.2.

School	Number of former pupils in sample	%
George Auden, Birmingham	3	0.8
Joseph Clarke, London	33	9.3
Exhall Grange, Coventry	115	32.4
Nansen, London	23	6.5
St. Vincents, Liverpool	37	10.4
Temple Bank, Bradford	23	6.5
West of England, Exeter	33	9.3
John Aird, London	18	5.1
Derby, Preston	21	5.9
East Anglian, Gorleston-on-Sea	12	3.4
Holmrook, Liverpool	21	5.9
New River, London	2	0.6
Shawgrove, Manchester	14	3.9
Total	355	100%

Table 15.1 Distribution of the 355 youngsters among the 13 schools taking part in the study.

Region	Number of Youngsters in sample	%
Northern	6	1.7
Yorks/Humberside	34	9.6
North Western	84	23.7
West Midlands	54	15.2
East Midlands	27	7.6
London North	59	16.6
London	27	7.6
Southern	34	9.6
South Western	23	6.5
Scotland	2	0.6
Wales	3	0.8
Other	2	0.6
Total	355	100

Table 15.2 Geographical distribution of the 355 youngsters in the sample.

The distance visual acuity of the better eye was available in the existing school records of 335 individuals. The acuities ranged from hand movements to better than 6/6 -3. The modal visual acuity, i.e. the most frequent occurring visual acuity, was between 6/60 +1 and 6/36 +1 and accounted for 94 of the youngsters. In the majority of cases (73.2%), the acuities in the better eye were between 6/60 and 6/18 +2. Thirty-two youngsters had acuities of less than 6/60. The distribution of distance visual acuity within the sample is given in Table 15.3.

Data on the primary ocular disorder responsible for the reduction in vision of the better eye was available in 341 of the cases and covered 30 classifications. The most frequently occurring disorder (18.9% of the sample) was aphakia following a congenital cataract. Five disorders accounted for the reduced vision in almost two-thirds of the sample (63.6%); these were pathological myopia, albinism, aphakia following congenital cataract, optic atrophy and congenital idiopathic nystagmus. The distribution of the primary ocular disorder among the sample is shown in Table 15.4.

The clinical characteristics of the sample can best be compared with the data published by Fine in 1968. Fine carried out a survey, between 1962 and 1965, of 817 children in 20 special schools for the blind and 1,374 children in 34 special schools and 8 special classes for the partially sighted in England and Wales. Clinical information was obtained in a similar manner to that of the present study. Fine divided both the blind and the partially seeing children into two groups: those born between 1951 and 1955 and those born in the period 1956 to 1960. The characteristics of the partially sighted children in this latter age group bear comparison with those of the youngsters in the current study.

Visual Acuity	Number of Youngsters	%
No Perception of Light	-	-
Perception of Light	-	-
Hand movements	1	0.3
Count fingers	1	0.3
$\frac{1}{60}$	1	0.3
$\frac{2}{60}$	8	2.3
$\frac{3}{60}$	10	2.8
$\frac{4}{60}$	5	1.4
$\frac{5}{60}$	6	1.7
$\frac{6}{60}$	60	16.9
$\frac{6}{60}+1 \rightarrow \frac{6}{36}+1$	94	26.5
$\frac{6}{24}-1 \rightarrow \frac{6}{24}+1$	58	16.3
$\frac{6}{18}-2 \rightarrow \frac{6}{18}+2$	48	13.5
$\frac{6}{12}-2 \rightarrow \frac{6}{12}+2$	22	6.2
$\frac{6}{9}-3 \rightarrow \frac{6}{9}+3$	14	3.9
$\frac{6}{6}-4 \rightarrow \frac{6}{6}$	8	2.3
Missing	19	5.3
Total	355	100%

Table 15.3 Distance visual acuity among the 355 youngsters in the sample.

Disorder	Number of Youngsters	%
Degenerative myopia (including detachment secondary to myopia)	35	9.9
Albinism (includes partial, total, ocular and all those labelled as nystagmus with albinism)	47	13.2
Buphthalmos	10	2.8
Microphthalmos	12	3.4
Aniridia	10	2.8
Coloboma	4	1.1
Corneal dystrophy	1	0.3
Unknown corneal lesion	1	0.3
Cataract in situ	14	3.9
Surgical aphakia	67	18.9
Dislocated lens (including Marfans)	7	2.0
Still's disease	5	1.4
Chorioretinitis/Choroiditis	1	0.3
Other disorder of uvea	1	0.3
Retinopathy and lesions of retinal vessels	2	0.6
Retrolental fibroplasia	1	0.3
Primary detachment	3	0.8
Tapeto retinal dystrophy and allied conditions including retinitis pigmentosa	9	2.5
Macular dystrophy/degeneration	22	6.2
Neoplasm of retina	1	0.3
Total achromatopsia	4	1.1
Other disorder of retina	1	0.3
Hereditary and primary optic atrophy	8	2.2
Other optic atrophy including secondary atrophy	21	5.9
Non classified optic atrophy	17	4.8
Other disorder of optic nerve	4	1.1
Disorder of vitreous	1	0.3
Nystagmus	31	8.7
Normal	1	0.3
Missing	14	
Total	355	

Table 15.4. Primary ocular disorder among the 355 youngsters in the sample.

Fine recorded 413 children in this category; 256 males and 157 females. The male to female ratio, 1.63:1, compares with that of 1.43:1 in the present study.

Fine grouped clinical diagnosis into 14 categories. The most frequently occurring disorder was cataract and lens displacement, being present in 33.2% of her sample. Five categories of disorder - cataract and lens displacement, nystagmus, albinism, optic atrophy and myopia - accounted for partial sight in 78.9% of the sample. The qualitative nature of this data compares favourably with that of the present study. The relative difference in the frequency of disorder between the two samples can probably be attributed to differences in diagnosis of disorder, in interpretation and classification of clinical data, and in the nature of the sampling processes.

The representative nature of the sample is difficult to define. The sample, being based on schools for the partially sighted, can be compared with the statistics issued by the D.E.S. which relate to the numbers of handicapped pupils receiving special education in England and Wales. The figures applicable to the current study show that in January 1977, 632 pupils aged 14 years and over and considered to be within the educational definition of partial sight, were being educated in special schools (D.E.S. 1978). Of the 355 youngsters forming the sample in the present study, 30, were aged 14 years and over at January 15th 1977. This would suggest that the sample comprised approximately half of the children in this category who were receiving special education in January 1977. This estimation, however, does not take into account partially sighted youngsters either entering or leaving special education subsequent to this date.

Such information is unfortunately not available from the published Government statistics.

A comparison can also be made with the figures issued by the D.H.S.S. concerning the registered partially sighted in England. The figures applicable to the current study show that 1,478 youngsters aged between 16 and 20 were registered as partially sighted as at 31st March 1979. Of the 304 individuals who returned a completed questionnaire, 178 were aged 16-20 years at 31st March 1979 and registered partially sighted at the time of completion of the questionnaire in June 1978, 1979 or 1980.
A further 27 individuals in this age group were either uncertain of their registration status or failed to reveal this information. These figures, based on a questionnaire response rate of 85%, can be extrapolated to the overall sample and then compared with the total number of youngsters registered partially sighted in this age group. The findings suggest that the sample contained approximately 14% of those registered partially sighted in England aged 16-20 years at 31st March 1979. A small proportion of the youngsters who returned the questionnaire, however, may not have been registered partially sighted at 31st March 1979; some may have been admitted to or removed from the register either before or after this date. It is known, for example, that 81 (54%) of the 1,478 youngsters in the 16-20 age group were admitted to the register in the 12 months ending 31st March 1979 (D.H.S.S. 1980).

15.2 Representative nature of the respondents

It was shown in Section 13 that 304 of the 355 youngsters returned a completed questionnaire - a response rate of 85.6%. The numbers of respondents among each of the 3 academic years utilized in the study together with the numbers involved in the visual ability experiments is given in Table 15.5. It was also shown in Section 13 that conclusions from questionnaire surveys are only valid if the respondents are representative of the total sample as a whole. Indeed, the problem of possible differences between the characteristics of the respondents and of the non-respondents can only be successfully overcome by the acquisition of a high return. The magnitude of the response from each of the three years and also of the overall total suggests, however, that such differences are unlikely to be present in the current study.

15.3 Method of analysis

The principal aim of the analysis was the identification of factors influencing the level of occupational success.

A well defined procedure was laid down for the analysis of the data. The levels of occupational success would be derived from the completed questionnaires and then related to data obtained from three sources - namely the examination and testing of the youngsters, the existing school records and the appropriate sections of the questionnaire.

It was decided that the statistical treatment of the data would primarily be undertaken using correlational analysis. The correlation

YEAR OF INVESTIGATION	EXAMINED	NON EXAMINED	TOTAL	RESPONDANTS	% RESPONDANTS
1st	35	54	89	78	87.6%
2nd	66	51	117	94	80.3%
3rd	94	55	149	132	88.6%
1+2+3	195	160	355	304	85.1%

Excludes one individual deceased between leaving school and receipt of questionnaire

Table 15.5 School leavers sampled in study.

coefficient is used to describe the degree of linear association between two variables and, in addition, forms a basis for predicting the score on one variable from that on another. Findings from such analysis, however, must be treated with caution since underlying causative factors can often be responsible for any one particular correlation.

It was recognized that in some cases, the level of measurement of the data would not be sufficient to permit this type of approach. It was, therefore, decided to adopt a descriptive technique in these cases.

It was agreed that, where possible, computer techniques should be used for the statistical analysis.

15.4 Computer techniques

The data from the visual ability research and from the educational and ophthalmic records was coded in a format suitable for analysis by computer. It was transferred first onto specially prepared data sheets and then onto computer cards. In the case of the completed questionnaires, the information was coded in the spacing along the right hand side of the questionnaire and then transferred onto computer cards. The codes used for the analysis are given in Appendix D.

The analysis was undertaken using the S.P.S.S. package (statistical package for the Social Sciences; Nie, Bent & Hull 1970) together with programmes written especially for the study (Clements 1980; 1981).

A number of checks were undertaken at various stages to ensure accuracy of the analysis. The data for each particular variable was listed initially by frequency. It was then listed for each individual youngster. The accuracy of these print-outs was then checked against the appropriate information contained within the data sheets and within the questionnaire. In the case of those variables derived by calculation, e.g. occupational success, age and length of schooling, the computer calculation was checked, in a random cross section of youngsters, against the value obtained by longhand. The accuracy of the programmes written especially for the study was first examined using test data and then by comparing a cross section of the results with those calculated by hand.

15.5 Post school educational and occupational characteristics of the respondents

Analysis of the 304 completed questionnaires revealed that 169 of the youngsters (55.6%) had either sought or had experienced some type of employment in the period since leaving school. The remaining 135 youngsters (44.4%) had enrolled in courses of special, further or higher education during this time.

Those who had continued in education had attended a wide spectrum of educational establishments (Table 15.6). The majority (71.8%) had entered establishments catering for the normally seeing. Of the 97 individuals in this category, 76 had undertaken courses at colleges of further education, 11 had transferred to schools for the normally sighted and 10 had been admitted to universities or polytechnics.

Thirty of the 135 youngsters had continued their education at establishments catering for the visually handicapped. Of these,

Establishment	Number of Youngsters	%
University	7	5.2
Polytechnics	3	2.2
Colleges of Further Education	76	56.3
Schools for the Normally Sighted	11	8.2
Royal Normal College	13	9.6
Hethersett	7	5.2
Harborne	10	7.4
Other type of establishment	7	5.2
Not known	1	0.7
Total	135	100%

Table 15.6 The type of educational establishments attended by the 135 youngsters undertaking higher or further education and training.

13 had entered the Royal Normal College for the Blind, Shrewsbury, 7 had taken places at Heathersett, Reigate, Surrey, and 10 had been admitted to Queen Alexandra College, Harborne, Birmingham.

Seven youngsters had attended educational establishments catering for other types of impairment.

The majority of the 76 youngsters who had entered colleges of further education were enrolled in courses leading to some form of educational certificate. Thirty (39.5%) were undertaking 'A' level studies, whilst a similar number were taking courses in subjects such as secretarial work and catering. 'A' level subjects were also being studied by a further 16 individuals, 8 of whom were attending schools for the normally sighted with the remainder at either the Royal Normal College or Chorleywood. Eleven youngsters were studying for 'O' levels. A further 30 were undertaking general and vocational courses, with the majority (22 individuals - 73.3%) attending educational establishments catering specifically for visual or other impairment. The type of course undertaken at the various educational establishments is shown in Table 15.7.

Approximately 40% of the leavers were enrolled in courses of less than one year's duration (3 terms or less) while a similar percentage were involved in 2 year courses. The distribution of the length of courses is shown in Table 15.8.

Of those undertaking courses of education or training after leaving school, 50.5% indicated that they were motivated by the desire to obtain more qualifications. Similarly, 37 individuals (27.4%) gave their reason as the wish to be trained in a job or skill. The analysis also showed that 10 youngsters were undecided on their choice of future occupation and 3 had been unable to find a job. The reason for entering further education and training was not

	'O' levels	'A' levels	Other Certificate	HND Degree	General	Vocational	Other	Missing	Total
University				7					7
Polytechnic/ College of Education			1	2					3
VIth Form College/College of Further Education	5	30	30		7		2	2	76
School	3	8							11
Royal Normal College	3	8				2			13
Hethersett						6		1	7
Harborne					4	5		1	10
Other			2		2	3			7
Unknown					1				1
Total	11	46	33	9	14	16	2	4	135

Table 15.7 The type of course undertaken by the 135 youngsters undertaking higher, or further education and training.

	Up to 3	4-6	7-9	10-12	13+	Other	Missing	
University			7					7
Polytechnics			1	2				3
Colleges of Further Education	33	36	3		1	2	1	76
School	4	7						11
Royal Normal College	2	2	4	5				13
Hethersett	5	1					1	7
Harborne	6	3					1	10
Other	4	2		1				7
Unknown							1	1
Total	54	51	15	8	1	2	4	135

Table 15.8 The length of the courses undertaken by the 135 youngsters in higher or further education and training.

given by 8 of the youngsters. The various responses, summarized in terms of educational establishment, are shown in Table 15.9.

Data based on 129 of the 135 youngsters, showed that only 10 individuals had made a job application prior to enrolling in a particular course.

It is interesting to note that approximately three-quarters of the 135 youngsters had entered educational establishments catering primarily for the normally seeing. The explanation for this tendency is unclear, but it is almost certainly related to the lack of specialist further educational facilities available to the partially sighted at both local and national level. The trend towards the educational integration of the handicapped, in general, may also be a further factor.

The number of youngsters within the sample undertaking courses of education (135 - 44.4%) is likely to be influenced, in part, by the large proportion of leavers from Exhall Grange. This school has a grammar stream and it could thus be expected that most of the youngsters in this stream would enter further or higher education. Indeed, of the 135 respondents in education, 58 (43.0%) were former pupils of Exhall Grange School.

The proportion of youngsters entering further education or training can be compared with the figure obtained by Kell et al (1974) in a study of 285 leavers from 6 schools for the partially sighted in London and the Home Counties and from Exhall Grange School. study revealed that over a third of the leavers had entered one of five categories of further education. The data covering the occupational and educational experiences of 128 leavers from four I.L.E.A. schools and from Joseph Clarke School shows that 43 youngsters entered colleges of

Table 15.9 The reasons for entering higher or further education and training.

	To be trained in a job	To get more qualifications	Unable to decide what to do	Unable to find job	Other
University	2	3	1		1
Polytechnic	1	2			
Colleges of Further Education	20	41	5	1	5
School		9			1
Royal Normal College	3	10			
Hethersett	3	2	1		
Harborne	5	1	1	1	1
Other	3	2			1
Not known			1		
Total	37	60	10	3	9

further education (33.4%), 8 undertook "blind assessment training" and one entered a sixth form. This figure (40.6%) compares favourably with that of the current study (41.2%). Unemployed youngsters from these 5 schools were not included in the sample of 128. The per-centage of youngsters undertaking further education or training could thus be an over-estimation.

Occupational success

It was shown in Section 13 that the measure of employment success, derived from information contained in the completed questionnaires, was defined in terms of a ratio:

$$\frac{\text{length of time in employment}}{\text{time available for employment.}}$$

The numerator was calculated from information supplied in response to questions concerning the duration of previous employments and the commencement of the current employment. The denominator was obtained by calculating the length of time elapsed between the date of leaving school or training institute and the receipt of the questionnaire. The possible values of the employment success index thus covered a range from 0 to 1.0 and encompassed the complete range from totally unemployed to fully employed in the period since finishing school.

The level of occupational success was obtained for 168 of the 169 youngsters who had sought employment. The information supplied by the remaining youngster was insufficient to permit a calculation of employment success.

It has already been shown (Section 13) that the length of time available for employment was largely dependent upon the date of leaving school. The mean period was found to be 49.7 weeks with a standard deviation of 7.0 weeks.

Forty-nine of the 168 youngsters (29.2%) had a level of employment success ranging from 0.9 to 1.0. Of these 49 youngsters, 16 had a value of 1.0 indicating that they had entered employment on leaving school and had had no periods of unemployment. In contrast, 25 youngsters (14.9%) had an index ranging from 0.0 to 0.1. Of these 25 individuals, 22 had not been employed between the time of leaving school and the receipt of the questionnaire. Ten of the 22 youngsters were either attending some form of adult day centre or undertaking some type of sheltered activity.

The median value of employment success, i.e. that score above and below which one-half of the frequencies lie, was 0.687. The upper quartile, i.e. that score above which one-quarter of the frequencies lie and below which three-quarters lie, was 0.914. These figures illustrate that half of the 168 youngsters were employed for at least two-thirds of the period available for employment. Indeed, a quarter of the youngsters were employed for 90% or more of this period. The distribution of occupational success among the 168 youngsters is illustrated in Fig. 15.1.

The majority of the 169 youngsters (86.4%) who sought employment on leaving school entered 5 distinct areas of employment. Of the 147 youngsters involved, 34 (23.2%) undertook general labouring jobs and 22 (15.0%) were employed in factory or warehouses. Clerical/office jobs were chosen by an additional 29 leavers (19.7%) and shop/sales assistant work was selected by a further 20 youngsters (13.6%). Seventeen leavers entered an occupation involving skilled or semi-skilled work. The distribution of the types of initial employment is shown in Table 15.10.

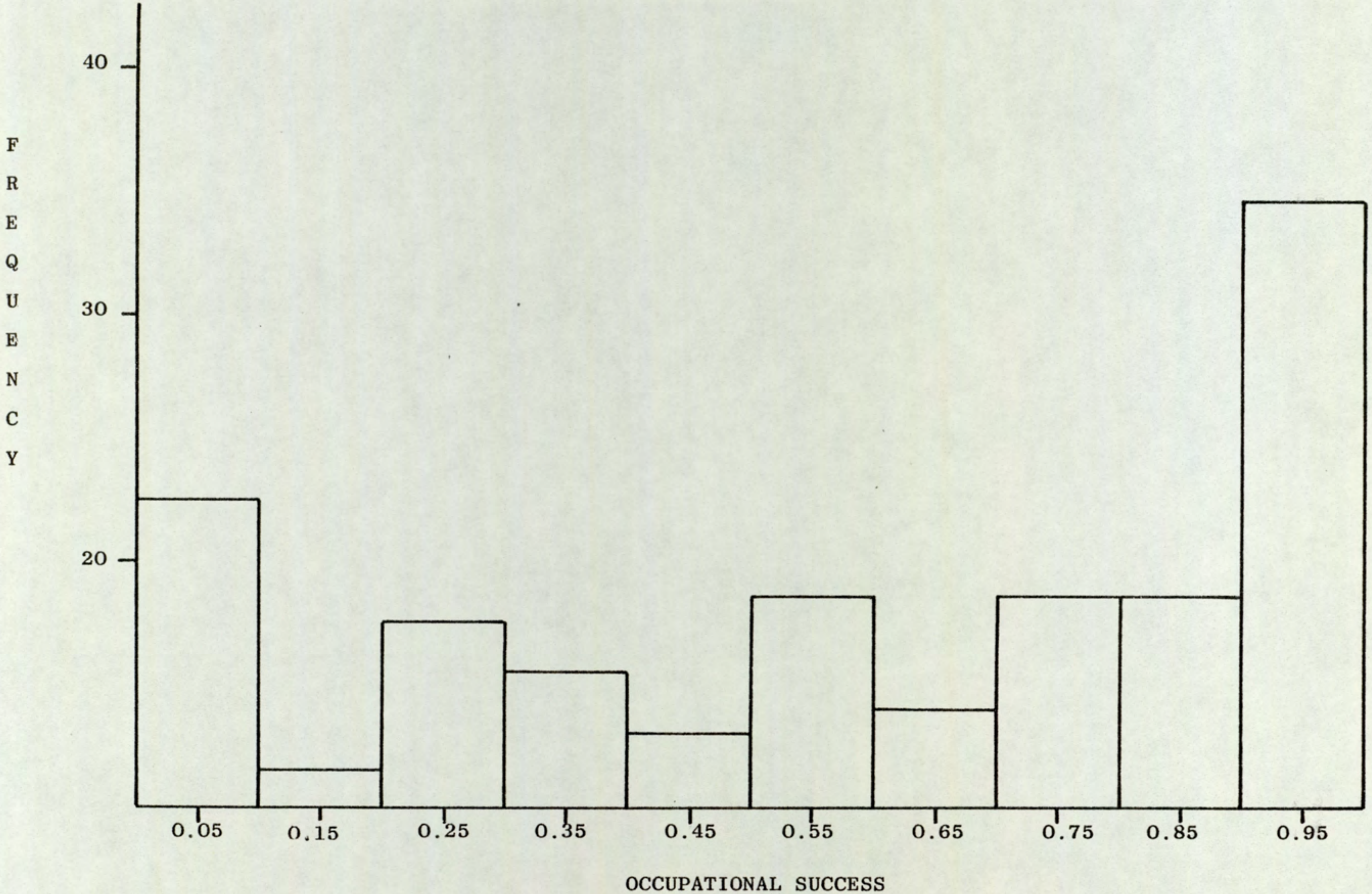


Fig. 15.1 Distribution of occupational success amongst 168 of the 169 youngsters

Job function	Number of Youngsters	%
Clerical/Office	29	19.7
Shop/Sales Assistant	20	13.6
Artisan(skilled/semi-skilled)	17	11.6
Factory/Warehouse	22	15.0
General Labour	35	23.8
Domestic	11	7.5
Welfare	7	4.7
Other	2	1.4
Missing	4	2.7
Total	147	100%

Table 15.10 The types of employment entered by the 147 youngsters on leaving school or training institute.

Suggestions for the initial employment originated from the careers officer in 34.5% of the occasions (50 individuals) whilst in 44 cases the youngsters took the initiative on their own. In 18 cases, the parents were involved whilst, in a further 10 cases, the advice came from friends or other relatives. Fourteen youngsters (9.0%) failed to answer the particular question in the questionnaire. The distribution of the source of idea for the initial employment is shown in Table 15.11. It is interesting to note that the school/head teacher apparently played little part in determining the choice of occupation. This finding is particularly surprising in view of the active careers education undertaken by the majority of the schools taking part in the study. The close involvement of the careers officers in the various school programmes, however, may account for this apparent anomaly.

The initial contact with the prospective employer was arranged by the careers officer in 66 cases, by the individual youngster in 36 cases and by the parents on 18 occasions (Table 15.12).

One hundred and twenty-eight of the 147 jobs were considered to be of a full-time nature (30 hours or greater) and 14 to be part-time. An additional 5 youngsters failed to answer the question requesting this information. One hundred and forty-two of the youngsters were known to be in paid employment and the remaining 5 youngsters omitted to answer this particular question.

Of the 118 initial occupations entered by leavers from the latter two academic years ,1977/78 and 1978/79, 45 were known to form part of the Government Youth Opportunities Programme. Data was not supplied to this question in three cases.

Sixty-nine of the 147 youngsters were still in the initial employment at the time of receipt of the questionnaire. The

Source of idea for initial employment	Number of Youngsters	%
Careers Officer	50	34.0
School/Head Teacher	3	2.0
Parents	18	12.2
Previous interviewer	2	1.4
Oneself	44	29.9
Friends/Other relatives	10	6.8
Advert	3	2.0
Other	3	2.0
Missing	14	9.5
Total	147	100%

Table 15.11 The source of the idea for the initial employment entered by the 147 youngsters.

Instigator of initial contact with employer	Number of Youngsters	%
Careers Officer	66	44.9
School/Head Teacher	2	1.4
Parents	18	12.3
Previous interviewer	-	-
Oneself	36	24.5
Friend/Other relative	8	5.4
Advert	1	0.7
Other	3	2.0
Missing	13	8.8
Total	147	100%

Table 15.12 The mode of initial contact for the first employments entered by the 147 youngsters.

remaining 78 youngsters gave a variety of answers to the question concerning the reason for leaving the initial occupation. Twenty-two of the 78 youngsters (28.2%) had either been employed in a temporary job or had reached the end of the particular course or programme. An additional 6 youngsters admitted to having been sacked whilst 7 gave visual problems and 6 ill-health as the reason for leaving. Nine individuals found a better job and 6 left due to poor financial or future prospects. The response from 18 of the 78 youngsters could not be categorized, and to some extent, may reflect either failure to admit to or to record the actual reason. The reasons for leaving the initial employment are shown in Table 15.13.

Of the 78 youngsters who left their first employment, 65 (83.3%) had managed to obtain a second job. The great majority of the 65 youngsters (92.3%) again entered the same 5 distinct areas of employment. Sixteen were employed in factory or warehouse work (24.6%), 13 in skilled or semi-skilled work, 12 in general labour, 11 as shop/sales assistant and 8 in clerical or office work. The distribution of types of employment is given in Table 15.14.

The idea for the second job arose primarily from the individual (29 cases - 44.6%) and from the careers officer (23 cases - 35.4%) (Table 15.15).

The contact with the prospective employer was arranged by the careers officer on approximately half the occasions (50.8%) and by the individual youngsters in 13 cases. The parents and friends or other relatives accounted for a further 6 and 5 youngsters respectively (Table 15.16).

Sixty-one of the 65 occupations were known to be full-time and

Reason for leaving	Number of Youngsters	%
Sacked	6	7.7
Financial/lack of future prospects	6	7.7
Visual	7	9.0
Other Health	3	3.8
Unable to cope	3	3.8
Better job	9	11.5
End of course/Temporary job	22	28.2
Other excuse	18	23.1
Missing	4	5.1
Total	78	100%

Table 15.13 Reasons given by the 78 youngsters for leaving the first employment.

Job	Number of Youngsters	%
Clerical/Office	8	12.3
Shop/Sales assistant	11	16.9
Artisan (skilled/semi-skilled)	13	20.0
Factory/Warehouse	16	24.6
General Labour	12	18.5
Domestic	2	3.1
Welfare	3	4.6
Other	-	-
Missing	-	-
Total	65	100%

Table 15.14 The types of occupation entered by the 65 youngsters in the second employment

Source of idea for second employment.	Number of Youngsters	%
Careers officer	23	35.4
School/Head teacher	-	-
Parents	1	1.5
Previous Interviewer/Employer	2	3.1
Oneself	29	44.6
Friends/Other relatives	6	9.2
Advert	2	3.1
Other	-	-
Missing	2	3.1
Total	65	

Table 15.15 The source of idea for the second employment entered by the 65 youngsters.

Instigator of Contact with employer	Number of Youngsters	%
Careers Officer	33	50.8
School/Head teacher	-	-
Parents	6	9.2
Previous interviewer/employer	2	3.1
Oneself	13	20.0
Friend/Other relative	5	7.7
Advert	2	3.1
Other	-	-
Missing	4	6.1
Total	65	100%

Table 15.16 The mode of the initial contact for the second employments undertaken by the 65 youngsters.

3 to be part-time. The remaining one youngster failed to answer the appropriate question.

Paid employment was being undertaken in 56 of the 65 jobs and unpaid work in 8 cases. The remaining individual did not answer the particular question.

Of the 50 occupations entered by the leavers from the 1977/78 and 1978/79 academic years, 15 were under the auspices of the Government Youth Opportunities Programme.

Thirty-six of the 65 youngsters (55.4%) were still employed in their second job at the time of receipt of the questionnaire. The reasons given by the remaining 29 youngsters for leaving the second job were varied. Six individuals had completed a training programme or temporary job, 4 had found a better job and 3 admitted to having been sacked. The reason given by a further 12 youngsters could not be covered by the categories laid down for the analysis. The reasons for leaving the second employment are shown in Table 15.17.

Twenty-one of the 29 youngsters obtained a third job. The five areas of employment were approximately equally distributed among these 21 individuals. Six youngsters were, however, undertaking factory/warehouse work (Table 15.18).

The sources of the idea for the job were similar to those for the second employment. Careers officers were involved in 8 cases whilst the individual took the initiative in a further 8 cases.

The initial contact with the prospective employer was similarly primarily arranged by either the careers office (8 cases) or by the youngster (8 occasions) (Table 15.20).

Reason for Leaving	Number of Youngsters
Sacked	3
Financial/Lack of future prospects	1
Visual	1
Other Health	1
Unable to cope	1
Better job	4
End of course/ temporary job	6
Other excuse	12
Missing	-
Total	29

Table 15.17 The reasons given by the 29 youngsters for leaving the second employment.

Job	Number of Youngsters
Clerical/Office Work	3
Shop/Sales Assistant	3
Artisan (skilled/ semi-skilled)	3
Factory/Warehouse	6
General Labour	4
Domestic	1
Welfare	1
Other	-
Missing	-
Total	21

Table 15.18 The types of occupation undertaken by 21 youngsters in the third employment.

Source of idea for third employment	Number of Youngsters
Careers Officer	8
School/Head Teacher	-
Parents	2
Previous Interviewer/Employer	1
Oneself	8
Friends/Other Relatives	1
Advertisement	1
Other	-
Missing	-
Total	21

Table 15.19 The source of idea for the third employment undertaken by the 21 youngsters.

Instigator of contact with prospective employer	Number of Youngsters
Careers Officer	8
School/Head Teacher	-
Parents	-
Previous Interviewer/Employer	-
Oneself	8
Friend/Other relative	2
Advertisement	-
Other	1
Missing	2
Total	21

Table 15.20 The mode of the initial contact for the third employments undertaken by the 21 youngsters.

Seventeen of the jobs were known to be paid and one unpaid. Data was, however, not provided by the 3 remaining youngsters.

Of the 21 youngsters in their third job, 17 were employed full-time and 2 were part-time. Two youngsters failed to answer the appropriate question.

Fourteen of the 21 jobs were undertaken by the leavers from the 1977/78 and 1978/79 academic years, 6 of these being part of the Youth Opportunities Programme.

Seventeen of the 21 youngsters were still in their third employment at the time of receipt of the questionnaire. The 4 remaining youngsters had been unable to find further employment.

The findings concerning the first occupation undertaken by the partially sighted youngsters can, to some extent, be compared with data from a study of normally seeing youngsters in England and Wales (Anon. 1980). This latter study, carried out under the auspices of the Department of Employment, was designed to provide information on the first employment undertaken on leaving school. The sample for the study was selected by careers officers from youngsters who had reached the minimum school leaving age during the 1977/78 academic year. The individuals were chosen at random on the basis of birth dates on the 5th, 15th or 25th of the month. The sample thus covered approximately 10% of the 16 year olds in England and Wales. Information was obtained from "administrative sources" and, where necessary, from postal questionnaires. Youngsters who had returned to school, entered further education or had not obtained a job by 31st December 1978 were excluded from the detailed analysis of the survey.

Half of the 14,411 female youngsters in employment were found to be undertaking clerical (31.9%) or selling jobs (18.9%). The occupations entered by the 19,793 males were found to be more diverse, with only one category, "processing, making, repairing and related occupations", accounting for more than 10% of the male sample. The distribution of the youngsters by occupation is shown in Table 15.21. A valid comparison of these findings with those of the current study is difficult to make on account of the differences in sample size and in classification of job function. It is interesting to note, however, that the combination of two categories "professional and related in science, supporting management and administration" and "clerical and related occupations" yields a figure of 22.9% which compares with the 19.7% obtained for the "clerical/office" classification of the present study. A further comparison can be made between the "selling" occupations: 12.5% for the normally sighted individuals and 13.6% for the partially seeing youngsters.

The data can also be compared with the findings from the studies of the partially sighted. The conclusions, however, are similarly limited owing to the differences in job classification, in the sizes and nature of the various samples and the period of assessment. The most comparable findings are those of the study by Kell et al (1974). Data on job function and educational progress is provided in this paper for 128 leavers from 4 I.L.E.A. schools and from Joseph Clarke School over the period 1971-1973 (Tables 4.2 and 4.3). The findings for the 70 youngsters in employment have been reclassified according to the categories used in the present study and are given in Table 15.22. The majority of the 70 youngsters entered clerical work (35.7%) or shop work (24.3%). Occupations

	% Male	% Female	% Total
Professional and related in science, supporting management and administration	8.4	0.7	4.6
Clerical and related occupations	4.7	31.9	18.3
Selling occupations	6.2	18.9	12.5
Catering, cleaning, hairdressing and other personal services occupations	3.7	12.8	8.3
Making and repairing occupations (excluding metal and electrical)	9.2	11.7	10.4
Processing, make-up, repairing and related occupations (metal and electrical)	24.2	1.8	13.0
Other	43.6	22.2	32.9

Table 15.21 Job function of 34,204 16 year olds entering their first employment in 1978 (After Anon 1980)

	No.	%
Clerical/Office work	25	35.7
Shop/Sales assistant	17	24.3
Artisan (Skilled/Semi-skilled)	13	18.6
Factory/Warehouse	7	10.0
General Labour	2	2.9
Domestic	-	-
Welfare	2	2.9
Other	4	5.7
Missing	-	-
Total	70	100%

Table 15.22 Job function undertaken by 70 leavers from 4 I.L.E.A. schools and from Joseph Clarke School (Kell et al 1974) recategorized using the classification of the present study.

involving skilled or semi-skilled work accounted for a further 18.6% of the youngsters and factory/warehouse work for an additional 10%. It has already been reported (Section 4) that the findings by Kell et al, being based on leavers from schools in the London area, are unlikely to be representative of the national trend. Moreover, it is not clear from the report whether the occupations listed are those of the initial or subsequent employments. In addition, the number of unemployed youngsters is not given. Nevertheless, when compared with the findings of the present study, the data of Kell et al in general, shows an increase in the numbers entering both clerical/ office work and shop work and a decrease in those undertaking factory/warehouse and general labour. The discrepancy in the findings of the two studies thus may well be explained by the regional bias of the Kell sample.

15.6 Investigation of hypotheses

It had been hypothesized at the outset of the study that the level of occupational success would be related to the sex of the individual.

The relationship between these two variables was expressed in terms of the point biserial correlation coefficient r_{pb} (Guilford 1965; Kurtz & Mayo 1979), males being alloted a score of one and females zero. The value of r_{pb} based on 168 youngsters, was $r_{pb} = 0.153$ and was statistically significant from zero ($t = 1.995$, $df = 166$, $p<0.05$. This result thus indicates that males are more likely to be successfully employed than females.

Several explanations can be advanced for this finding, it is possible that discrimination in favour of male youngsters was practised by potential employers. The result, however, could also reflect the traditional rôle playing of the two sexes.

The age of the youngster was considered to be a possible factor influencing the level of occupational success. Partially sighted youngsters are generally held to be less socially and educationally mature than their normally sighted peers of an equivalent age. Consequently, it was felt that the level of employment success might increase with increase in age of the youngster.

The age of the youngsters at the time of receipt of the questionnaire was calculated and then compared with the level of occupational success. The relationship between age and success was expressed in terms of the Pearson product moment correlation r. The value of r, based on 168 youngsters, was not statistically significant. ($r = -0.088$, $df = 166$, $t = -1.140$, $p < 0.127$). It was concluded that there was no linear relationship between the age of the youngsters and the level of occupational success. A possible reason for the lack of an apparent correlation was the truncated range of ages of the youngsters, the mean age of the respondents at the time of receipt of the questionnaire being 17.33 years and the standard deviation 1.34 years. The effect of truncation on correlational analysis is well illustrated, for example, by Runyon & Haber (1973). Indeed, the relationship amongst the normally sighted between age and the ability to obtain employment is well defined (Boyers 1975). In general, the probability of obtaining employment decreases linearly with increase in age.

The nature of potential occupations and of employment prospects vary from region to region. It was therefore hypothesized that the level of occupational success might be related to the youngster's place of abode.

The classification schema adopted for place of abode was based on that used by the D.H.S.S. for the publication of statistics relating to the numbers of registered blind and partially sighted in England (D.H.S.S. 1980). The influence of place of abode was then considered in terms of a descriptive approach.

Owing to the differing numbers of youngsters within the various categories, it is not possible to obtain a precise indication of the effect of abode on the level of occupational success. Some insight can be obtained, however, from a comparison of the median and upper quartile values for each region and for the sample as a whole.

Forty-two of the 169 youngsters (24.9%) were drawn from the North Western region. The relatively large number of individuals from this region stemmed largely from the participation in the study of 4 schools from the Liverpool, Manchester and Preston areas. Fourteen of the 42 youngsters had an employment success index of between 0.9 and 1.0. The median value of occupational success for this group was 0.675 and the upper quartile 0.925. These findings thus compare favourably with those for the total sample (median 0.687; upper quartile 0.914).

An approximately equal number of youngsters were contained within each of two categories - the West Midlands (29 individuals) and the London North region (25 individuals). The level of occupational success appeared to be evenly distributed among the youngsters in the West Midland group. The median was 0.650 and the upper quartile 0.819. The distribution of success among the youngsters in the London North region, however, appeared to be skewed towards the higher levels of employment success. Eight of the 25 youngsters had an occupational success index of equal to or less than 0.3. In contrast, the level of success in 14 cases was equal to or better than 0.7. The median (0.725) and the upper quartile (0.911) reflect this general tendency. The results from the two groups suggest that, in general, the youngsters from the North Western region were slightly more successful than those from the West Midlands.

An approximately equal number of youngsters were contained in each of five categories; the Yorkshire/Humberside, East Midlands, London, Southern and South Western regions.

Five of the 17 youngsters from the Yorkshire/Humberside region had an index of equal to or less than 0.1. A further eight individuals were found to have a value of between 0.3 and 0.6. Indeed, the values for the median (0.450) and the upper quartile (0.592) reflect the poor level of occupational success amongst this group. In contrast, the leavers from the East Midlands appeared to have fared more favourably, 6 of the 13 youngsters having an employment success index of between 0.9 and 1.0. Indeed,this trend was demonstrated by the high values for both the median (0.850) and the upper quartile (0.946) which were also higher than those for the sample as a whole. A similar finding was also present for the leavers from the Southern and South Western groups. Eight of the 14 individuals from the Southern region had an occupational success index of between 0.8 and 1.0. The median was 0.833 and the upper quartile 0.930. Five of the 12 youngsters in the South Western group exhibited an index of greater than or equal to 0.9 with the median being 0.750 and the upper quartile 0.940.

The youngsters from the London group, however, were less successful in this respect. The distribution of occupational success was clearly bimodal in nature. Five of the youngsters had an index of equal to or less than 0.1 whilst four had a value of between 0.9 and 1.0. The median for this group was 0.350 and the upper quartile 0.931.

The range of occupational success among the groups is shown in Figs 15. 2 to 15. 9

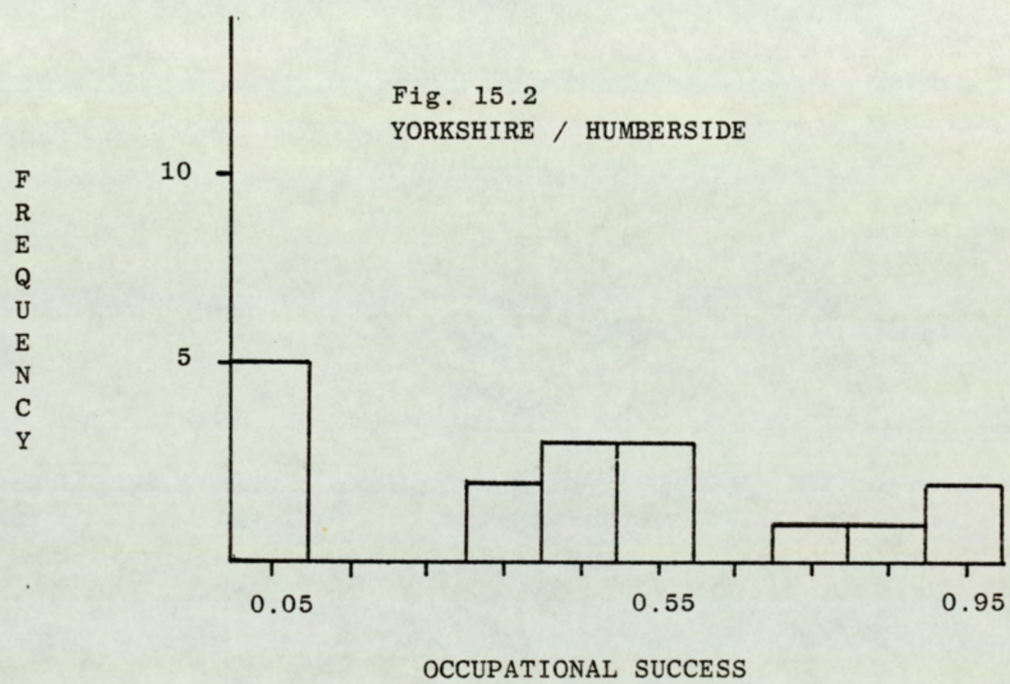
The number of youngsters in the four remaining groups, Northern Scotland, Wales and "other" were insufficient to permit analysis.

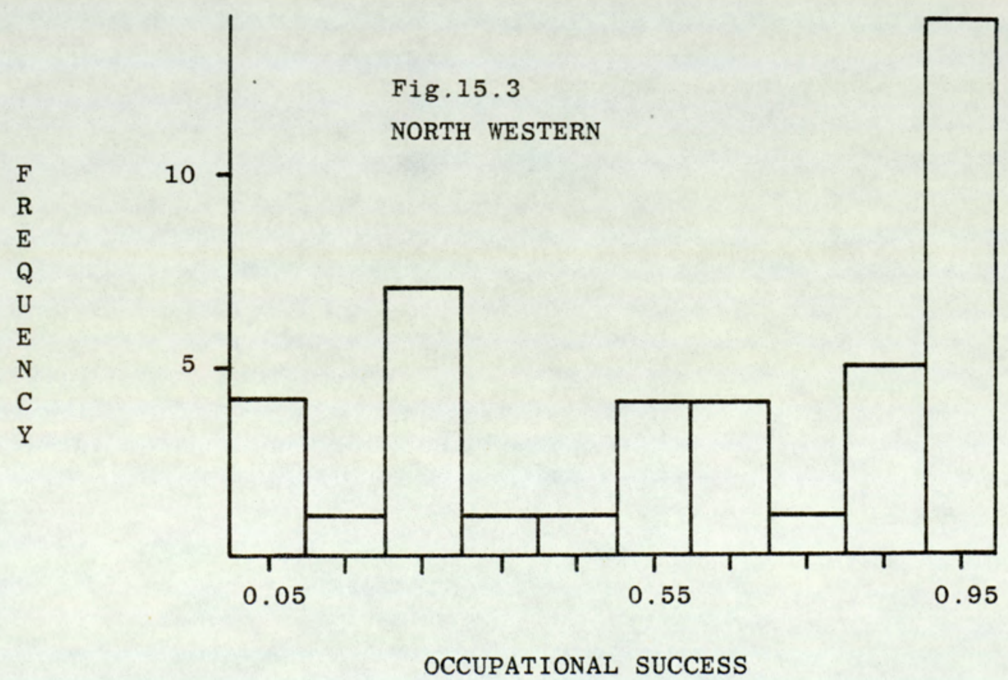
The type of special school attended was considered to be a factor influencing the subsequent level of occupational success.

Youngsters attending day special schools benefit from the special educational approach, but are also able to interact with the society outside of these confines. In contrast, youngsters from residential schools would appear to be denied this latter interaction on such a regular basis. The merits of special education, in general, have been discussed in Section 4. It was shown that some authors advocate special education for the partially sighted whilst others denigrate it.

The type of special school attended is largely dependent upon the residential locality of the youngster since the extent of the special educational provisions vary from region to region. Consequently, the regional distribution of the youngsters may be a causative factor in any association between the type of school and the level of occupational success. Indeed, of the 64 respondents

Fig. 15.2 - 15.9 Distribution of occupational success by region.





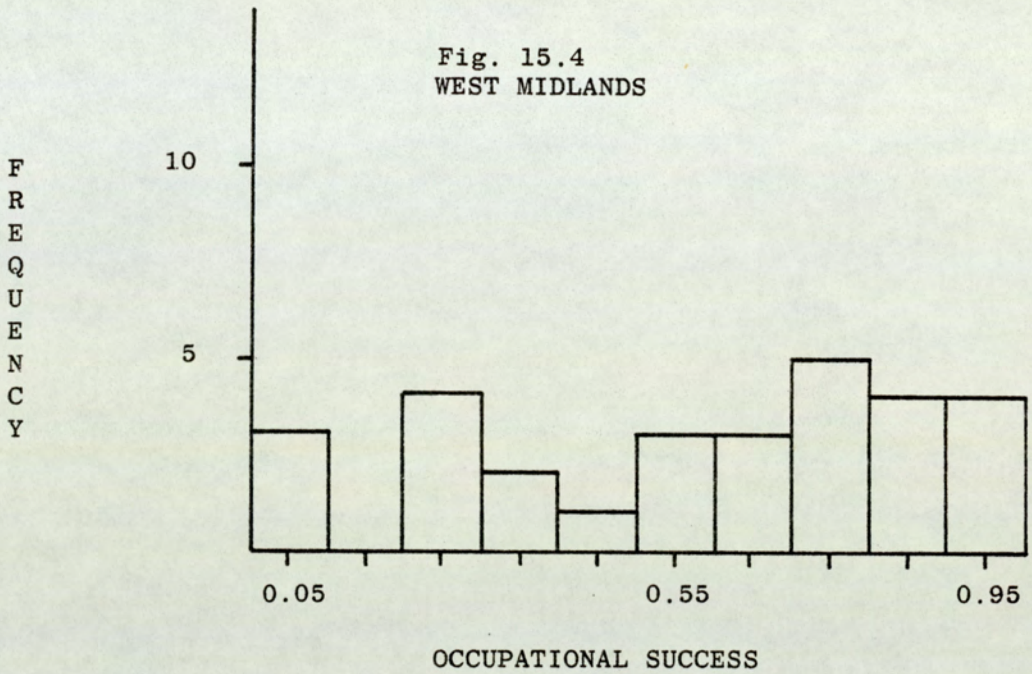


Fig. 15.4
WEST MIDLANDS
FREQUENCY
10
5
0.05
0.55
0.95
OCCUPATIONAL SUCCESS

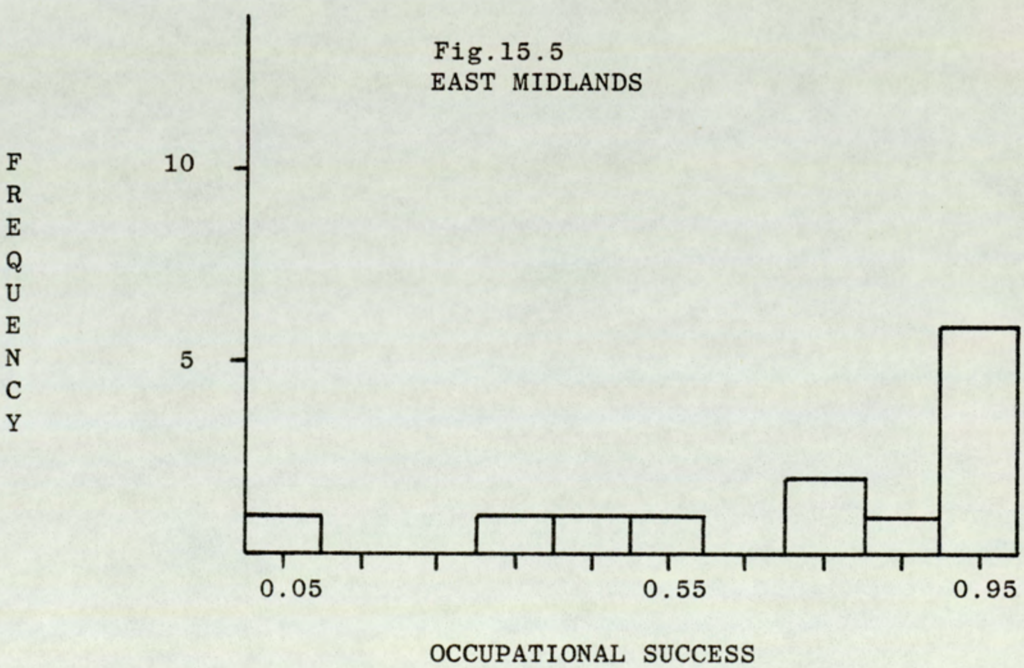


Fig.15.5
EAST MIDLANDS
FREQUENCY
10
5
0.05
0.55
0.95
OCCUPATIONAL SUCCESS

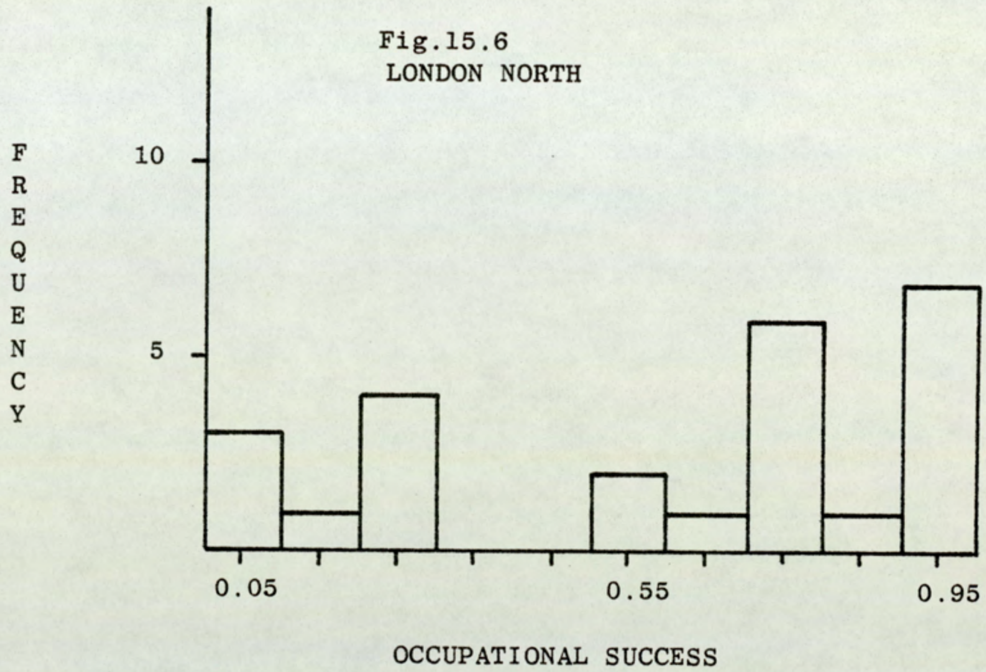


Fig.15.6
LONDON NORTH
FREQUENCY
10
5
0.05
0.55
0.95
OCCUPATIONAL SUCCESS

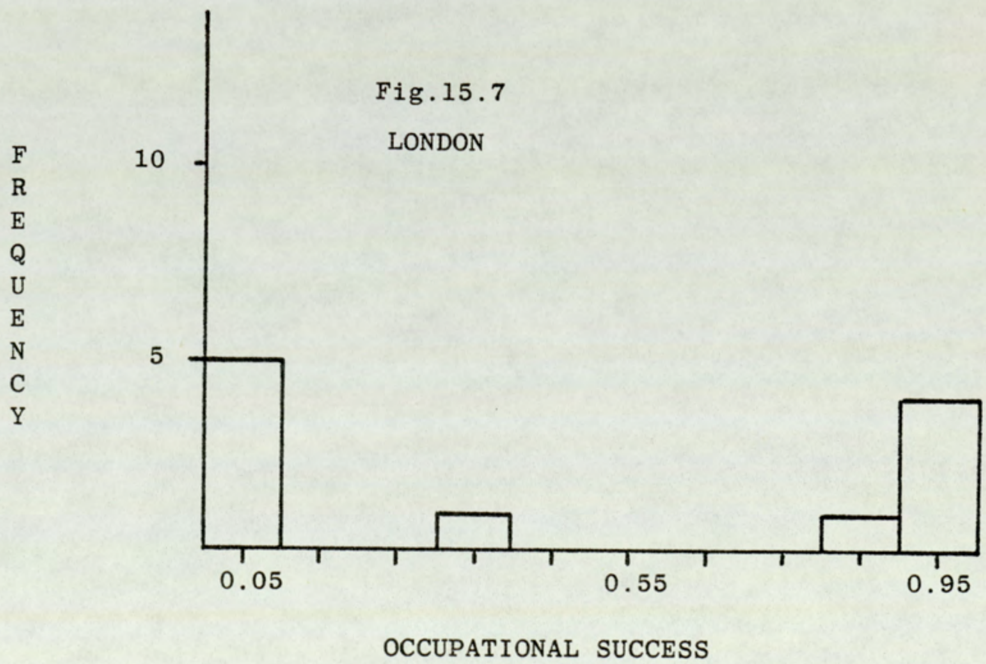


Fig.15.7
LONDON
FREQUENCY
10
5
0.05
0.55
0.95
OCCUPATIONAL SUCCESS

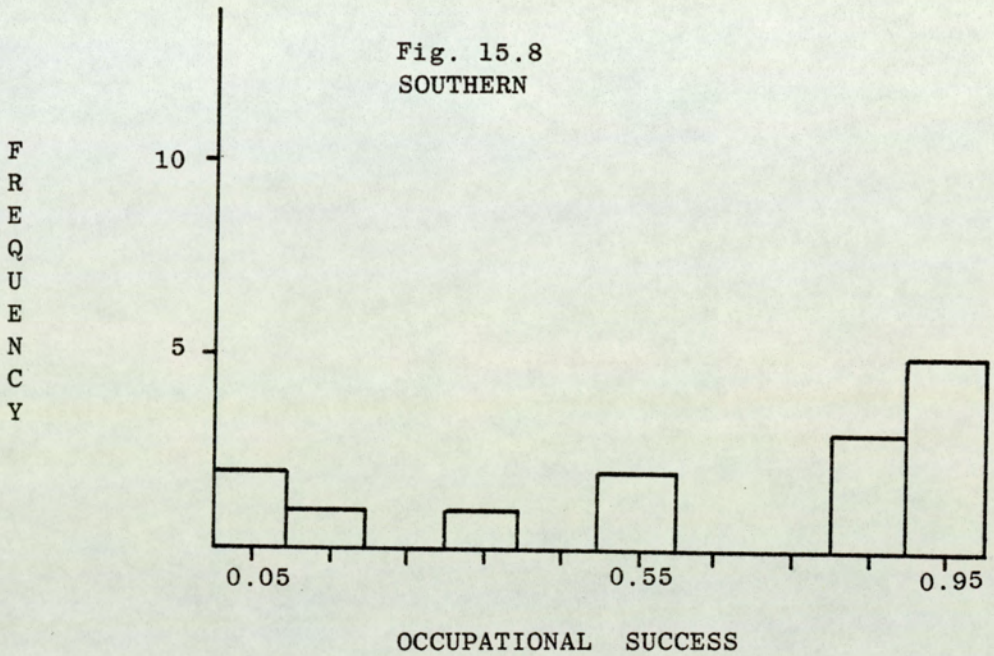


Fig. 15.8
SOUTHERN
FREQUENCY
10
5
0.05
0.55
0.95
OCCUPATIONAL SUCCESS

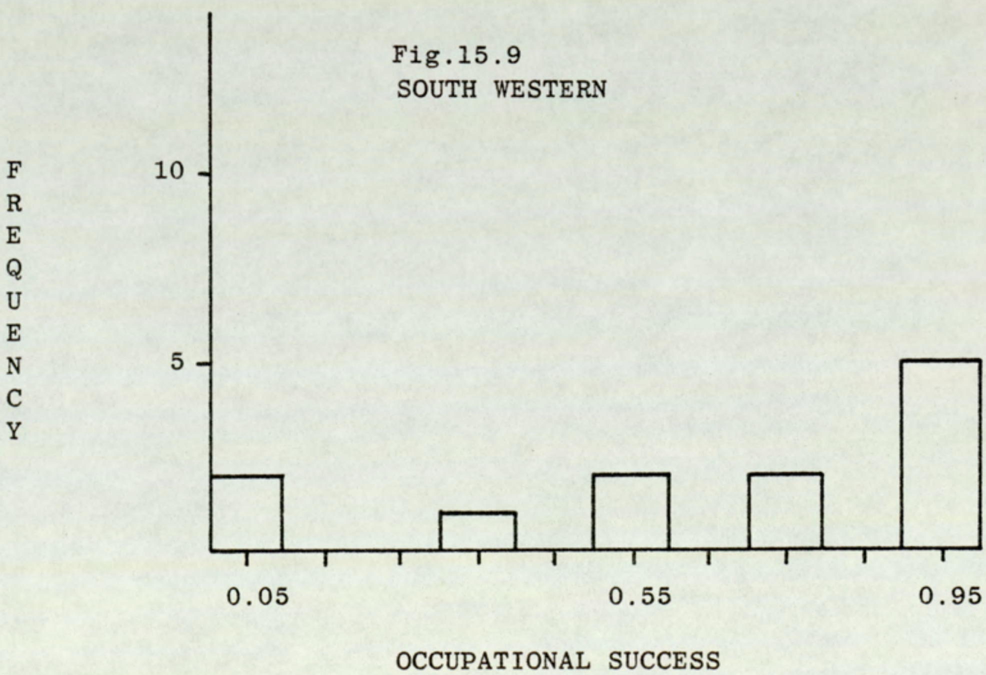


Fig.15.9
SOUTH WESTERN
FREQUENCY
10
5
0.05
0.55
0.95
OCCUPATIONAL SUCCESS

seeking employment on leaving school and who attended day schools, 34 were former pupils of schools in the London and Home Counties. It can also be argued that the inclusion of youngsters from the grammar stream of Exhall Grange School might bias any result in favour of the residential schools. Analysis of the schools attended by the individual youngster, however, shows that of the 35 respondents from the grammar stream of Exhall Grange, only 9 entered employment. Nevertheless, it must be pointed out that of the 104 youngsters who had previously attended residential schools and who were seeking employment, 50 were from Exhall Grange. The distribution of the former school attended by the youngsters seeking employment is given in Table 15.23.

The relationship between the type of special school attended and the level of occupational success was expressed in terms of the point biserial correlation coefficient r_{pb}. Day schools were allocated a score of one and boarding schools a score of zero. The value of r_{pb}, based on 168 youngsters was -0.140. The presence of the negative sign shows that the finding was in favour of the youngsters attending residential schools. Nevertheless, the result was not statistically significant (df = 166 $t = 1.822$ $p < 0.1$ indicating a lack of association between the type or school attended and the subsequent employment success.

The length of education received in schools for the visually handicapped was considered to be a factor influencing the level of occupational success. Discussions with teachers of the partially sighted, however, revealed a conflict of opinions regarding the nature of the relationship. Some teachers believed that a lengthy

DAY			RESIDENTIAL
George Auden	1	50	Exhall Grange
Joseph Clarke	18	16	St Vincents
Nansen	8	18	West of England
Temple Bank	13	13	Derby
John Aird	6	7	East Anglian
Holmrook	13		
Shawgrove	5		
Total	64	104	Total

Table 15.2 3 Former school attended by 168 of the 169 youngsters seeking employment on leaving school or training institute.

period of education in the closeted environment of a special school would have a detrimental effect on the level of occupational success whilst others believed that it would have the opposite effect.

The length of attendance was considered in terms of the total number of school terms, the figures being rounded up or down to the nearest complete term. The appropriate information on the length of schooling was obtained from the school records and from the data contained within the questionnaire (questions 1 and 2). The relationship between duration of schooling and occupational success was then expressed by the Pearson product moment correlation r (Runyon & Haber 1973).

Complete educational data was available in 150 of the 168 cases. Data on the remaining 18 youngsters was not available for a variety of reasons including incomplete school records and inadequate answers to the questions contained in the questionnaire. The value of r, based on the 150 youngsters, was found to be $r = 0.043$. This value was not statistically significant ($df = 148$, $t = 0.524$ $p < 0.302$). It was concluded that there was no linear relationship between the length or visually handicapped education and the level of occupational success.

It was hypothesized, following the semi-structured interviews, that the possession, quality and extent of academic qualifications might influence the level of occupational success. In addition, it was also suggested that the possession of qualifications was an important factor in overcoming the interview/job application "hurdle". Indeed, it was felt that qualifications not only represented a recognized measure of intellectual attainment to the potential employer, but also indicated, in the case of the partially sighted, an ability to carry out a task comparable with that of the normally sighted.

The data on qualifications was obtained from the responses to question 5 of the questionnaire. The qualifications were grouped according to the type and number of passes. No qualifications was ranked as 0, 1-4 C.S.E.'s as 1, 5+ C.S.E.'s as 2, 1-4 'O' levels as 3, 5+ 'O' levels as 5 and 'A' levels as 6. A C.S.E. grade one pass was considered to be equivalent to an 'O' level pass. Spearman's r_s and Kendal's τ correlation coefficients (Siegel 1956) were then calculated between the highest ranked qualification of each individual and the corresponding level of occupational success.

The two correlations were based on 151 of the 169 youngsters in employment. The question on qualifications was not answered in 11 of the cases and the responses from the twelfth youngster were insufficient to calculate a measure of occupational success. The value of Spearman's r_s was 0.213 and this was statistically significant ($df = 155$, $t = 2.714$, $p < 0.004$). The corresponding value of Kendal's τ, $\tau = 0.158$, was also statistically significant ($z = 2.936$, $p < 0.005$). The difference in the magnitude of the two correlation coefficients is due to the fact that the two measures have different underlying scales and are not numerically directly comparable to each other (Siegel 1956). The results of the analysis thus showed that there was a small, but statistically significant, linear relationship between the level of academic qualifications and the degree of occupational success. It is possible, however, that intelligence could be the factor influencing the correlation.

The possession of qualifications has also been found to be of importance for normally sighted youngsters. Colledge (1977) reviewed two employment surveys of 16-19 year olds carried out for the Manpower Services Commission in 1976 and 1977. She concluded that there was a strong relationship for this age group between lack of qualifications and the frequency and length of time in unemployment.

The results of a survey of 34,204 normally sighted 16 year old school leavers entering employment in 1978 (Anon 1980), showed that nearly 40% of the youngsters had reached G.C.E. 'O' level or equivalent in at least one subject. In contrast, the findings for the current study show that only 20 of the 157 youngsters (12.7%) had reached this standard. The distribution of qualifications among the sample is given in Table 15.24. A comparison of the findings from the two studies must be treated with caution due to the differences in sample size. Nevertheless, the results would seem to suggest that partially sighted school leavers are less well qualified than their normally sighted peers. Indeed, this finding would appear to underline the importance for the partially sighted of possessing academic qualifications.

Level of qualification	Number of youngsters	%
None	40	23.8
1 - 4 C.S.E.'s	50	29.8
5+ C.S.E.'s	47	28.0
1 - 4 'O' levels	12	7.1
5+ 'O' levels	6	3.6
'A' level +	2	1.2
Unknown	11	6.5
Total	168	

Table 15.24 Level of qualification possessed by 168 of the 169 youngsters in employment

It was hypothesized, as a result of the semi-structured interviews, that the degree of occupational success would increase linearly with increase in the level of achievement motivation. The desire to achieve was measured with the Edwards Personal Preference Schedule (Edwards 1959) and also by the scale developed by Lynn (1969).

The correct responses to the Edwards Scale were summed together and the relationship between occupational success and the number of correct answers expressed in terms of the Pearson product moment correlation r.

The value of r was based on 166 of the 169 respondents in employment. Two of the remaining three youngsters had failed to complete the requisit questions in the questionnaire whilst the other had not given sufficient information to permit an evaluation of occupational success. The value of the correlation was $r = -0.111$. The presence of a negative sign in the correlation indicates, however, that the degree of occupational success increased with decrease in the level of achievement motivation. This finding was thus contrary to that expressed in the original hypothesis, but in any event, the value of the correlation was not statistically significant ($t = -1.43$, $df = 166, p < 0.1$.

A similar analysis was carried out for the Lynn Scale. The number of correct responses from the individual questions forming the scale were summed and the relationship between the degree of achievement motivation and the level of occupational success analysed in terms of the Pearson r. The data was based on information available from 54 of 169 respondents in employment. The reduced sample size was due to the fact that the Lynn Scale had only been administered to youngsters in the second and third academic years. The value of r, calculated for the 54 youngsters, was $r = -0.136$, and was not statistically significantly different from zero ($t = -0.999$, $df = 52$, $p < 0.162$). The presence of the negative sign for this second achievement scale is thus in accord with that for the Edwards Scale.

It was concluded that there was no linear relationship between achievement motivation, measured by the Edwards and Lynn Scales, and the level of occupational success.

The results of the semi-structured interviews had suggested that those individuals possessing the drive to overcome the hypothesized interview/job application hurdle were more likely to exhibit a high level of occupational success. As a result, it was hypothesized that the occupational success index would increase with increase in internal (decrease in external) Locus of Control (Section 12). It was shown previously that some youngsters completed the full Rotter Scale of 25 questions during their final term of schooling, whilst others answered a reduced scale of 13 questions within the questionnaire. It was decided that the most suitable approach, would be to analyse the Rotter Scale for all the youngsters in terms of the responses to the 13 questions. It was felt that, in this way, the resulting correlation with occupational success would be based on the maximum number of youngsters.

The responses to the Rotter Scale (questions 47, 54, 55, 57, 59, 60, 64, 65, 70 and 72) were scored in terms of external belief. These responses were then summed and the relationship between the number of external scores and the occupational index expressed in terms of the Pearson r. The results for the correlation were based on data available for 167 of the 169 respondents in employment. One youngster did not answer the questions contained in the questionnaire, whilst the other respondent did not provide sufficient information for the evaluation of occupational success.

The value of r for the 167 youngsters was found to be -0.04. This value was not significantly different from zero (df = 165, t = 0.467, $p < 0.3$). It was concluded that there was no linear relationship between locus of control and occupational success.

The scales used in the study to measure both achievement motivation and locus of control were designed for use among the normally sighted. It is possible, therefore, that the scales were not in fact assessing the intended variables. This factor may thus account for the lack of an apparent correlation between these variables and occupational success.

It was hypothesized as a result of the semi-structured interviews that youngsters with a positive attitude towards their impairment would exhibit a higher level of occupational success. Consequently, four questions were devised to assess various aspects of this particular hypothesis. These questions required either a "Yes" or a "No" response. The relationship between the response to each individual question and the level of occupational success was expressed in terms of the point biserial correlation coefficient. A response of "Yes" was scored as 1 and that of "No" as 0.

A correlation of $r_{pb} = -0.233$ was obtained for the question "Would you describe yourself as a handicapped person?" The value, based on 161 respondents and statistically significant at the $p < 0.001$ level (df = 159, t = -3.02) indicated an association between this topic and employment success. The presence of the negative sign indicated that the correlation was in favour of those who did not consider themselves to be handicapped.

A smaller corelation, $r_{pb} = -0.196$ was found for a related question "Does your visual problem prevent you from leading a normal life?" This value was also statistically significant (df = 163 $t = -2.552$, $p < 0.006$) and discriminating in favour of those who felt that their impairment did not inhibit their lifestyle.

Non-significant correlations approximating to zero were obtained for the two remaining questions "Do you ignore your visual problem?" and "Does your visual problem restrict your life in any way?" The correlations from the four questions are listed in Table 15.25.

It was also hypothesized that the ability to adapt to the normally sighted environment was a factor influencing the level of occupational success. Consequently six questions were included in the questionnaire to test this hypothesis. The relationship between the response to the particular question and the employment success index was again expressed in terms of the point biserial correlation coefficient.

Analysis showed that the response to only one of the six questions was significantly associated with the employment success index. A correlation of $r_{pb} = -0.235$ (df = 162 $t = 3.077$ $p < 0.001$) was obtained to the question "Do you think it is up to the normally sighted person to make an effort to understand partial sight?" The correlation discriminated in favour of those respondents who answered in the negative to this question. The correlations for each of the remaining 5 questions all approximated to zero. (Table 15.26)

The findings from the semi-structured interviews had also suggested that youngsters possessing the capacity to make a realistic self appraisal of job capability might exhibit an enhanced level of occupational success. Six questions were consequently included in

Question	No. of Youngsters	r_{pb}	Significance level
Does your visual problem prevent you from leading a normal life?	165	-0.196	$p < 0.006$
Do you ignore your visual problem?	164	-0.097	N.S.
Would you describe yourself as a handicapped person ?	161	-0.233	$p < 0.001$
Does your visual problem restrict your life in anyway ?	161	-0.33	N.S.

Table 15 .25. Point biserial correlations between occupational success and the response to each of four questions concerning the youngsters attitude to visual impairment.

	No. of Youngsters	r_{pb}	Significance level
In order to succeed in life is it necessary to make normally sighted people understand your problem ?	161	-0.066	N.S.
Do you think it is up to the normally sighted person to make an effort to understand partial sight?	164	-0.235	$p < 0.001$
Have you had to change your way of life in order to be accepted by normally seeing people ?	165	-0.012	N.S.
Do you think that the normally sighted world understands partial sight ?	164	0.074	N.S.
Do you tell as few people as possible that you have a visual problem ?	164	+0.042	N.S.
When with normally sighted people do you pretend not to have a visual problem ?	165	+0.070	N.S.

Table 15.26. Point biserial correlations between occupational success and the response to each of six questions concerning adaptation to the sighted world.

the questionnaire to test this hypothesis. Analysis was undertaken using the point biserial correlation. The results of the analysis, however, showed that all 7 correlations were not statistically significantly different from zero. (Table 15.27).

Three questions were included in the questionnaire to ascertain the attitude and performance of the youngsters at the job interview situation. In particular, the questions were designed to investigate the youngster's handling of the visual issues. The results showed that none of the topics contained in these questions was significantly associated with occupational success. The values for each of the correlations are given in Table 15. 28.

Two hypotheses were examined at the suggestion of the D.H.S.S. It was hypothesized that occupational success would be related to the level of family encouragement. The relationship between the employment success index and the response to the question "Did/Does your family encourage you to find a job?" was expressed in terms of the point biserial correlation r_{pb}. The value of r_{pb}, based on the responses from 115 youngsters, approximated to zero and was not statistically significant (r_{pb} = -0.026, df = 113, t = 0.276 $p < 0.1$.

Questions	No. of Youngsters	r_{pb}	Significance level
Do you ever apply for a job without first thinking whether you can do the job ?	136	-0.080	N.S.
Does your visual problem restrict the type of jobs you apply for ?	131	0.080	N.S.
Before applying for a job, do you discuss with anyone your ability to do the job ?	134	-0.046	N.S.
Do you only apply for a particular type of job ?	134	0.083	N.S.
Do you consider your visual problem when you apply for a job ?	133	0.033	N.S.
Do you consider your ability to do the job before you apply for it ?	135	-0.125	N.S.
When applying for a job, do you consider whether you might have any problems if you get the job ?	135	-0.135	N.S.

Table 15.27. Point biserial correlations between occupational success and the response to each of seven questions concerned with self appraisal of visual handicap.

Question	No. of Youngsters	r_{pb}	Significance level	
At interviews for a job, do you tell the interviewer that you have a visual problem ?	131	-0.083	1.269	N.S.
When being interviewed for a job, do you generally tell the interviewer that you are partially sighted ?	126	0.008	1.861	N.S.
At interviews, do you explain to your interviewer just how much you can see ?	128	-0.043	0.448	N.S.

Table 15.28 Point biserial correlations between occupational success and the response to each of three questions concerning the youngsters' performance at job interview.

It was additionally hypothesized that youngsters with an unemployed relative would exhibit a decreased level of occupational success. This topic was examined by the question "Is anyone in your family unable to get a job?" The relationship between the occupational success index and the response to this question was expressed in terms of the point biserial r_{pb}. The value of the correlation, based on 116 youngsters, was statistically significant ($r_{pb} = 0.199$, df = 114, $t = -2.168$ $p<0.05$). The result indicated that youngsters with an unemployed relative, in general, did less well in employment than those who came from a background of full employment. This finding is in accord with the results from a survey of 550 unemployed 16-18 year olds, carried out in 1977 under the auspices of the Manpower Services Commission. The survey showed that 14% of the youngsters had fathers who were unemployed, 21% had a brother or sister unemployed, and 19% came from a household where no-one was in full time work.

It was hypothesized at the outset of the study that the nature of the primary ocular disorder might affect the level of occupational success.

Information on the type of ocular disorder was obtained primarily from form B.D.8 and from the youngsters' ophthalmological records. In the case of youngsters taking part in the visual ability experimental work, this information was augmented by results from the ocular examination. The classification of ocular disorder was based upon the system adopted by the International Association for the Prevention of Blindness (Anon 1964) and on the work of Fraser & Friedmann 1967; Fine 1968; Schappert-Kimmijser, Colenbrander & Franken 1968; Sorsby 1972; and Schappert-Kimmmijser, Hansen, Haustrate-Gosset, Lindstedt, Skydsgaard & Warburg 1975.

The relationship between ocular disorder and the employment success index cannot be easily represented in terms of a statistical coefficient. Consequently, it was felt that the most suitable approach would be to adopt a descriptive technique illustrating the distribution of occupational success among each particular disorder.

It was, however, recognised that the validity of any conclusion from such an approach would be dependant upon the numbers of youngsters within the various categories.

The ocular diagnosis was available in the record cards of 159 of the 169 respondents involved in employment. One of the youngsters, however, who was suffering from bilateral macular dystrophy, failed to provide sufficient information for the calculation of occupational success. The nature of the ocular disorder was not contained in the available records of the 10 remaining cases.

The range of disorders covered 22 categories. The distribution of youngsters within the various categories is shown in Table 15.29

Four groups, congenital nystagmus, albinism, myopia and surgical aphakia, each contained 20 or more individuals, and two disorders, macular dystrophy and secondary optic atrophy accounted for 11 and 12 youngsters respectively. The remaining 16 categories, however, each contained 5 or less youngsters. Consequently, the lack of numbers within the various categories limited the analysis to an investigation of these six disorders.

The distribution of occupational success among the 6 disorders is shown in Figs. 15.10 to 15.15. It was decided to describe the shape of each distribution in terms of the median and the upper quartiles.

Fourteen of the 24 youngsters (58.3%) with high myopia had an occupational success index ranging from 0.8 to 1.0. In contrast, only

Disorder	No. of Youngsters
Myopia	24
Albinism	22
Buphthalmos	4
Microphthalmos	4
Aniridia	5
Coloboma	2
Cataract in situ	5
Surgical aphakia	27
Dislocated lens	4
Still's Disease	2
Chorioretinitis/Choroiditis	1
Retinopathy & Lesions of retinal vessels	1
Primary detachment	2
Tapeto-retinal dystrophy & allied conditions	4
Macular dystrophy/degeneration	11
Total achromatopsia	1
Other disorder of the retina	1
Hereditary & primary optic atrophy	5
Other optic atrophy including secondary atrophy	11
Non classifiable optic atrophy	4
Other disorder	1
Nystagmus	20
Missing data	7
Total	168

Table 15.29 Primary ocular disorder among 168 of the 169 youngsters seeking employment on leaving school or training institute.

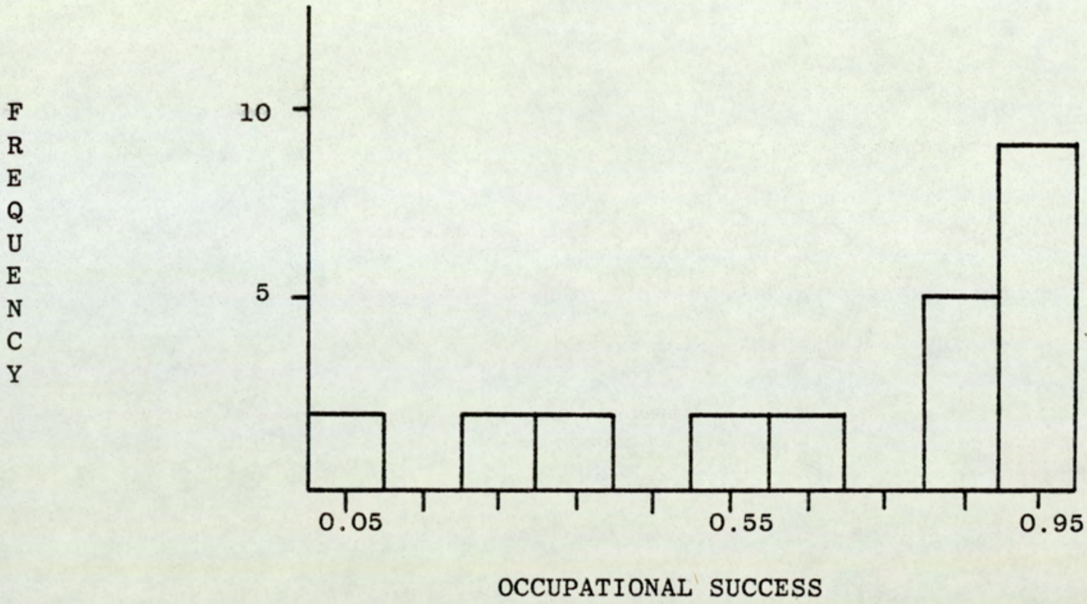


Fig. 15.10 Distribution of occupational success amongst 24 youngsters with high myopia.

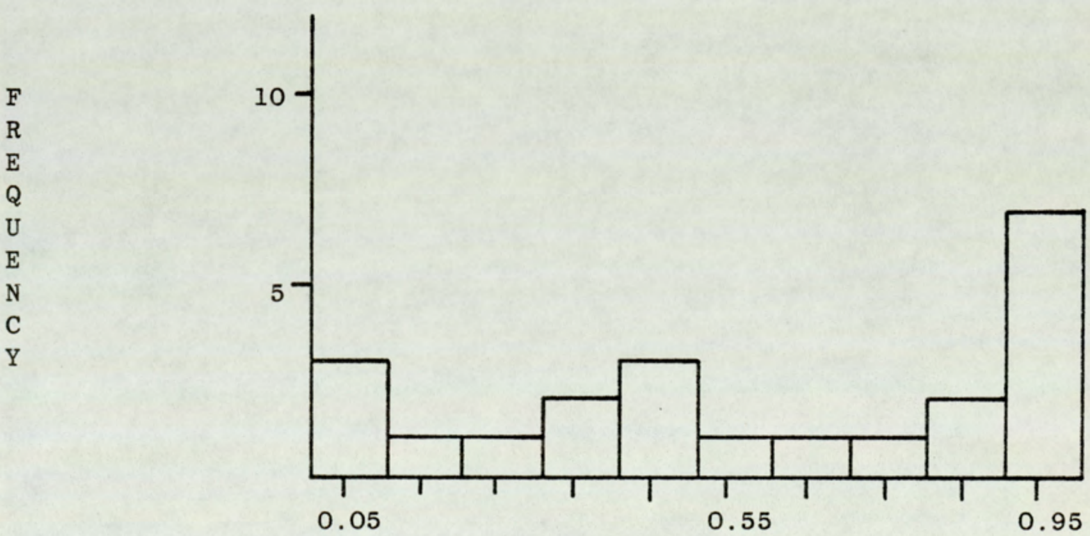


Fig. 15.11 Distribution of occupational success amongst 22 youngsters with albinism.

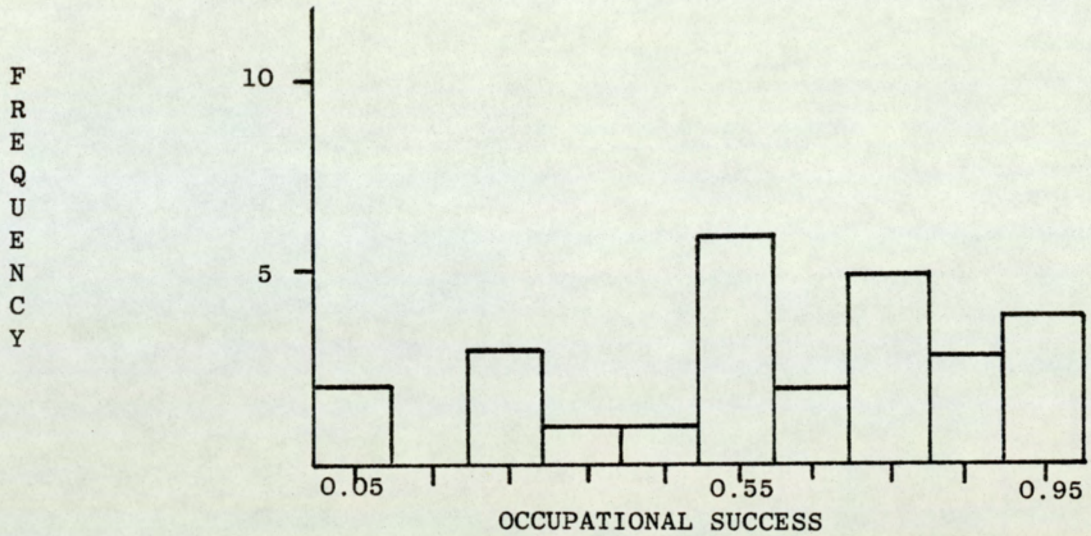


Fig. 15.12 Distribution of occupational success amongst 27 youngsters with surgical aphakia.

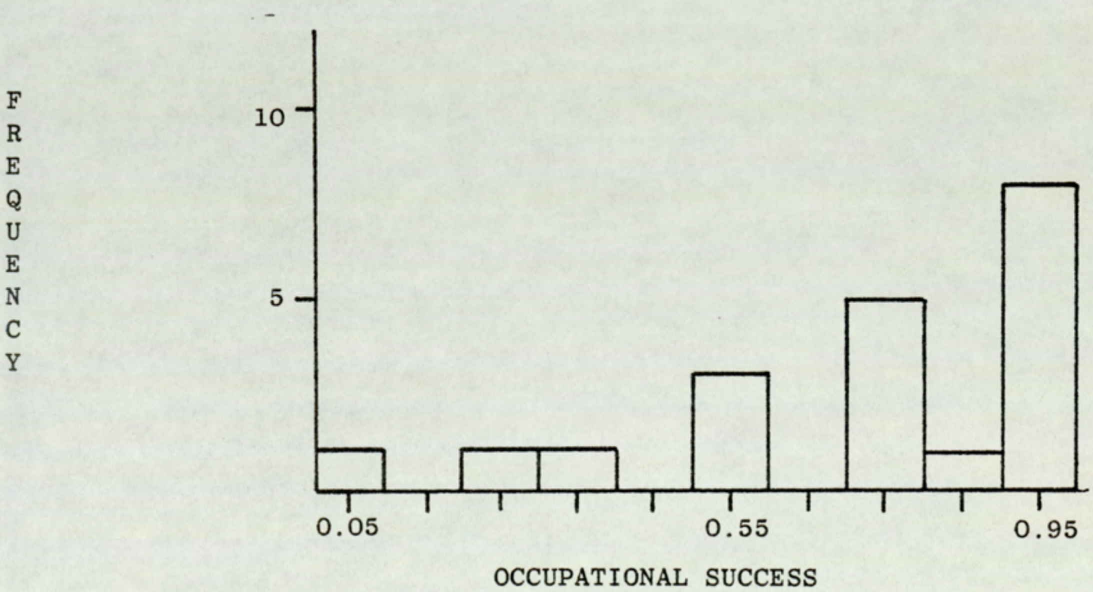


Fig. 15.13 Distribution of occupational success amongst 20 youngsters with congenital idiopathic nystagmus.

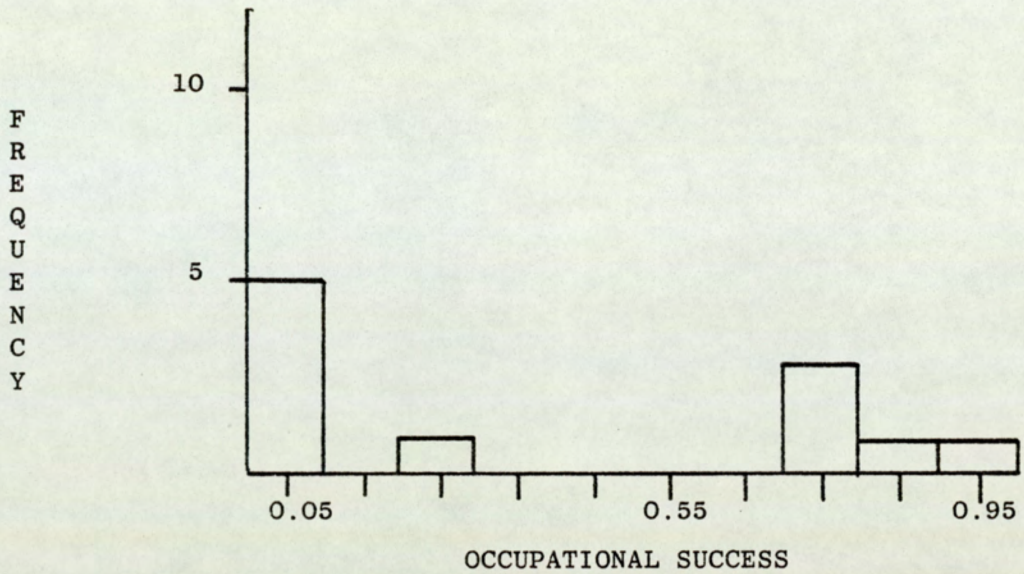


Fig.15.14 Distribution of occupational success amongst 11 youngsters with secondary optic atrophy.

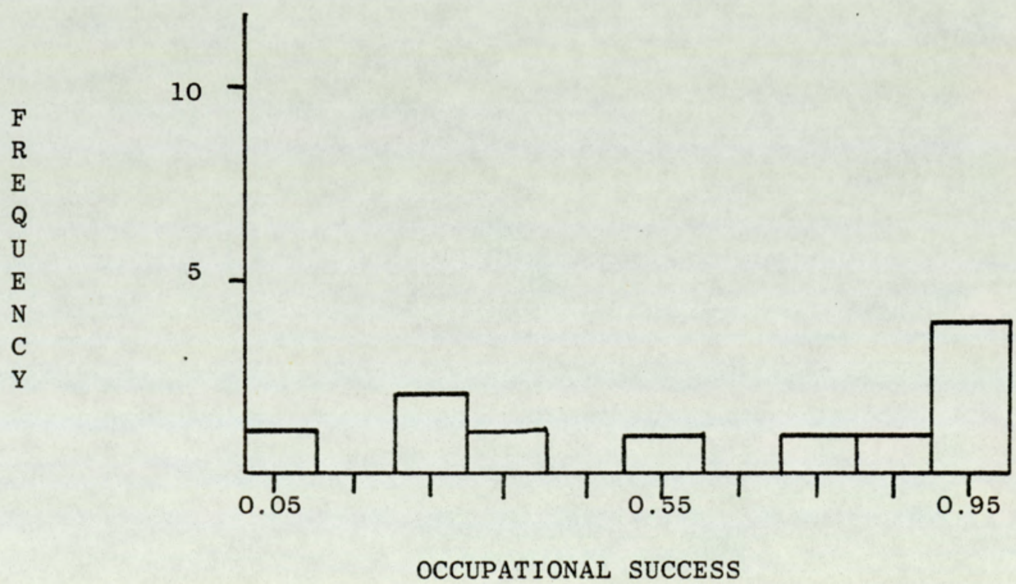


Fig. 15.15 Distribution of occupational success amongst 11 youngsters with macular degeneration/dystrophy.

two youngsters had an index of 0.1 or less. The value of the median was 0.84 and that of the upper quartile 0.93.

Nine of the 22 albinos (40.9%) also possessed an occupational success of between 0.8 and 1.0. Three youngsters had a score of 0.1 or less. The median value of occupational success was 0.600 and the upper quartile 0.921.

Approximately one-quarter of the 27 youngsters with surgical aphakia had an employment success ranging from 0.8 to 0.9. Almost half of these youngsters had scores between 0.5 and 0.8. Indeed, only two individuals had a value of less than 0.1. The median was 0.625 and the upper quartile 0.808.

Nine of the twenty youngsters with congenital idiopathic nystagmus had an occupational success of between 0.8 and 1.0. Indeed, 8 of these 9 individuals had scores greater than 0.90. Only one youngster had a score of less than 0.1. The value of the median was 0.78 and that of the upper quartile 0.937.

The distribution of the scores for the youngsters with secondary optic atrophy appeared to follow a bi-modal tendency. Five of the 11 youngsters had a score of less than 0.1 and seven a score of greater than 0.7. The median and upper quartile reflect this trend, being 0.25 and 0.775 respectively.

In contrast, 5 of the 11 youngsters classified as having macular dystrophy/degeneration had scores of between 0.8 and 1.0. One youngster had a score of less than 0.1. The median was 0.75 and that of the upper quartile 0.931.

The values of the median and upper quartile for each of the 6 disorders and for the 168 youngsters as a whole are given in Table 15.30.

It would appear that the distribution of occupational success in three of the disorders, high myopia, albinism and congenital idiopathic nystagmus is negatively skewed. This finding suggests that youngsters

Disorder	Median	Upper Quartile
High myopia	0.840	0.933
Albinism	0.600	0.921
Aphakia	0.625	0.808
Congenital Nystagmus	0.78	0.937
Optic Atrophy	0.25	0.775
Macular degeneration/ dystrophy	0.75	0.931
Total sample of 168 youngsters	0.687	0.914

Table 15.30 Comparison of median and upper quartile values of occupational success amongst 6 primary ocular disorders.

with one of these three conditions are relatively successful in obtaining and holding down employment. In contrast, the distribution of occupational success amongst those with surgical aphakia seems to follow a normal distribution. The results also imply that ,in general, youngsters with high myopia, were more successful than those with congenital idiopathic nystagmus who, in turn, were slightly more successful than the albinos. The youngsters with surgical aphakia were the least successful of the four groups. A comparison of the results with those obtained for the sample as a whole, shows that individuals with high myopia or congenital idiopathic nystagmus, in general, exhibit an above average level of occupational success.

Although the sample size of youngsters with macular dystrophy/ degeneration is approximately half that of the previous 4 groups, the distribution of occupational success also has the appearance of being negatively skewed. In contrast, the distribution for those with secondary optic atrophy appears to be distinctly bimodal; some youngsters exhibiting an enhanced degree of success and others a poor level.

The findings for the three groups, albinism, congenital nystagmus and high myopia, are perhaps, in retrospect, not surprising. Individuals with albinism and congenital idiopathic nystagmus frequently exhibit an enhanced level of near vision compared to that at distance. In addition, as Siegel (1976) points out, tyrosinase - positive albino's usually obtain a distance visual acuity of between $\frac{20}{30}$ and $\frac{20}{200}$. Marked field loss is usually absent in these two conditions and vision can frequently be improved by reducing the amplitude of the nystagmus with an appropriate direction of gaze or head posture. The clinical characteristics of albinism have been discussed in more detail by

Siegel 1976; Taylor 1978 and Francois 1980. Youngsters with high myopia can frequently exhibit a good distance visual acuity and by removal of spectacles can often achieve an excellent level of near vision.

It was suggested that, with the factor of potentially good near vision common to these three groups, the youngsters might have entered occupations primarily involving close work. Analysis of the employments undertaken by the three groups of youngsters, however, revealed little evidence of this trend.

It was hypothesized at the outset of the study that occupational success would be related to distance visual acuity.

The conventional distance acuity data for the study was derived in two distinct ways. The acuity was determined firstly as part of the visual ability investigations (Section 8) and secondly from the last entry in the existing ophthalmic records of the youngsters. It was acknowledged that the data obtained by this latter approach would be subject to considerable error variance in that the acuity would have been recorded by various clinicians using differing types of test chart over variable periods of time. Nevertheless, this procedure was felt to be justified on the grounds that it provided some indication of the acuities of those youngsters who had not taken part in the visual ability research.

The distance acuity data obtained by these two methods was transposed into Snellen decimal form by the process of linear interpolation adopted in Section 8. The relationship between occupational success and each measure of distance acuity was then expressed in terms of the non-parametric correlation coefficients Spearman's r_s and Kendal's tau. The correlations for the research measurements were based on the binocular evaluation of acuity whilst those for the record card data were calculated from the best eye acuity.

The correlations for the acuity measurement, carried out on the sample of Exhall Grange youngsters from the 1976/77 academic year, (Section 8) were $r_s = 0.164$ and $\tau = 0.125$. The results, based on 14 individuals were not significantly different from zero ($r_s = 0.164$, $df = 12$, $t = 0.576$, $p < 0.288$; $\tau = 0.125$, $z = 0.623$, $p < 0.268$). The corresponding values for the major study of distance acuity which involved youngsters from the 1977/78 and 1978/79 academic years were $r_s = 0.058$, and $\tau = 0.041$. The values, based on 71 individuals, approximated to zero and were not statistically significant ($r_s = 0.058$ $df = 69$, $t = 0.483$, $p < 0.315$: $\tau = 0.041$, $z = 0.715$, $p < 0.313$.

The results thus indicated that there was no linear relationship between occupational success and the measure of distance acuity obtained in the visual ability research.

A similar analysis was carried out for the distance acuity data extracted from the ophthalmological records of the youngsters. The corresponding correlations, based on 152 youngsters, were $r_s = 0.195$ ($df = 149$, $t = 2.44$, $p < 0.008$) and $\tau = 0.144$ ($df = 149$, $z = 2.64$, $p < 0.006$).

These values thus indicated the presence of a small but statistically significant linear association between the record card distance acuity and the level of occupational success.

Clearly, the two sets of results are in direct contradiction to each other. The reason for this discrepancy is not clear. It could be argued, for example, that the research measurement might reasonably be expected to possess less variance and therefore present a more reliable indication of any association between distance acuity and occupational success. In contrast, the level of statistical significance associated with the correlations for the record card data cannot be ignored.

From a statistical point of view, the discrepancy between the correlations suggested that the two measurement systems were in fact assessing two separate and distinct visual functions. The Spearman and Kendall correlations between the two sets of data for both the 14 and 64 of the 71 youngsters were, however, large and highly significant. This result thus indicated that the two sets of data were providing measurements of the same function, i.e. Snellen acuity. The values of the correlations are given in Table 15.31 Further analysis with the Sign Test (Siegel 1956) showed that in both cases, the record card acuities were significantly higher (i.e. better) than those obtained during the visual ability work ($p < 0.022$ and $p < 0.003$ respectively).

It was also hypothesized that the occupational success might be related to near acuity. The data on conventional near acuity was obtained as part of the visual ability work (Section 8); an assessment of both reduced Snellen and continuous prose acuity was carried out at 35 cm.

It was decided not to use the measure of near acuity taken from the ophthalmological records of the youngsters. It was felt that this data, in addition to possessing the limitations associated with the distance measurement, contained a further source of potential error in that there was no way of ascertaining the viewing distance adopted in each case. It is known that near acuity is influenced by viewing distance. Hence the record card

Number of Youngsters	Correlation	df	t	z	Significance level
14	$r_s = 0.832$	12		-	$p < 0.001$
14	$\tau = 0.727$	-	-	0	$p < 0.001$
64	$r_s = 0.807$	62		-	$p < 0.001$
64	$\tau = 0.682$		-	0	$p < 0.001$

Table 15.31 Summary of the correlation between occupational success and the various measures of distance visual acuity.

data must be regarded as suspect. The reduced Snellen data obtained during the study at a fixed distance of 35 cm. was transformed into decimal format, partial scores being converted by the process of linear interpolation. Acuity levels of less than 6/60, but greater than perception of light were alloted an artibrary value of -66 and that of light perception a value of -77. The association between the level of occupational success and the continuous prose acuity was also expressed in terms of the Spearman and Kendall correlation coefficients. Acuities of less than N48, but greater than perception of light were allotted an arbitrary score of 66.

The correlations for the reduced Snellen acuity pilot investigation ($r_s = 0.082$, $df = 12$, $t = 0.308$, $p < 0.390$; $\tau = 0.068$, $z = 0.339$ $p < 0.370$) and the major study ($r_s = 0.056$, $df = 70$ $t = 0.469$, $p < 0.321$; $\tau = 0.037$ $z = 0.460$, $p < 0.333$) were not statistically signficant. The values for the Times Roman acuity were also not significant ($r_s = -0.060$, $df = 71$, $t = 0.506$, $p < 0.309$; $\tau = -0.041$, $z = 0.513$, $p < 0.312$). The presence of the minus sign for these latter two correlations was in accord with the computer coding which had allocated high values for poor acuities The results thus indicated that there was no linear association between occupational success and the level of reduced Snellen or continuous prose acuities obtained at a viewing distance of 35 cm.

It was also hypothesized that occupational success might be related to acuity determined by the modified techniques (Section 8).

Ten of the 24 youngsters examined with the modified distance acuity test sought employment on leaving school. The relationship between the level of occupational success and the modified distance acuity score was expressed in terms of the Pearson correlation coefficient r. The value of r, based on these 10 youngsters, was however, not statistically significant ($r = 0.487$; $df = 8$, $t = 1.577$).

Unfortunately, of the 10 youngsters examined with the modified near acuity task, none had sought employment. The relationship between occupational success and this near acuity task cannot thus be ascertained.

The relationship between occupational success and the integrity of the visual field was also investigated.

A measure of the peripheral field (Section 9) had been obtained for of the 169 respondents who had sought employment on leaving school. Of these youngsters, only 8 had been found to have a bilateral field defect to the stimulus combination V3. Clearly this number of youngsters is insufficient to form any definite conclusions. Nevertheless, it is interesting to note that 5 of the 8 youngsters exhibited a level of occupational success well below the median value of 0.687 based on the 168 youngsters as a whole. Indeed, two subjects exhibited very poor levels of occupational success, the index being zero for subject M.M. and 0.042 for subject G.R. The former individual had a concentric contraction of approximately in one eye and a defect occupying 3 of the 4 quadrants in the other eye. Subject G.R. had remaining concentric fields of in each eye. A similar concentric contraction of approximately in each eye was found in youngster C.B. who had an employment success index of 0.308. A poor level of occupational success (0.2777) was also noted in the case of subject S.R. who had a right sided bilateral paracentral scotoma.

In contrast, 3 youngsters (subjects G.D., S.P., and M.S.) showed a high level of success. The most successful of these was M.S., totally blind in one eye and with a concentric contraction in the other, who had an employment success index of 0.944. Subject S.P., with a bilateral nasal hemianopia secondary to an intra cranial lesion, was also relatively successful in this respect, the index being 0.867. A similar level of success was also achieved by G.D. who was found to have a para central ring scotoma in each eye. The remaining youngster, subject A.D., with a concentric contraction in each eye, had an index of 0.556.

A measure of the central fields had been obtained on of the 168 respondents who had sought employment on leaving school. Of these, only 5 had shown bilateral central field defects. Indeed, in 4 of these 5 cases, the field loss had been detected when carrying out investigation of the peripheral field (subjects S.R., S.N., G.R., and M.S.). The remaining youngster, subject D.S., had an occupational success index of 0.222 and field loss in quadrant III of the right eye and quadrants I and II of the left.

It was hypothesized that employment success would be related to the integrity of the colour sense. The level of colour vision was assessed with the H-R-R and City University Colour Vision Tests (Section 10).

Twenty-three of the youngsters exhibiting an H-R-R colour vision defect sought employment on leaving school. Of these, 14 showed a defective red-green system (R-G) and a normal blue-yellow (B-Y) response, a "strong" R-G defect being found in 2 cases. Six of the 20 youngsters demonstrated a strong B-Y defect in conjunction with either a "mild" (2 cases) or a "strong" R-G loss (4 cases). The distribution of occupational success amongst the youngsters with an H-R-R colour vision defect is shown in Table 15. 32.

Unfortunately there was an insufficient number of youngsters within the various categories to form any definite conclusions. Nevertheless, the distribution of occupational success amongst those with a "mild" or "medium" R-G defect would seem to be approximately normally distributed. This finding would suggest that "mild" or "medium" R-G defects do not adversely influence the level of occupational success. It is also interesting to note that of the 4 individuals with both a strong R-G and a strong B-Y defect, only one showed an employment success index below that of the median for the sample as a whole.

Sixty-seven of the 169 respondents who sought employment on leaving school had been assessed with the City University Colour Vision test. Twenty-three of the 67 youngsters demonstrated either a R-G loss (4 cases), a B-Y loss (14 cases) or a combined R-G/B-Y deficiency. It is difficult to draw any definite conclusions owing to the lack of numbers within the categories and to the variation in severity of the defect within any one particular category. Nevertheless, occupational success appeared to be normally distributed among the 3 categories. It is interesting to note, however, that of the 11 youngsters making two or more errors on the test, 7 had occupational success levels of less than that for the sample as a whole (0.687) (Table 15.33).

		B-Y			
		Normal	Mild	Medium	Strong
	Normal				
R-G	Mild	0.222 0.630 0.648 0.688 0.900 0.915 1.000	0.848		0.042 0.741
	Medium	0.393 0.541 0.593 0.870 0.907	0.277	0.830	
	Strong	0.235 0.867			0.308 0.735 0.939 0.963

Table 15.32 Occupational success amongst the 23 individuals with an H-R-R colour vision defect.

Colour Defect	Number of Errors	Occupational Success
R-G	3	0.235
	3	0.393
	1	0.593
	3	0.870
B-Y	3	0.000
	2	0.042
	1	0.183
	1	0.541
	1	0.633
	2	0.745
	1	0.830
	1	0.867
	1	0.870
	1	0.907
	1	0.917
	1	0.958
	1	0.963
	1	1.000
R-G/B-Y	2 + 1	0.151
	3 + 3	0.308
	3 + 1	0.532
	4 + 2	0.735
	Achromatopsic	0.939

Table 15.33 Distribution of occupational success amongst the 23 observers with a City Test colour vision defect.

It was hypothesized that occupational success would be related to the level of dynamic acuity. Unfortunately, only six statistically significant values of β were obtained from the youngsters who left school at the end of the 1978/79 academic year. Of these six youngsters, only two had entered employment.

16 CONCLUSIONS

Much has been gained from this study both in terms of the results and also in the implications for further research into the visual ability and employment capability of the partially sighted.

The review of the literature revealed the complex nature of visual ability. It showed that the use of residual vision is affected by many inter-related factors which are not only visual, but also psychological and sociological in origin. Despite the progress made in the study, the importance of each individual component as well as the extent of overlap and interaction between the various factors is still poorly defined. As a result, the development of tests to measure visual ability is inhibited by the lack of a clear understanding of visual ability itself. The difficulty (described in Section 11) of obtaining valid and repeatable visual performance data from the partially sighted also underlines a further problem associated with the development of such tests. Nevertheless, special techniques have been developed during the study for the measurement of distance and near acuity, peripheral and central visual fields, and also colour vision. In addition, the experiments involving dynamic acuity have reached a stage whereby statistically significant values of β, i.e. the dynamic component, have been obtained. The work on visual ability, however, suggests that performance with residual vision cannot be meaningfully assessed using one particular test, but requires a series of tests.

The results of the study have shown that occupational success, as measured by job tenure in the period immediately after leaving school, is related to a number of factors: males are more successful than females and the chance of holding down a job also increases with the level of academic qualifications. Higher levels of occupational success are obtained by youngsters exhibiting a positive attitude to their visual impairment and also by those who do not expect the normally sighted to make an effort to understand partial sight. Employment success, however, is lower amongst those with an unemployed member of the family. The degree of association between occupational success and each of these factors is, nevertheless, small. The values of the various correlations are given in Table 16.1.

The relationship between occupational success and distance acuity, ironically, remains unresolved. This is due to the discrepancy in the correlations for the values obtained from the record card for those from the research measurement of acuity (Section 9). Clearly, this aspect warrants more attention. Further studies involving an investigation of the contrast sensitivity function might help to resolve this matter. The technique enables the whole spectrum of visual functioning to be evaluated whilst visual acuity measures response at only one extreme point (Campbell & Green 1965). The concept has been reviewed by Abadi (1974) and Arden (1978). It has been shown that the contrast sensitivity function alters in various disorders (Bodis-Wollner 1972; Florentini & Maffei 1976; Hess & Garner 1977; Hess & Howell 1977; Sjöstrand & Frisen 1977; Arden & Gocukoglu 1978; Arden & Jacobson 1978; Hess & Woo 1978). The curve can take on various modifications

Variable	Type of Analysis	Value	Significance Level
Sex	r_{pb}	0.153	p<0.05
Age	r	-0.088	NS
Place of abode	Descriptive	-	-
Type of Special School	r_{pb}	-0.140	NS
Length of Attendance	r	0.043	NS
Qualification	r_s	0.213	p<0.004
	†	0.158	p<0.005
Achievement motivation:			
Edwards scale	r	-0.111	NS
Lynn scale	r	-0.136	NS
Internal/External locus of control:Rotter scale	r	-0.04	NS
Attitude to handicapped 4 questions: Highest:	r_{pb}	-0.233	p<0.001
Adaptation to normally sighted 6 questions: Highest:	r_{pb}	-0.235	p<0.001
Self appraisal and job capability: 7 questions: Highest:	r_{pb}	-0.135	NS
Performance at job interview 4 questions: Highest:		-0.026	NS
Family encouragement	r_{pb}	-0.026	p<0.05
Presence of an unemployed relative	r_{pb}	0.199	p<0.05
Ocular disorder	Descriptive	-	-
Distance visual acuity	r_s	0.195	p<0.008
Highest (record card)	†	0.144	p<0.006
Near visual acuity: Highest:		0.060	NS
Peripheral field	Descriptive	-	-
Central field	Descriptive	-	-
Colour vision	Descriptive	-	-
Dynamic acuity	Descriptive	-	-

Table 16.1 Summary of the results obtained in the study.

and these are shown in Fig. 16.1. Loss of the high spatial frequency response is analogous to visual acuity and affects the resolution of the detail. The loss of the low spatial frequency response, however, can seriously impair general performance (Taylor 1981). A very limited pilot study was undertaken towards the end of the project in order to establish the suitability of such a technique for the partially sighted. The study, carried out on 4 observers, showed that although valid measurements could in fact be obtained, the method was rather laborious to carry out.

The relationship between occupational success and the integrity of the visual field could not be established due to the lack of an adequate number of youngsters with such defects entering employment. The results showed that several of the youngsters with extensive field defects exhibited poor levels of success whilst others with similar levels of field loss seemed to have no difficulty in this respect. It has been known for some time that individuals with field loss resulting from either retinal or cortical damage can often "fill-in" their field loss (Gerritis 1969; Gassel 1966; Walls 1954). A study of this phenomenon would be of value in relation to visual field loss.

Lack of numbers also prevented the relationship being established between occupational success and the state of the colour vision.

The absence of any substantial correlation between occupational success and each of the topics investigated during the study raises several important issues. The magnitude and diversity of the correlates adds support to the view that occupational success is

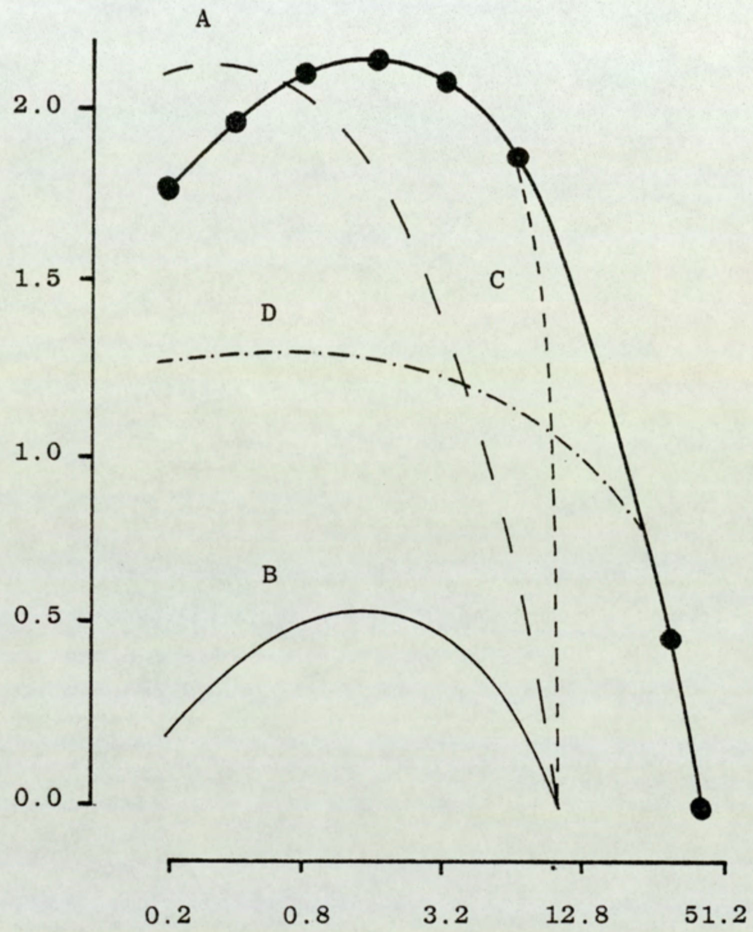


Fig. 16.1. The contrast sensitivity function (bold curve) and modifications of the curve by disease (curves A, B, C and D).
(After Arden 1978)

complex factor involving many components. Analysis of the data, in any event, was carried out at a primary level - correlation techniques were used to investigate the presence of linear associations between the success index and individual factors. It can be expected, however, that some potential associations might be non-linear in nature. The further investigation of such relationships is clearly indicated. The primary mode of analysis also ignored potential relationships between occupational success and two or more vairables considered together. Investigation of such relationships would clearly be of value in any future work. This approach would necessitate, however, the involvement of larger numbers of youngsters than was available for this study. Further methods of investigation could involve the use of both multiple correlation and factor analysis. This latter technique identifies the presence of clusters of variables related on one aspect to the dependent variable .

The use of statistics in analysing results from the partially sighted must, however, be kept in perspective. Many different types of ocular disorder lead to partial sight and within any one particular disorder, the level of impairment can vary considerably. Many of these youngsters also suffer from various types of systemic involvement causing additional problems, such as deafness, hyper-activity and physical impairment. It is against this background that the use of statistics must be equated. Indeed, in a similar study of handicapped youngsters, Tuckey, Parfitt & Tuckey state that :

"The more we looked at this group of 788
handicapped school-leavers, the more complex
did the findings become. No leaver was
like any other; even within each category
of handicap, the wide range of disability and
potential makes overall conclusions a gross
over simplification."

The experience gained from the current study supports this view.

A further consideration is the borderline between pure and applied research. This study has undoubtedly highlighted some of the issues related to the employment of partially sighted youngsters. Nevertheless, the findings have to be weighted against the practical implications for those working at the employment placement interface. The experience gained from the current study suggests that research should also be undertaken into employment itself. Such work should concentrate on identifying the visual thresholds associated with particular jobs. The data provided by the current study could provide a base line for this work. A related area of research would involve the creation of specific job openings for the partially sighted. Such research would concentrate on identifying the strengths of the partially sighted rather than the weaknesses. One potential area of employment might, for example, be that of proof reading.

This study has shown that, in the consideration of both visual ability and occupational potential among the partially sighted, aspects of vision other than visual acuity must be taken into account. Such factors are likely to include the nature of ocular disorder, the integrity of the visual field and the capacity to resolve moving detail. Psychological and sociological factors such as the youngsters' attitude to visual impairment and the role of the family unit are also likely to play an important part.

The original premise that the results from one test alone might provide an indication of occupational potential, must be replaced by a multi-variable approach to predicting employment success. Such an approach should be prospective in nature and involve the assessment of youngsters not just in the transition between school and adult life, but also in the final years of schooling. Conclusive results are likely to emerge only with the establishment of an assessment procedure covering all aspects of employment.

APPENDIX A

The semi - structured interview form.

THE UNIVERSITY OF ASTON IN BIRMINGHAM

THE DEPARTMENT OF OPHTHALMIC OPTICS

THE VISUAL ABILITY AND EMPLOYMENT CAPABILITY OF THE PARTIALLY SIGHTED SCHOOL LEAVER

Employee questionnaire - semi structured interview

Interviewer: VJS/MW/JW

Location:

Male/female:

My name is John Wild and this is my colleague Viv Shackleton/Michael Wolffe.

First of all we would like to thank you for agreeing to talk to us.

We spoke briefly about our project in the letter we sent to you. Part of the project is concerned with the problems that arise when partially sighted school leavers look for and find suitable employment. We hope one day to be able to help future leavers obtain a job.

We would like to ask you some questions about your job. Before we start, however, we would like to remind you that:

a) anything you say will become strictly confidential.

b) no one in your firm or business will ever know about your answers to the questions.

c) your name will never be mentioned in any type of report etc.

d) if there are any questions which you do not wish to answer, do not feel obliged to do so - there is no need.

First we would like to ask you some details about your job.

Could you please tell me what you do?

(obtain definition)

What is the name and address of the people you work for?

How long have you had this job? (nearest 1/12)

Who suggested you might do this type of job?

At what age did you leave school?

What examinations did you take? (obtain success rate)

How did you obtain this job?

1. Were (academic) qualifications necessary for this job? YES/NO

2. Did your employer ask whether you possessed any (academic) qualifications before he employed you? YES/NO

3. Have you ever been prevented from accepting any job because of your lack of qualifications? YES/NO

Now I would like you to tell me more about your present job. Have you had any problems with your work?

PROBES

1. Source and nature of advice about prospective job - methods of obtaining job.

2. Adjustment to job - (lack of) experience, qualifications, training.

3. Visual difficulty

4. Quality, effort and work rate.

5. Attitudes of employer and fellow employees.

6. Travel.

What would you say were the <u>best</u> things about your job and the <u>worst</u> things.

<u>PROBE</u>

1. Income, responsibility.

2. Sense of achievement.

3. Relationships with employees and employer.

4. Enjoyment of work.

Now I would like to ask you a few questions about your previous jobs.

How many jobs have you had since you left school?
What did each job involve? (obtain definition of each)

How long did you stay in each job?

How did you obtain these jobs?

Who suggested you might like to do these jobs?

What were the good points and the bad points about your previous jobs?

PROBE

1. Income responsibility.

2. Sense of achievement.

3. Relationships with employees and employer.

4. Enjoyment of work.

Could you tell me about any problems you had in these jobs

PROBE

1. Source and nature of advice about prospective job, methods of obtaining job.

2. Adjustment to job (lack of) experience qualifications or training.

3. Visual difficulty.

4. Quality, effort and work rate.

5. Attitudes of employer and fellow employees.

6. Travel.

Now I would like to discuss your present job a bit more. We have already talked about some of these points, but I am going to mention them again to make sure that we have not missed anything.

Does your employer or immediate supervisor know that you are partially sighted? YES/NO

Did you have any previous experience of the work you do in your present job? YES/NO

If yes (1) where was experience gained?

(2) was any previous experience necessary for that job?

If no have you learnt the job as you went along? YES/NO

Have you ever been refused a job because of your lack of any previous experience? YES/NO

Do you have difficulties in seeing well enough to do your job? YES
Sometimes
NO

If sometimes or yes

How does this affect your work?

Is there anything in general that you find difficult because of your eyesight? YES/NO

If yes what?

Have you ever been asked to leave a job beeause you could not see very well? YES/NO

Is it important for you to work as fast as your workmates? YES/NO

Is it difficult for you to work as fast as your workmates? YES/NO

Have you ever been asked to leave a job because you were unable to keep up with normally sighted workers? YES/NO

Do you get on well with your workmates? YES/NO
If NO why not?

Are your workmates helpful? YES/NO
If No why not?

Do you get on well with your boss and/or immediate supervisor? YES/NO
If NO why not?

Have you ever left a job because you did not get on with your workmates, or your boss? YES/NO

Do you have any difficulty travelling to and from work? YES/NO
If YES why?

How do you travel to and from work?

Do you travel with another person? YES/NO
If YES who?

Have you ever had to leave or been unable to accept any job because of difficulties in travelling to and from the job? YES/NO
If YES why?

Are you happy with the wage you earn? YES/NO

Do you consider you have a position of responsibility? YES/NO

Do you enjoy doing this type of work? YES/NO

Do you feel your work is of value to the firm? YES/NO

Do you feel your work is of value to others outside the firm? YES/NO

Are you satisfied with your present job? YES/NO

If YES why?

If NO why?

Now I am going to ask you a few questions about your home background

Do you live with your parents? YES/NO

If NO how long is it since you left home?

Why did you leave?

Is anyone else in your family registered as P.S. or blind? YES/NO
if YES who?

Do your parents live together? YES/NO

What job does your father have?

What job does your mother have?

Could you tell me about your home background - probe for number in family

(Brothers
(Sisters
(Mother
(Father

Finally a few questions about any higher education you might have received.

Did you attend College, University, or Training Centre after leaving school? YES/NO

If YES (i) which?

(ii) for how long?

(iii) what did you study?

('O' level, 'A' level, diploma, degree, etc).

Were you successful? YES/NO

If NO why not?

Would you tell me about your time at college?
Did you have any problems coping with college life?

PROBES

1. Adjustment

2. Visual difficulty

3. Quality effort to work rate

4. Attitudes of academic staff and fellow students.

Now I would like to ask you a few specific questions about your further education. We have discussed some of them before but I want to make certain we have not missed any points

Did you ever have difficulty seeing well enough to study? YES

SOMETIMES

NO

If YES how did this affect your studying?

Did you find it difficult to keep up with your fellow students? YES/NO

Did you get on with your fellow students? YES/NO

If NO why not?

Finally two questions

Would you mind if we contacted your employer?
We would, of course, not reveal anything said
in this discussion YES/NO

If NO why not?

Lastly in comparing yourself with your normally
sighted workmates, do you feel that you are
successful in your job? YES/NO

Thank you for taking part in our discussion.

Do you have any comments or is there anything further you would like to say?

APPENDIX B

NOTE : For the purposes of illustration, the material contained in this appendix has been photographically reduced in size by approximately 15%.

Overleaf ... Fig.B1. The covering letter to the youngsters who had previously been examined as part of the study.

THE UNIVERSITY
OF ASTON
IN BIRMINGHAM

Gosta Green, Birmingham B4 7ET/Tel: 021.359 3611 Ex

Department of Ophthalmic Optics

DEAR

YOU WILL PROBABLY REMEMBER MY TESTING YOUR VISION LAST YEAR.

THIS WAS PART OF A STUDY DESIGNED TO HELP FUTURE VISUALLY HANDICAPPED SCHOOL LEAVERS OBTAIN A JOB. IT IS BEING CARRIED OUT FOR THE DEPARTMENT OF HEALTH AND SOCIAL SECURITY.

WE WOULD NOW LIKE TO LEARN ABOUT THE THINGS YOU HAVE DONE SINCE LEAVING SCHOOL. WE WOULD BE VERY GRATEFUL, THEREFORE, IF YOU WOULD FILL IN THIS QUESTIONNAIRE. IT IS DIVIDED INTO <u>4 PARTS</u>, BUT YOU WILL SEE FROM THE INSTRUCTIONS THAT YOU WILL ONLY HAVE TO ANSWER <u>2 PARTS</u>.

WE DO HOPE THAT YOU WILL COMPLETE THE QUESTIONNAIRE, FOR YOUR HELP IS ESPECIALLY IMPORTANT TO US. AS A RESULT, YOU WILL BE HELPING FUTURE VISUALLY HANDICAPPED SCHOOL LEAVERS.

WE WOULD BE GRATEFUL IF YOU WOULD RETURN THE COMPLETED QUESTIONNAIRE, AS SOON AS POSSIBLE, IN THE PREPAID ENVELOPE. YOUR ANSWERS WILL BE TOTALLY CONFIDENTIAL. WE WILL BE PLEASED TO <u>SEND YOU £1 IF YOU RETURN THE COMPLETED QUESTIONNAIRE PROMPTLY</u>.

BEFORE YOU START, CAREFULLY READ THE NEXT PAGE MARKED <u>INSTRUCTIONS</u>.

YOURS SINCERELY,

JOHN WILD.

Telex 336997

Overleaf ... Fig.B2. The covering letter to the youngsters who had not previously been examined as part of the study.

THE UNIVERSITY
OF ASTON
IN BIRMINGHAM

Gosta Green, Birmingham B4 7ET/Tel: 021.359 3611 Ex

Department of Ophthalmic Optics

Head of Department: Professor G V Ball MSc, FBOA, HD

DEAR

YOU MAY BE AWARE THAT LAST YEAR WE VISITED ST VINCENTS SCHOOL AS PART OF A STUDY DESIGNED TO HELP FUTURE VISUALLY HANDICAPPED SCHOOL LEAVERS OBTAIN A JOB.

SISTER CLARE SUGGESTED THAT YOU MIGHT BE WILLING TO HELP US WITH OUR WORK WHICH IS BEING CARRIED OUT FOR THE DEPARTMENT OF HEALTH AND SOCIAL SECURITY.

WE ARE INTERESTED IN LEARNING ABOUT THE THINGS YOU HAVE DONE SINCE LEAVING SCHOOL. WE WOULD BE VERY GRATEFUL, THEREFORE, IF YOU WOULD FILL IN THIS QUESTIONNAIRE. IT IS DIVIDED INTO <u>4 PARTS</u>, BUT YOU WILL SEE FROM THE INSTRUCTIONS THAT YOU WILL ONLY HAVE TO <u>ANSWER 2 PARTS</u>.

WE DO HOPE THAT YOU WILL COMPLETE THE QUESTIONNAIRE, FOR YOUR HELP IS ESPECIALLY IMPORTANT TO US. AS A RESULT, YOU WILL BE HELPING FUTURE VISUALLY HANDICAPPED SCHOOL LEAVERS.

WE WOULD BE GRATEFUL IF YOU WOULD RETURN THE 2 COMPLETED PARTS, AS SOON AS POSSIBLE, IN THE PREPAID ENVELOPE. YOUR ANSWERS WILL BE TOTALLY CONFIDENTIAL. WE WILL BE PLEASED TO <u>SEND YOU £1</u> IF <u>YOU RETURN THE COMPLETED QUESTIONNAIRE PROMPTLY</u>.

BEFORE YOU START, CAREFULLY READ THE NEXT PAGE MARKED INSTRUCTIONS.

YOUR SINCERELY,

JOHN WILD.

Telex 336997

Overleaf ... Fig.B3. The first follow - up letter.

THE UNIVERSITY
OF ASTON
IN BIRMINGHAM

Gosta Green, Birmingham B4 7ET/Tel: 021.359 3611 Ex

Department of Ophthalmic Optics

Head of Department: Professor G V Ball MSc FBOA HD

DEAR

WE HAVE HAD MANY REPLIES TO OUR QUESTIONNAIRE WHICH WE SENT OUT RECENTLY. SO FAR WE DO NOT APPEAR TO HAVE RECEIVED YOUR REPLY. MAY WE ASK YOU TO COMPLETE THE QUESTIONNAIRE AS SOON AS POSSIBLE.

EVERY SINGLE REPLY IS REALLY MOST IMPORTANT NOT ONLY TO US, BUT ALSO TO THE FUTURE LEAVERS WHOM THE STUDY IS DESIGNED TO HELP.

ONCE AGAIN, WE DO HOPE THAT YOU WILL DECIDE TO HELP US BY COMPLETING THE QUESTIONNAIRE AND RETURNING IT IN THE PRE-PAID ENVELOPE WE SENT YOU.

YOURS SINCERELY

J WILD

Telex 336997

Overleaf ... Fig.B4. The second follow - up letter.

THE UNIVERSITY
OF ASTON
IN BIRMINGHAM

Gosta Green, Birmingham B4 7ET/Tel: 021.359 3611 Ex

Department of Ophthalmic Optics

Head of Department: Professor G V Ball MSc FBOA HD

DEAR

SO FAR WE HAVE NOT RECEIVED A REPLY TO EITHER THE QUESTIONNAIRE OR THE LETTER WE SENT YOU.

IN CASE YOU HAVE LOST THE ORIGINAL QUESTIONNAIRE WE ENCLOSE ANOTHER COPY AND A FURTHER PREPAID ENVELOPE.

THE AIM OF THE STUDY IS TO HELP FUTURE PARTIALLY SIGHTED SCHOOL LEAVERS OBTAIN A JOB.

WE ARE MOST ANXIOUS FOR YOUR CO-OPERATION IN THE STUDY AND WE HOPE THAT YOU WILL RETURN THE COMPLETED QUESTIONNAIRE AS SOON AS POSSIBLE.

YOURS SINCERELY,

JOHN WILD

Telex 336997

Overleaf ... Fig.B5. The third follow - up letter.

THE UNIVERSITY
OF ASTON
IN BIRMINGHAM

Gosta Green, Birmingham B4 7ET/Tel: 021.359 3611 Ex

Department of Ophthalmic Optics

DEAR

WE ARE SORRY THAT SO FAR WE HAVE NOT RECEIVED YOUR COMPLETED QUESTIONNAIRE.

WHEN YOU CONSIDER THINGS, WE ARE SURE YOU WILL REALISE THAT WE DEPEND ENTIRELY UPON THE HELP OF PEOPLE LIKE YOURSELF.

WHILE IT MIGHT SEEM A CHORE FOR YOU TO FILL IN THE QUESTIONNAIRE, PERHAPS YOU WILL HAVE SECOND THOUGHTS.

IT REALLY IS LIKE WE SAID IN THE FIRST LETTER - YOUR HELP IS ESPECIALLY IMPORTANT NOT ONLY TO US BUT ALSO TO FUTURE PARTIALLY SIGHTED SCHOOL LEAVERS.

WE ENCLOSE ANOTHER QUESTIONNAIRE AND A FURTHER PREPAID ENVELOPE IN THE HOPE THAT YOU WILL CHANGE YOUR MIND AND HELP US WITH OUR STUDY.

YOURS SINCERELY,

JOHN WILD

Telex 336997

Overleaf ... Fig.B6. The questionnaire sent to the leavers from the 1977/78 and 1978/79 academic years.

INSTRUCTIONS

1. PLEASE FILL IN THE FIRST PART. IT IS MARKED WITH ONE SPOT IN THE TOP RIGHT HAND CORNER OF EACH PAGE.
   TO ANSWER SOME QUESTIONS PUT A TICK IN THE BOX; FOR OTHER QUESTIONS JUST WRITE IN YOUR ANSWERS. IGNORE THE COLUMN ON THE FAR RIGHT HAND SIDE OF EACH PAGE, IT IS FOR OUR USE ONLY.
   PLEASE USE CAPITAL LETTERS.

2. THEN,
   IF YOU ARE EMPLOYED, FULL TIME OR PART TIME, FILL IN THE PART MARKED EMPLOYMENT. IT HAS TWO SPOTS IN THE TOP RIGHT HAND CORNER OF EACH PAGE.
   (IF YOUR JOB IS PART OF A GOVERNMENT WORK EXPERIENCE SCHEME, FILL IN THIS PART).
   (IF YOUR EMPLOYMENT INCLUDES DAY OR BLOCK RELEASE AT COLLEGE, COMPLETE THIS PART AND NOT THE FURTHER EDUCATION AND TRAINING PART).

   IF YOU ARE UNEMPLOYED, FILL IN THE PART MARKED OUT OF WORK. IT HAS THREE SPOTS IN THE TOP RIGHT HAND CORNER OF EACH PAGE.

   IF YOU ARE IN A RESIDENTIAL HOME, AT A TRAINING CENTRE, SCHOOL, COLLEGE OR UNIVERSITY, FILL IN THE PART MARKED FURTHER EDUCATION AND TRAINING. IT HAS FOUR SPOTS IN THE TOP RIGHT HAND CORNER OF EACH PAGE.

3. ANSWER THE QUESTIONS IN THE SAME WAY AS YOU DID IN PART ONE.

4. REMEMBER TO READ EVERY HEADING OR QUESTION VERY CAREFULLY. IF YOU FIND THAT IT TAKES YOU A LONG TIME TO FILL THE QUESTIONNAIRE IN, DO NOT TRY TO DO IT ALL AT ONCE.

5. IF YOU HAVE DIFFICULTY WRITING, GET A FRIEND OR RELATIVE TO WRITE YOUR ANSWERS IN FOR YOU. IF YOU WISH YOU CAN TYPE IN THE ANSWERS YOURSELF.

6. WE SHOULD BE GRATEFUL IF YOU WOULD RETURN THE COMPLETED QUESTIONNAIRE IN THE PREPAID ENVELOPE AS SOON AS POSSIBLE.

<u>R E M E M B E R</u>

EVERYONE FILLS IN THE F I R S T PART ●

IF YOU ARE IN A JOB, FILL IN THE S E C O N D PART ●●

IF YOU ARE OUT OF WORK, FILL IN THE T H I R D PART ●●●

IF YOU ARE IN A RESIDENTIAL HOME, AT A TRAINING CENTRE, OR IN FURTHER EDUCATION, FILL IN THE F O U R T H PART ●●●●

c/1-3

c/4

c/5

c/6

c/7

c/8-9

FIRST PART

1. WRITE IN THE SPACE BELOW THE EXACT DATE THAT YOU LEFT DERBY SCHOOL.

   DAY.............MONTH.........YEAR.......

TICK ONE

2. DID YOU GO TO ANY OTHER SCHOOLS FOR THE VISUALLY HANDICAPPED?

   YES ☐ NO ☐ c/10

   IF NO, GO ONTO QUESTION 3.

   IF YES, WRITE IN THE SPACE BELOW THE NAMES OF THE SCHOOLS AND THE APPROXIMATE DATES YOU STARTED AND FINISHED.

   SCHOOL......................................

   STARTED..............(MONTH)..........(YEAR)

   FINISHED.............(MONTH)..........(YEAR)

   SCHOOL......................................

   STARTED..............(MONTH)..........(YEAR)

   FINISHED.............(MONTH)..........(YEAR)

TICK ONE

3. DID YOU GET ANY QUALIFICATIONS AT SCHOOL?

   YES ☐ NO ☐

   IF NO, GO ONTO QUESTION 4.

   IF YES, LIST YOUR QUALIFICATIONS (AND GRADES) IN THE SPACE BELOW.

c/11

c/12

c/13

c/14

c/15

c/16

c/17

TICK ONE

4. ARE YOU REGISTERED AS PARTIALLY SIGHTED?

   YES ☐ NO ☐ c/18

5. ARE YOU REGISTERED AS BLIND?

   YES ☐ NO ☐ c/19

TICK ONE

6. ARE YOU REGISTERED AS DISABLED? YES ☐ NO ☐ ☐ c/20

7. DOES ANYONE IN YOUR FAMILY HAVE A <u>SIMILAR</u> VISUAL PROBLEM?

TICK

A. NO. A ☐ ☐ c/21

B. ONE PARENT. B ☐ ☐ c/22

C. BOTH PARENTS. C ☐ ☐ c/23

D. ELDER BROTHERS OR SISTERS. D ☐ ☐ c/24

E. YOUNGER BROTHERS OR SISTERS. E ☐ ☐ c/25

TICK ONE

8. DO YOU HAVE ANY SPECTACLES? YES ☐ NO ☐ ☐ c/26

IF <u>YES</u>

A. DO YOU WEAR THEM FOR:

1. LONG DISTANCE. 1 ☐

2. READING 2 ☐ ☐ c/27

3. BOTH. 3 ☐

B. HOW OFTEN DO YOU WEAR THEM FOR THIS PURPOSE?

1. CONSTANTLY. 1 ☐

2. OCCASIONALLY. 2 ☐ ☐ c/28

3. NEVER. 3 ☐

9. DO YOU HAVE ANY VISUAL AIDS OTHER THAN ORDINARY SPECTACLES? YES ☐ NO ☐ ☐ c/29

IF <u>YES</u>

DO YOU USE THEM? YES ☐ NO ☐ ☐ c/30

10. DID YOU GO TO ANY WORK EXPERIENCE COURSES WHILST AT SCHOOL? YES ☐ NO ☐ ☐ c/31

IF <u>YES</u> DESCRIBE THESE:

............................(SUBJECT/JOB) ☐ c/32

AT....................(CENTRE/COLLEGE/FIRM) ☐ c/33

HOW LONG DID YOU ATTEND?..................

11. AT THIS MOMENT ARE YOU: TICK ONE

A. IN FULL TIME EMPLOYMENT ONLY? A

B. IN FULL TIME EMPLOYMENT AND ON DAY/BLOCK RELEASE COURSES? B

C. IN PART TIME EMPLOYMENT? C

D. IN VOLUNTARY OR UNPAID EMPLOYMENT? D

E. UNEMPLOYED? E

F. IN FULL TIME EDUCATION? F

G. AT A REHABILITATION OR TRAINING CENTRE? G

H. IN A RESIDENTIAL HOME? H

I. OTHER -- PLEASE DESCRIBE? I

12. HAVE YOU ATTENDED ANY WORK PREPARATION SCHEME, ASSESSMENT OR TRAINING COURSE SINCE LEAVING SCHOOL? TICK ONE

YES

NO

c/34

IF YES DESCRIBE THESE:

................................(SUBJECT/JOB)

AT......................(CENTRE/COLLEGE/FIRM) c/35

HOW LONG DID YOU ATTEND?

FROM.............(DATE) TO............(DATE) c/36

HERE ARE SOME QUESTIONS TO FIND OUT YOUR THOUGHTS ON PARTICULAR THINGS IN LIFE. TICK EITHER <u>YES</u> OR <u>NO</u> FOR EACH QUESTION. THERE ARE NO RIGHT OR WRONG ANSWERS.

		TICK ONE	
13.	DO YOU TELL AS FEW PEOPLE AS POSSIBLE THAT YOU HAVE A VISUAL PROBLEM?	YES ☐ NO ☐	☐ c/37
14.	DOES YOUR VISUAL PROBLEM PREVENT YOU FROM LEADING A NORMAL LIFE?	YES ☐ NO ☐	☐ c/38
15.	DO YOU IGNORE YOUR VISUAL PROBLEM?	YES ☐ NO ☐	☐ c/39
16.	WOULD YOU DESCRIBE YOURSELF AS A HANDICAPPED PERSON?	YES ☐ NO ☐	☐ c/40
17.	IN ORDER TO SUCCEED IN LIFE IS IT NECESSARY TO MAKE NORMALLY SIGHTED PEOPLE UNDERSTAND YOUR PROBLEM?	YES ☐ NO ☐	☐ c/41
18.	DOES YOUR VISUAL PROBLEM RESTRICT YOUR LIFE IN ANY WAY?	YES ☐ NO ☐	☐ c/42
19.	WHEN WITH NORMALLY SIGHTED PEOPLE DO YOU PRETEND NOT TO HAVE A VISUAL PROBLEM?	YES ☐ NO ☐	☐ c/43
20.	DO YOU THINK IT IS UP TO THE NORMALLY SIGHTED PERSON TO MAKE AN EFFORT TO UNDERSTAND PARTIAL SIGHT?	YES ☐ NO ☐	☐ c/44
21.	HAVE YOU HAD TO CHANGE YOUR WAY OF LIFE IN ORDER TO BE ACCEPTED BY NORMALLY SEEING PEOPLE?	YES ☐ NO ☐	☐ c/45
22.	DO YOU THINK THAT THE NORMALLY SIGHTED WORLD UNDERSTANDS PARTIAL SIGHT?	YES ☐ NO ☐	☐ c/46

IF YOU HAVE <u>NEVER APPLIED</u> FOR A JOB GO ONTO QUESTION 33.

		TICK ONE	
23.	AT INTERVIEWS FOR A JOB, DO YOU TELL THE INTERVIEWER THAT YOU HAVE A VISUAL PROBLEM?	YES ☐ NO ☐	☐ c/47
24.	DO YOU EVER APPLY FOR A JOB WITHOUT FIRST THINKING WHETHER YOU CAN DO THE JOB?	YES ☐ NO ☐	☐ c/48
25.	DOES YOUR VISUAL PROBLEM RESTRICT THE TYPE OF JOBS YOU APPLY FOR?	YES ☐ NO ☐	☐ c/49
26.	BEFORE APPLYING FOR A JOB, DO YOU DISCUSS WITH ANYONE YOUR ABILITY TO DO THE JOB?	YES ☐ NO ☐	☐ c/50
27.	WHEN BEING INTERVIEWED FOR A JOB, DO YOU GENERALLY TELL THE INTERVIEWER THAT YOU ARE PARTIALLY SIGHTED?	YES ☐ NO ☐	☐ c/51
28.	DO YOU ONLY APPLY FOR A PARTICULAR TYPE OF JOB?	YES ☐ NO ☐	☐ c/52
29.	DO YOU CONSIDER YOUR VISUAL PROBLEM WHEN YOU APPLY FOR A JOB?	YES ☐ NO ☐	☐ c/53
30.	DO YOU CONSIDER YOUR ABILITY TO DO THE JOB BEFORE YOU APPLY FOR IT?	YES ☐ NO ☐	☐ c/54
31.	AT INTERVIEWS, DO YOU EXPLAIN TO YOUR INTERVIEWER JUST HOW MUCH YOU CAN SEE?	YES ☐ NO ☐	☐ c/55
32.	WHEN APPLYING FOR A JOB, DO YOU CONSIDER WHETHER YOU MIGHT HAVE ANY PROBLEMS IF YOU GOT THE JOB?	YES ☐ NO ☐	☐ c/56

THE REST OF THE QUESTIONS IN THIS SECTION ARE ABOUT YOU AS A PERSON AND ARE NOT ABOUT JOBS IN PARTICULAR. WE WOULD LIKE TO KNOW MORE ABOUT YOU, SO THAT WE CAN RELATE THIS TO THE JOB THAT INTERESTS YOU.

PLEASE DON'T WORRY IF SOME OF THE QUESTIONS SEEM STRANGE OR IF THEY APPEAR MORE THAN ONCE. THIS IS NOT TO TRICK YOU, BUT TO COMPARE ONE THING WITH ANOTHER.

EACH QUESTION HAS TWO ANSWERS. WE ASK YOU TO SELECT ONE ANSWER OR THE OTHER. SOMETIMES NEITHER ANSWER MAY BE EXACTLY TRUE OF YOU, BUT PLEASE TRY TO CHOOSE THE ONE WHICH IS NEAREST YOUR THOUGHTS.

HERE ARE SOME QUESTIONS TO FIND OUT YOUR OPINION ON CERTAIN THINGS. EACH QUESTION HAS TWO ANSWERS, A AND B, TICK THE ONE ANSWER WHICH DESCRIBES MOST CLOSELY THE WAY YOU FEEL NOW.

SOMETIMES YOU MAY AGREE OR DISAGREE WITH BOTH A AND B. IF SO, STILL CHOOSE ONLY ONE OF THE ANSWERS. TICK ONE BOX ONLY FOR EACH QUESTION.

THERE ARE NO RIGHT OR WRONG ANSWERS. ANSWER EACH QUESTION.

		TICK ONE	
33.A)	I LIKE TO SOLVE PUZZLES AND PROBLEMS THAT OTHER PEOPLE HAVE DIFFICULTY WITH.	A ☐	☐ c/57
B)	I LIKE TO FOLLOW INSTRUCTIONS AND DO WHAT IS EXPECTED OF ME.	B ☐	
34.A)	I WOULD LIKE TO BE A RECOGNISED SPECIALIST IN SOME JOB.	A ☐	☐ c/58
B)	I LIKE TO HAVE MY WORK ORGANISED AND PLANNED BEFORE BEGINNING.	B ☐	
35.A)	I LIKE TO BE ABLE TO DO THINGS BETTER THAN OTHER PEOPLE.	A ☐	☐ c/59
B)	I LIKE TO TELL AMUSING JOKES AT PARTIES.	B ☐	
36.A)	I LIKE TO DO JOBS THAT OTHERS THINK REQUIRE SKILL AND EFFORT.	A ☐	☐ c/60
B)	I LIKE TO COME AND GO IN LIFE AS I WANT.	B ☐	
37.A)	I LIKE TO FORM NEW FRIENDSHIPS.	A ☐	☐ c/61
B)	I LIKE TO BE SUCCESSFUL IN THE THINGS I DO.	B ☐	

TICK ONE

38.A) I LIKE TO BE LOYAL TO MY FRIENDS. A B c/62

B) I LIKE TO SOLVE PROBLEMS THAT OTHER PEOPLE HAVE DIFFICULTY WITH.

39.A) I LIKE MY FRIENDS TO ENCOURAGE ME WHEN I MEET WITH FAILURE. A B c/63

B) I LIKE TO DO TASKS THAT OTHER PEOPLE RECOGNISE AS NEEDING A LOT OF SKILL.

40.A) I WOULD LIKE TO BE APPOINTED CHAIRMAN OF A COMMITTEE. A B c/64

B) I WOULD LIKE TO WRITE A GREAT BOOK OR PLAY.

41.A) I FEEL GUILTY WHEN I KNOW I HAVE DONE SOMETHING WRONG. A B c/65

B) I WOULD LIKE TO BE A RECOGNIZED EXPERT ON SOME JOB.

42.A) I LIKE TO DO MY BEST IN WHATEVER I UNDERTAKE. A B c/66

B) I LIKE TO HELP PEOPLE WHO ARE LESS FORTUNATE THAN I AM.

43.A) I LIKE TO EAT IN NEW AND STRANGE RESTAURANTS. A B c/67

B) I LIKE TO DO THINGS BETTER THAN OTHER PEOPLE CAN.

44.A) I LIKE TO WORK HARD AT ANY JOB I UNDERTAKE. A B c/68

B) I LIKE TO BE ABLE TO SAY I HAVE DONE A DIFFICULT JOB WELL.

TICK ONE

45 .A) I WOULD LIKE TO DO SOMETHING OF GREAT IMPORTANCE. A

B) I LIKE PRAISING PEOPLE I ADMIRE. B

c/69

46.A) I WOULD LIKE TO WRITE A GREAT NOVEL OR PLAY. A

B) I LIKE TO ATTACK POINTS OF VIEW THAT ARE NOT THE SAME AS MINE. B

c/70

HERE ARE SOME QUESTIONS TO FIND OUT MORE ABOUT YOU AS A PERSON. EACH QUESTION HAS TWO ANSWERS, A AND B. TICK THE ONE ANSWER YOU AGREE WITH MOST CLOSELY.

IF YOU AGREE OR DISAGREE WITH BOTH A AND B, PLEASE STILL DECIDE ON ONE ANSWER ONLY. TICK ONE BOX ONLY FOR EACH QUESTION.

THERE ARE NO RIGHT OR WRONG ANSWERS. ANSWER EACH QUESTION.

TICK ONE

47.A) MANY OF THE UNHAPPY THINGS IN PEOPLE'S LIVES ARE PARTLY DUE TO BAD LUCK. A ☐

B) PEOPLE'S MISFORTUNES RESULT FROM THE MISTAKES THEY MAKE. B ☐

☐ c/72

54.A) IN THE CASE OF THE WELL PREPARED PUPIL THERE IS RARELY IF EVER SUCH A THING AS AN UNFAIR TEST. A ☐

B) MANY TIMES EXAM QUESTIONS TEND TO BE SO UNRELATED TO CLASS WORK THAT STUDYING IS USELESS. B ☐

☐ c/80

c/1-3

☐ c/4

55.A) BECOMING A SUCCESS IS A MATTER OF HARD WORK. LUCK HAS LITTLE OR NOTHING TO DO WITH IT. A ☐

B) GETTING A GOOD JOB DEPENDS MAINLY ON BEING IN THE RIGHT PLACE AT THE RIGHT TIME. B ☐

☐ c/5

57.A) WHEN I MAKE PLANS, I AM ALMOST CERTAIN THAT I CAN MAKE THEM WORK. A ☐

B) IT IS NOT ALWAYS WISE TO PLAN TOO FAR AHEAD BECAUSE MANY THINGS TURN OUT TO BE A MATTER OF GOOD OR BAD FORTUNE ANYHOW. B ☐

☐ c/7

TICK ONE

58.A) THERE ARE CERTAIN PEOPLE WHO ARE JUST NO GOOD. A c/8

B) THERE IS SOME GOOD IN EVERYBODY. B

59.A) IN MY CASE GETTING WHAT I WANT HAS LITTLE OR NOTHING TO DO WITH LUCK. A c/9

B) MANY TIMES WE MIGHT JUST AS WELL DECIDE WHAT TO DO BY TOSSING A COIN. B

60.A) WHO GETS TO BE BOSS OFTEN DEPENDS WHO WAS LUCKY ENOUGH TO BE IN THE RIGHT PLACE FIRST. A c/10

B) GETTING PEOPLE TO DO THE RIGHT THING DEPENDS UPON ABILITY. B

63.A) ONE SHOULD ALWAYS BE WILLING TO ADMIT MISTAKES. A c/13

B) IT IS USUALLY BEST TO COVER UP ONE'S MISTAKES. B

64.A) IT IS HARD TO KNOW WHETHER OR NOT A PERSON REALLY LIKES YOU. A c/14

B) HOW MANY FRIENDS YOU HAVE DEPENDS UPON HOW NICE A PERSON YOU ARE. B

65.A) IN THE LONG RUN THE BAD THINGS THAT HAPPEN TO US ARE BALANCED BY THE GOOD ONES. A c/15

B) MOST MISFORTUNES ARE THE RESULT OF LACK OF ABILITY, IGNORANCE, LAZINESS OR ALL THREE. B

68.A) A GOOD LEADER MAKES IT CLEAR TO EVERYBODY WHAT THEIR JOBS ARE. A c/18

B) A GOOD LEADER EXPECTS PEOPLE TO DECIDE FOR THEMSELVES WHAT THEY SHOULD DO. B

70.A) PEOPLE ARE LONELY BECAUSE THEY DON'T TRY TO BE FRIENDLY.

B) THERE'S NOT MUCH USE IN TRYING TOO HARD TO PLEASE PEOPLE — IF THEY LIKE YOU, THEY LIKE YOU.

A
B

c/20

72 A) WHAT HAPPENS TO ME IS MY OWN DOING.

B) SOMETIMES I FEEL THAT I DON'T HAVE ENOUGH CONTROL OVER THE DIRECTIONS MY LIFE IS TAKING.

A
B

c/22

EMPLOYMENT

83. WRITE IN THE SPACE BELOW THE NAME OF YOUR JOB. c/ 31-32

84. DESCRIBE IN THE SPACE BELOW THE TYPE OF WORK YOU DO.

TICK ONE

85. IS YOUR JOB PART OF A GOVERNMENT WORK EXPERIENCE PROGRAMME?

YES
NO
c/33

86. IS THIS YOUR FIRST JOB SINCE LEAVING SCHOOL?

YES
NO
c/34

IF YES, GO ONTO QUESTION 87.

IF NO:

A) HOW MANY JOBS HAVE YOU HAD SINCE LEAVING SCHOOL (NOT COUNTING YOUR PRESENT JOB)?

.............(NUMBER) c/35

B) DESCRIBE IN THE SPACE BELOW THE TYPE OF WORK YOU DID IN EACH JOB.

1ST JOB............................ c/ 36-37
....

2ND JOB............................ c/ 38-39
....

3RD JOB............................ c/ 40-41
....

4TH JOB............................ c/ 42-43
....

C) HOW LONG DID YOU STAY IN EACH JOB?

1ST JOB............................	c/ 44-45
2ND JOB............................	46-47
3RD JOB............................	48-49
4TH JOB............................	50-51

D) WHO GAVE YOU THE IDEA THAT YOU MIGHT DO EACH OF THESE JOBS?

1ST JOB............................	c/52
2ND JOB............................	c/53
3RD JOB............................	c/54
4TH JOB............................	c/55

E) WHO ARRANGED THE INTIAL CONTACT WITH EACH EMPLOYER?

1ST JOB............................	c/56
2ND JOB............................	c/57
3RD JOB............................	c/58
4TH JOB............................	c/59

F) WHAT WAS THE REASON FOR LEAVING EACH JOB?

1ST JOB............................	c/60
2ND JOB............................	c/61
3RD JOB............................	c/62
4TH JOB............................	c/63

G) WERE ANY OF THE JOBS PART TIME?

TICK ONE

YES ☐

NO ☐

IF YES, WHICH JOB?

....

c/64

c/65

c/66

c/67

H) WERE ANY OF THE JOBS UNPAID?

IF YES, WHICH JOB?

....

TICK ONE

YES [ ]
NO [ ]

c/68 c/69 c/70 c/71

I) WERE ANY OF THE JOBS PART OF THE GOVERNMENT WORK EXPERIENCE SCHEME?

IF YES WHICH JOB?

....

YES [ ]
NO [ ]

c/72 c/73 c/74 c/75

THE FOLLOWING QUESTIONS ARE ABOUT YOUR PRESENT JOB.

c/76-77 78-79 c/1-3

87. WRITE IN THE SPACE BELOW THE EXACT DATE THAT YOU STARTED YOUR PRESENT JOB.

DAY.............MONTH..........YEAR.........

c/4

88. WHO GAVE YOU THE IDEA THAT YOU MIGHT DO THIS JOB?

c/5

89. WHO ARRANGED THE INITIAL CONTACT WITH YOUR EMPLOYER?

c/6

TICK ONE

90. DO YOU GO TO DAY OR BLOCK RELEASE AT COLLEGE?

YES [ ]
NO [ ]

c/7

91. DO YOU WORK MORE THAN 30 HOURS PER WEEK (INCLUDING DAY OR BLOCK RELEASE AT COLLEGE)?

YES [ ]
NO [ ]

c/8

92. IS THE JOB UNPAID?

YES [ ]
NO [ ]

c/9

TICK ONE

93. BEING HONEST, OVERALL HOW SATISFIED ARE YOU WITH YOUR PRESENT JOB?

VERY SATISFIED
SATISFIED
NEITHER
DISSATISFIED
VERY DISSATISFIED

c/10

TICK ONE

94. DID YOUR FAMILY ENCOURAGE YOU TO FIND A JOB?

YES
NO

c/11

95. IS ANYONE IN YOUR FAMILY UNABLE TO GET A JOB?

YES
NO

c/12

96. BEFORE YOUR PRESENT JOB, HOW MANY JOBS DID YOU APPLY FOR?

........................(NUMBER).

c/ 13-1

A) LIST BELOW THE TYPES OF JOBS YOU HAVE APPLIED FOR.

1ST JOB.........................
2ND JOB.........................
3RD JOB.........................
4TH JOB.........................
5TH JOB.........................

c/ 15-16
17-18
19-20
21-22
23-24

B) WHO GAVE YOU THE IDEA THAT YOU MIGHT DO THESE JOBS?

1ST JOB.........................
2ND JOB.........................
3RD JOB.........................
4TH JOB.........................
5TH JOB.........................

c/25
c/26
c/27
c/28
c/29

C) WHAT WAS THE MOST LIKELY REASON FOR NOT BEING GIVEN EACH JOB?

1ST JOB............................ ☐ c/30

2ND JOB............................ ☐ c/31

3RD JOB............................ ☐ c/32

4TH JOB............................ ☐ c/33

5TH JOB............................ ☐ c/34

OUT OF WORK

TICK ONE

97. HAVE YOU BEEN EMPLOYED SINCE LEAVING SCHOOL?

YES ☐ / NO ☐ — ☐ c/35

IF NO, GO ONTO QUESTION 98.

IF YES,

A) HOW MANY JOBS HAVE YOU HAD?

....................(NUMBER). ☐ c/36

B) DESCRIBE IN THE SPACE BELOW THE TYPE OF WORK YOU DID.

1ST JOB............................ ☐☐ c/37-38

.... ☐☐ 39-40

2ND JOB............................ ☐☐ 41-42

.... ☐☐ 43-44

3RD JOB............................

....

4TH JOB............................

....

C) HOW LONG DID YOU STAY IN EACH JOB?

1ST JOB............................ ☐☐ c/45-46

2ND JOB............................ ☐☐ 47-48

3RD JOB............................ ☐☐ 49-50

4TH JOB............................ ☐☐ 51-52

D) WHO GAVE YOU THE IDEA THAT YOU MIGHT DO EACH OF YOUR PREVIOUS JOBS?

1ST JOB............................ ☐ c/53

2ND JOB............................ ☐ c/54

3RD JOB............................ ☐ c/55

4TH JOB............................ ☐ c/56

E) WHO ARRANGED THE INITIAL CONTACT WITH EACH EMPLOYER?

1ST JOB........................ ☐ c/57

2ND JOB........................ ☐ c/58

3RD JOB........................ ☐ c/59

4TH JOB........................ ☐ c/60

F) WHAT WAS THE REASON FOR LEAVING EACH JOB?

1ST JOB........................ ☐ c/61

2ND JOB........................ ☐ c/62

3RD JOB........................ ☐ c/63

4TH JOB........................ ☐ c/64

TICK ONE

G) WERE ANY OF THE JOBS PART TIME?

IF YES, WHICH JOB? YES ☐ ☐ c/65

.... NO ☐ ☐ c/66

☐ c/67

H) WERE ANY OF THE JOBS UNPAID? ☐ c/68

IF YES, WHICH JOB? YES ☐

NO ☐

.... ☐ c/69

☐ c/70

I) WERE ANY OF THE JOBS PART OF THE GOVERNMENT WORK EXPERIENCE SCHEME? YES ☐ ☐ c/71

IF YES, WHICH JOB? NO ☐ ☐ c/72

....

☐ c/73

98. DOES YOUR FAMILY ENCOURAGE YOU TO FIND A JOB? YES ☐ ☐ c/74

NO ☐ ☐ c/75

99. IS ANYONE ELSE IN YOUR FAMILY UNABLE TO GET A JOB? ☐ c/76

YES ☐

NO ☐ ☐ c/77

☐ c/78

100. HOW MANY JOBS HAVE YOU APPLIED FOR? c/ 79-80

........................(NUMBER). c/ 1-3

c/4

A) LIST BELOW THE TYPES OF JOBS YOU HAVE APPLIED FOR. c/

1ST JOB........................ 5-6

2ND JOB........................ 7-8

3RD JOB........................ 9-10

4TH JOB........................ 11-12

5TH JOB........................ 13-14

6TH JOB........................ 15-16

7TH JOB........................ 17-18

8TH JOB........................ 19-20

9TH JOB........................ 21-22

10TH JOB........................ 23-24

B) WHO GAVE YOU THE IDEA THAT YOU MIGHT DO THESE JOBS? c/25

1ST JOB........................ c/26

2ND JOB........................ c/27

3RD JOB........................ c/28

4TH JOB........................ c/29

5TH JOB........................ c/30

6TH JOB........................ c/31

7TH JOB........................ c/32

8TH JOB........................ c/33

9TH JOB........................ c/34

10TH JOB........................

C) WHAT WAS THE MOST LIKELY REASON FOR NOT BEING GIVEN EACH JOB? ☐ c/35

1ST JOB........................... ☐ c/36

2ND JOB........................... ☐ c/37

3RD JOB........................... ☐ c/38

4TH JOB........................... ☐ c/39

5TH JOB........................... ☐ c/40

6TH JOB........................... ☐ c/41

7TH JOB........................... ☐ c/42

8TH JOB........................... ☐ c/43

9TH JOB........................... ☐ c/44

10TH JOB..........................

FURTHER EDUCATION AND TRAINING

101. WHAT IS THE NAME OF THE SCHOOL / TRAINING INSTITUTE / COLLEGE / POLYTECHNIC / UNIVERSITY YOU ATTEND? ☐ c/45

102. WHAT ARE YOU STUDYING FOR? ☐ c/46

103. HOW LONG IS THE COURSE? ☐ c/47

104. WHICH ONE OF THE FOLLOWING BEST DESCRIBES WHY YOU WENT TO TRAINING CENTRE / COLLEGE UNIVERSITY OR WHY YOU STAYED ON AT SCHOOL? ☐ c/48

TICK ONE

A. TO BE TRAINED IN A JOB. A ☐

B. TO GET MORE QUALIFICATIONS. B ☐

C. UNABLE TO DECIDE WHAT TYPE OF JOB TO DO. C ☐

D. UNABLE TO FIND A JOB. D ☐

E. OTHER - PLEASE DESCRIBE. E ☐

105. DID YOU APPLY FOR ANY JOBS BEFORE YOU WENT TO COLLEGE / TRAINING CENTRE OR BEFORE YOU STAYED ON AT SCHOOL? ☐ c/49

TICK ONE

YES ☐

NO ☐

IF YES,

A) LIST BELOW THE TYPE OF JOBS YOU APPLIED FOR.

c/

1ST JOB........................ ☐☐ 50-51

2ND JOB........................ ☐☐ 52-53

3RD JOB........................ ☐☐ 54-55

4TH JOB........................ ☐☐ 56-57

5TH JOB........................ ☐☐ 58-59

B) WHO GAVE YOU THE IDEA THAT YOU MIGHT DO THESE JOBS?

1ST JOB............................ ☐ c/60

2ND JOB............................ ☐ c/61

3RD JOB............................ ☐ c/62

4TH JOB............................ ☐ c/63

5TH JOB............................ ☐ c/64

C) WHAT WAS THE MOST LIKELY REASON FOR NOT BEING GIVEN EACH JOB?

1ST JOB............................ ☐ c/65

2ND JOB............................ ☐ c/66

3RD JOB............................ ☐ c/67

4TH JOB............................ ☐ c/68

5TH JOB............................ ☐ c/69

APPENDIX C

Computer coding

<u>CODING FOR FIRST, SECOND AND THIRD QUESTIONNAIRES</u>

C 1-3	<u>Case number</u>		
C 4	<u>Card in case number</u>		
C 5	<u>Sex</u>	1	Male
		0	Female
C 6	<u>Age</u> (at time questionnaire posted)		
	i.e. 14.6.78		
	14.6.79		
	11.6.80		
	< 16 11/12	1	
	17 - 17 11/12	2	
	18 - 18 11/12	3	
	19 - 19 11/12	4	
	> 20	5	
C 7	<u>Type of School</u>		
	Day	1	
	Boarding	0	
C 8-9	<u>School</u>		
	George Auden	1	
	Joseph Clarke	2	
	Exhall Grange	3	
	Nansen School	4	
	St Vincents	5	
	Temple Bank	6	
	West of England	7	
	John Aird	8	
	Derby School	9	
	East Anglian	10	
	Holmrook	11	
	New River	12	
	Shawgrove	13	
C 10	<u>Length of P.S. Schooling</u>		
	< 6 terms < 2 years	1	
	7-12 terms < 4 years	2	
	13-18 terms < 6 years	3	
	19-24 terms < 8 years	4	
	25-30 terms <10 years	5	
	31-36 terms <12 years	6	
	37+ terms >12 years	7	

C 11-17	Qualifications			
	Yes No	C/11	1/0	
	1-4 C.S.E.'s	C/12	1/0	
	5+ C.S.E.'s	C/13	1/0	
	1-4 O levels	C/14	1/0	
	5+ O levels	C/15	1/0	
	A levels +	C/16	1/0	
	Others	C/17	1/0	
C 18	Registered as Partially Sighted			
	Yes	1		
	No	0		
C 19	Registered as Blind			
	Yes	1		
	No	0		
C 20	Registered as Disabled			
	Yes	1		
	No	0		
C 21-25	Relatives with similar problem			
	None	C/21	1/0	Yes-1 No-0
	One parent	C/22		
	Both parents	C/23		
	Elder brothers/sisters	C/24		
	Younger brothers/sisters	C/25		
C 26	Spectacles possessed			
	Yes	1		
	No	0		
C 27	Usage of Spectacles			
	Long distance	1		
	Reading	2		
	Both	3		
C 28	Spectacles worn			
	Constantly	1		
	Occasionally	2		
	Never	3		
C 29	Possession of L.V.A.'s			
	Yes	1		
	No	0		
C 30	Usage of L.V.A.'s			
	Yes	1		
	No	0		

C 31-33 <u>Work experience courses whilst at school</u>

C 31	Yes/No	1/0
C 32	Type	
C 33	How long	

C 34-36 <u>Work preparation scheme, assessment or training course, since leaving school</u>

C 34	Yes/No	1/0
C 35	Type	
C 36	How long	

C 37-46 <u>10 "Adaptation" Questions</u>

Yes	1
No	0

C 47-56 <u>10 Attitude at Interview Questions</u>

C 47	(C 51)	1 Yes	(Brackets indicate
C 48	(C 47)	0 No	corresponding column
C 49	(C 55)		for second and third
C 50	(C 48)		questionnaire)
C 51	(C 49)		
C 52	(C 50)		
C 53	(C 52)		
C 54	(C 53)		
C 55	(C 54)		
C 56	(C 56)		

C 57-70 <u>14 Need for Achievement Questions</u>

High achievement	1
Low achievement	0

C 71 - C 23 <u>Internal-External Locus of Control Questions</u>

C 72 13 Questions common to every respondent
C 80
C 5 <u>Card 2</u> 1 External answer
0 Internal answer
C 8 filler
C 9
C 10
C 13 filler
C 14
C 15
C 18 filler
C 20
C 22

C 24-30 <u>8 Lynn Need for Achievement Questions</u>

1 High achievement
0 Low achievement

EMPLOYMENT SECTION

C 31-32		<u>Present job classification</u>		
		Clerical/office	1	
		Shop/sales assistant	2	
		"Artisan" (skilled/semi-skilled)	3	
		Factory/warehouse	4	
		General labour	5	
		Domestic	6	
		Welfare	7	
		Other	8	
	(C33)	<u>? Government Work Experience</u>		(Brackets indicating columns for second and third year questionnaires)
		Yes	1	
		No	0	
C 33	(C34)	<u>First Job</u>		
		Yes	1	
		No	0	
C 34	(C35)	<u>Number of previous jobs</u>		
		1 job	1	
		2 jobs	2	
		3 jobs	3	
		Etc		
C 35-36	(C36-37)	<u>Classification of previous jobs</u>		
C 37-38	(C38-39)			
C 39-40	(C40-41)	Clerical/office	1	
C 41-42	(C42-43)	Shop/sales assistant	2	
		"Artisan" (skilled/semi-skilled)	3	
		Factory/warehouse	4	
		General labour	5	
		Domestic	6	
		Welfare	7	
C 43-44	(C44-45)	<u>Length of stay in previous jobs</u>		
C 45-46	(C46-47)			
C 47-48	(C48-49)	Coded in literal transcript		
C 49-50	(C50-51)			
C 51	(C52)	<u>Idea to do previous jobs</u>		
C 52	(C53)			
C 53	(C54)	Job placement/Careers officer	1	
C 54	(C55)	School/Headteacher	2	
		Parents	3	
		Interviewer/previous employer	4	
		Oneself/no-one	5	
		Other	6	
		Friends/other relative	7	
		Advert	8	

C 55 (C56)	Initial contact with employer	
C 56 (C57)		
C 57 (C58)	Job placement/careers officer	1
C 58 (C59)	School	2
	Parents	3
	Previous employer	4
	Oneself	5
	Advert	6
	Friend/other relative	7
	Other	8
C 59 (C60)	Reason for leaving	
C 60 (C61)		
C 61 (C62)	Sacked	1
C 62 (C63)	Financial/lack of future prospects	2
	Visual	3
	Other health	4
	Unable to cope	5
	Other excuse	6
	Better job	7
	End of course/temporary job	8
C 63 (C64)	Full or part-time job	
C 64 (C65)		
C 65 (C66)	Yes	1
C 66 (C67)	No	0
C 67 (C68)	Unpaid jobs	
C 68 (C69)		
C 69 (C70)	Yes	1
C 70 (C71)	No	0
-- (C72)	Government Work Experience	
-- (C73)		
-- (C74)	Yes	1
-- (C75)	No	0
C 71-72 (C76-77)	Length employed in present job	
	Coded in literal transcript (weeks)	
C 75 (C5)(Card 3)	Idea for present job	
	Job placement/careers officer	1
	School/Headteacher	2
	Parents	3
	Interviewer/previous employer	4
	Oneself/no-one	5
	Other	6
	Friends/relatives	7
	Advert	8

C 76 (C6)	<u>Initial Contact</u>	
	Job placement/careers officer	1
	School	2
	Parents	3
	Previous employer	4
	Oneself	5
	Advert	6
	Friend/other relative	7
	Other	8
C 77 (C7)	<u>Day/Block Release</u>	
	Yes	1
	No	0
C 78 (C8)	<u>30 hours per week</u>	
	Yes	1
	No	0
C 79 (C9)	<u>Unpaid</u>	
	Yes	1
	No	0
C 5-14 (--) Card 3	<u>10 Satisfaction questions</u>	
	Satisfied	3
	Neither	2
	Dissatisfied	1
-- (C10)	<u>Global satisfaction question</u>	
	Very satisfied	1
	Satisfied	2
	Neither	3
	Dissatisfied	4
	Very dissatisfied	5
-- (C11)	<u>Family encouragement</u>	
	Yes	1
	No	0
-- (C12)	<u>Family unemployed</u>	
	Yes	1
	No	0
C 15-16 (C13-14)	<u>Number of job applications</u>	
	0	
	0 jobs	0
	1 job	1
	2 jobs	2
	3 jobs	3
	Etc.	

C 17-18 (C15-16)	Job classification	
C 19-20 (C17-18)		
C 21-22 (C18-19)	Clerical/office	1
C 23-24 (C20-21)	Shop/sales assistant	2
C 25-26	"Artisan" (skilled/semi-skilled)	3
	Factory/warehouse	4
	General labour	5
	Domestic	6
	Welfare	7

C 27 (C25)	Idea	
C 28 (C26)		
C 29 (C27)	Job placement/careers officer	1
C 30 (C28)	School/headteacher	2
C 31 (C29)	Parents	3
	Interviewer/previous employer	4
	Oneself/no-one	5
	Other	6
	Friends/relatives	7
	Advert	8

C 32 (C30)	Reason for application failure	
C 33 (C31)		
C 34 (C32)	Visual	1
C 35 (C33)	Age	2
C 36 (C34)	Lack of experience	3
	Lack of qualifications	4
	Not taken	5
	None available/job gone	6
	Don't know	7
	Other	8

UNEMPLOYED SECTION

C 37 (C35)	? Been employed	
	Yes	1
	No	0

C 38 (C36)	Number of jobs	
	None	0
	1 job	1
	2 jobs	2
	3 jobs	3
	Etc.	

C 39-40 (C37-38)	Classification of previous jobs	
C 41-42 (C39-40)		
C 43-44 (C41-42)	Clerical/office	1
C 45-46 (C43-44)	Shop/sales assistant	2
	"Artisan" (skilled/semi-skilled)	3
	Factory/warehouse	4
	General labour	5
	Domestic	6
	Welfare	7

C 47-48 (C45-46)	<u>Length of stay in previous employments</u>	
C 49-50 (C47-48)		
C 51-52 (C49-50)	Literal transcribe (weeks)	
C 53-54 (C51-52)		
C 55 (C53)	<u>Idea</u>	
C 56 (C54)		
C 57 (C55)	Job placement/careers officer	1
C 58 (C56)	School/head teacher	2
	Parents	3
	Interviewer/previous employer	4
	Oneself/no-one	5
	Other	6
	Friends/relatives	7
	Advert	8
C 59 (C57)	<u>Initial Contact</u>	
C 60 (C58)		
C 61 (C59)	Job placement/careers officer	1
C 62 (C60)	School	2
	Parents	3
	Previous employer	4
	Oneself	5
	Advert	6
	Friend/other relative	7
C 63 (C61)	<u>Reason for leaving</u>	
C 64 (C62)		
C 65 (C63)	Sacked	1
C 66 (C64)	Financial/lack of future prospects	2
C		
	Visual	3
	Other health	4
	Unable to cope	5
	Other excuse	6
	Better job	7
	End of course/temporary job	8
C 67 (C65)	<u>Full/Part time</u>	
C 68 (C66)		
C 69 (C67)	Yes	1
C 70 (C68)	No	0
C 71 (C69)	<u>Unpaid</u>	
C 72 (C70)		
C 73 (C71)	Yes	1
C 74 (C72)	No	0
-- (C73)	<u>Government Work Experience</u>	
-- (C74)		
-- (C75)	Yes	1
-- (C76)	No	0
-- (C77)	<u>Family Encouragement</u>	
	Yes	1
	No	0

--	(C78)	Family unemployed	
		Yes	1
		No	0
C 75-76	(C79-80)	Number of previous applications	
		None	0
		1 job	1
		2 jobs	2
		3 jobs	3
		Etc.	
C 5-6	Card 4	Job classification of previous applications	
C 7-8			
C 9-10		Clerical/office	1
C11-12		Shop/sales assistant	2
C13-14		"Artisan"	
C15-16		(skilled/semi-skilled)	3
C17-18		Factory/warehouse	4
C19-20		General labour	5
C21-22		Domestic	6
C23-24		Welfare	7
C 25		Idea	
C 26			
C 27		Job placement/careers officer	1
C 28		School/headteacher	2
C 29		Parents	3
C 30		Previous employer/interviewer	4
C 31		Oneself/no-one	5
C 32		Other	6
C 33		Friends/relatives	7
C 34		Advert	8
C 35		Reason for failure	
C 36			
C 37		Visual	1
C 38		Age	2
C 39		Lack of experience	3
C 40		Lack of qualifications	4
C 41		Not taken	5
C 42		None available/job gone	6
C 43		Don't know	7
C 44		Other	8

FURTHER EDUCATION AND TRAINING

C 45		Type of establishment	
		University	1
		Poly/Coll. of Education	2
		Sixth Form Coll./Coll of F.E.	3
		School	4
		R.N.C./Chorleywood	5
		Hethersett	6
		Harborne	7
		Other	8

C 46	<u>Course</u>	
	"O" Levels	1
	"A" Levels/O.N.D.	2
	Other Certificate Course	3
	Degree/H.N.D.	4
	General non certificate	5
	Vocational	6
	Other	7

C 47	<u>Length of course</u>		
	3 terms	1 year	1
	4-6 terms	2 years	2
	7-9 terms	3 years	3
	10-12 terms	4 years	4
	13+ terms	4 years	5
	Other		8

C 48	<u>Reason for F.E. & T.</u>	
		1
		2
		3
		4
		5

C 49	<u>Job applications</u>	
	Yes	1
	No	0

C50-51	<u>Job Classification</u>	
C52-53		
C54-55	Clerical/office	1
C56-57	Shop/sales assistant	2
C58-59	"Artisan"	
	(skilled/semi-slilled)	3
	Factory/warehouse	4
	General labour	5
	Domestic	6
	Welfare	7

C 60	<u>Idea</u>	
C 61		
C 62	Job placement/careers officer	1
C 63	School/head teacher	2
C 64	Parents	3
	Interviewer/previous employer	4
	Oneself/no-one	5
	Other	6
	Friends/relatives	7
	Advert	8

C 65 C 66 C 67 C 68	<u>Reason for failure</u>	
	Visual	1
	Age	2
	Lack of experience	3
	Lack of qualifications	4
	Not taken	5
	None available/job gone	6
	Don't know	7
	Other	8

<u>BIOGRAPHICAL, EDUCATIONAL AND OPHTHALMOLOGICAL DATA</u>

C 5	<u>I.Q. Test</u>	
	W.I.S.C.	1
	S.B.	2
	Williams	3
	T.M.	4
C 6-8	<u>I.Q. Score</u> (includes full scale of W.I.S.C. Test)	
C 9-11	<u>Score on performance scale of W.I.S.C.</u>	
C 12-14	<u>Score on verbal scale of W.I.S.C.</u>	
C 15-20	<u>Date of I.Q. Test</u>	
C 21-22	<u>Length of Visually Handicapped Education</u>	
C 23-24	<u>Place of Abode</u>	
	Northern	1
	Yorks/Humberside	2
	North Western	3
	West Midlands	4
	East Midlands	5
	London North	6
	London	7
	Southern	8
	South Western	90
	Scotland	10
	Wales	11
	Other	12
	Unknown	13
C 25-30	<u>Date of admission to present school</u>	
C 31-36	<u>Date of birth</u>	
C 37-38	<u>Age at onset of visual disability/eyetrouble</u>	
	At birth/prenatal/congenital	1
	1 day - 4½ years	2
	5 - 9 ½ years	3
	10+ years	4

C 39-40	<u>Age at onset of partial sight</u>	
	At birth/prenatal/congenital	1
	1 day - 4½ years	2
	5 - 9½ years	3
	10+ years	4
C 41-42	<u>Age at onset of blindness</u>	
	At birth/prenatal/congenital	1
	1 day - 4½ years	2
	5 - 9½ years	3
	10+ years	4
C 43	<u>Prognosis</u>	
	Likely to deteriorate	1
	Likely to improve	2
	Stationary	3
	Uncertain	4
C 44-46	<u>Primary lesion</u>	
C 47-49	<u>Secondary lesion</u>	
	Eyeball	1
	Degenerative myopia including detachment secondary to myopia	101
	Albinism in ludes partial total ocular and all those labelled as nystamus with albinism	102
	Buphthalmos	103
	Microphthalmos	104
	Aniridia	105
	Coloboma (If only coloboma of iris together with some other disorder categorise as latter disorder)	106
	Other disorder of eyeball	107
	<u>Conjunctiva</u>	2
	<u>Cornea</u>	3
	Ulcer	306
	Dystrophy	307
	Band/Keratopathy	308
	Unknown Corneal lesions	309

Lens	4
Cataract in situ	401
Surgical aphakia	402
Dislocated lens including Marfans	403
Other disorder of lens	404
Uveal tract	5
Iritis, irdocyclitis, uveitis	501
Still's disease	502
Choriorentinitis/Choroiditis	503
Other disorder of uvea	504
Retina	6
Retinopathy and lesions of retinal vessels	601
etrolental fibroplasia	602
Primary detachment	603
Tapetoretinaldystrophy and allied conditions including R.P.	604
Macular dystrophy/degeneration	605
Neoplasm of retina/choroid	606
Total achromatopsia	607
Other disorders of retina	608
Optic nerve and visual pathways including cortex	7
Hereditory and primary optic atrophy	701
Other optic atrophy including secondary atrophy	702
Non classified optic atrophy	703
Other disorder	704
Vitreous	8
Site and type indefinite or not reported	9
Nystagmus only to be used as primary classification if classification elsewhere impossible.	901
Normal	902

C 50 R Visual field

C 51 L Visual field

	Nil	1
	<10°	2
	Contracted	3
	Central scotoma	4
	Hemianopia	5
	Good	6
C 52	<u>Presence of additional handicap</u>	
	Low intelligence	1
	Physical disability	2
	Hearing loss	3
	Maladjustment	4
	Speech and language difficulty	5
	Epilepsy	6
	Other	7
C 54	<u>Presence of similar defects in family</u>	
	Yes	1
	No	0
C 55-60	<u>Date of</u>	
C 61-66	<u>Date of leaving school</u>	

C 5-40 Card 6 <u>Record card refraction data</u>

<u>Right eye</u>

C 5-10 Sphere
C 11-16 Cylinder
C 17-19 Axis

<u>Left eye</u>

C 20-25 Sphere
C 26-31 Cylinder
C 32-34 Axis

C 35-40 Detailed refraction

C41-48 <u>Record card distance visual acuity data (Ranked classification)</u>

No perception of light	1
Perception of light	2
Hand movements	3
Count fingers	4
$\frac{1}{60}$	5
$\frac{2}{60}$	6
$\frac{3}{60}$	7
$\frac{4}{60}$	8
$\frac{5}{60}$	9
$\frac{6}{60}$	10
$\frac{6}{60}$ +1; $\frac{6}{36}$; $\frac{6}{36}$ + 1	11
$\frac{6}{24}$ -1; $\frac{6}{24}$; $\frac{6}{24}$ + 1	12
$\frac{6}{18}$ -2; $\frac{6}{18}$ -1; $\frac{6}{18}$;	
$\frac{6}{18}$ +1; $\frac{6}{18}$ +2;	13
$\frac{6}{12}$ -2; $\frac{6}{12}$ - 1; $\frac{6}{12}$;	
$\frac{6}{12}$ +1; $\frac{6}{12}$ + 2;	14
$\frac{6}{9}$ -3; $\frac{6}{9}$ -2; $\frac{6}{9}$ -1; $\frac{6}{9}$;	
$\frac{6}{9}$ +1; $\frac{6}{9}$ +2; $\frac{6}{9}$ +3	15
$\frac{6}{6}$ -4; $\frac{6}{6}$ -3; $\frac{6}{6}$ -2; $\frac{6}{6}$ -1; $\frac{6}{6}$ $\rightarrow$	16

C 41-42	R acuity
C 43-44	L acuity
C 45-46	"Binocular" acuity
C 47-48	"Best" acuity

C 49-64 Record card distance visual acuity data (Snellen decimal classification)

C 49-52	R acuity
C 53-56	L acuity
C 57-60	"Binocular" acuity
C 61-64	"Best" acuity
C 65-70	Date of acuity assessment

C 71 Record card near visual acuity
C 16 (Card 7)

88	No P.L.
77	P. of L
66	<N 48
48	N 48
36	N 36
24	etc.

C 71-72	R acuity
C 73-74	Distance (cm.)
C 75-76	Lacuity
C 77-78	Distance (cm.)
C 79-80	"Binocular" acuity
C 5-6 (Card 7)	Distance (cm.)
C 7-8	"Best" acuity
C 9-10	Distance (cm.)
C 11-16	Date of near acuity assessment

C 17-25 Record card near visual acuity with L.V.A.

C 17	L.V.A.? Yes/No Yes - 1 No - 0
C 18-19	Acuity (R, L or Binocular; regardles of distance) Coding as for C 6/71 - C 7/16
C 20-25	Date of near acuity assessment

C 26 Examined as part of current study?

Yes/No Yes - 1 No - 0

C 27-62 Current refraction data
Right eye

C 27-32	Sphere
C 33-38	Cylinder
C 39-41	Axis

Left eye

C 42-47	Sphere
C 48-53	Cylinder
C 54-56	Axis
C 57-62	Date of assessment

C 63-70	<u>Current Distance visual acuity</u> (Ranked classification)
	Coding as for C 6/41-48
C 63-64	R acuity
C 65-66	L acuity
C 67-68	"Binocular" acuity
C 69-70	"Best" acuity
C 71 C 12 (Card 8)	Current distance visual acuity (Snellen decimal classification)
C 71-74	R acuity
C 75-78	L acuity
C 5-8	"Binocular" acuity
C 9-12	"Best" acuity
C 13-20	<u>Near Snellen acuity (ranked classification)</u>

No P of L	- 88
P. of L.	- 77
$<\frac{6}{60}$	- 66
$\frac{6}{60}$	10
$\frac{6}{60}+1$; $\frac{6}{36}$; $\frac{6}{36}+1$	11
$\frac{6}{24}-1$; $\frac{6}{24}$; $\frac{6}{24}+1$	12
$\frac{6}{18}-2$; $\frac{6}{18}-1$; $\frac{6}{18}$; $\frac{6}{18}+1$; $\frac{6}{18}+2$	13
$\frac{6}{12}-2$; $\frac{6}{12}-1$; $\frac{6}{12}$; $\frac{6}{12}+1$; $\frac{6}{12}+2$	14
$\frac{6}{9}-3$; $\frac{6}{9}-2$; $\frac{6}{9}-1$; $\frac{6}{9}$;	
$\frac{6}{9}+1$; $\frac{6}{9}+2$; $\frac{6}{9}+3$	15
$\frac{6}{6}-4$; $\frac{6}{6}-3$; $\frac{6}{6}-2$; $\frac{6}{6}-1$; $\frac{6}{6} \rightarrow$	16

C 13-14	R acuity
C 15-16	L acuity
C 17-18	"Binocular" acuity
C 19-20	"Best" acuity
C 21-36	<u>Near Snellen acuity</u> (Snellen decimal classification)

No P of L.	- 88
P. of L.	- 77
$<\frac{6}{60}$	- 66

Then conventional scoring

C 21-24	R acuity
C 25-28	Lacuity
C 29-32	"Binocular" acuity
C 33-36	"Best" acuity

C 37-44	Times Roman Near Acuity Assessment
	C 6/71 Coding as for C7/16
C 37-38	R acuity
C 39-40	Lacuity
C 41-42	"Binocular" acuity
C 43-44	"Best" acuity
C 49-50	Date of distance and near accuity assessments.

APPENDIX D

Published material

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Screening Optometric Patients by Questionnaire: Methods of Improving Response

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Abstract

Mailed questionnaires are a quick and cheap means of obtaining data, but they have two disadvantages. They often produce low response rates irrespective of the nature of the group sampled, and they may seen inappropriate for clinical samples with visual problems. High response rates are needed for reliable results and valid conclusions. This paper presents a set of techniques enabling high response rates to be obtained. It also reports research showing that such techniques are appropriate even for the partially sighted.

Key Words: mailed questionnaire, partial sight, response rate

Clinical research based on follow-up studies often involves gaining information from patients at times and places other than in the consulting room. A relatively quick and inexpensive method of obtaining such information is the mailed questionnaire. This technique involves reading and responding to questions and, therefore, may seem inappropriate for clinical samples such as the visually handicapped. In addition, mailed questionnaires typically yield very low response rates even with the normally sighted.[1] Consequently, any conclusions drawn from the results may well be invalid. A poor return rate can often be improved by the use of a simple-to-follow set of techniques which have been developed from social science research. This paper presents these techniques in the hope that they will be more widely adopted by clinical researchers. It describes the use of the techniques with a sample of partially sighted school leavers. The results show that very high response rates can be obtained even from such an *a priori* unpromising sample.

METHODS

A questionnaire was sent to partially sighted school leavers to obtain information about their occupational experiences during the first year after leaving school. The sample originally consisted of 89 individuals, of whom 85 were traceable. They were aged between 17 and 20 and had left schools for the visually handicapped during the previous academic year.

Thirty-five subjects had been examined by one of the authors on a number of occasions during the previous academic year. They were all fully conversant with the purpose of the study. The remaining 50 subjects had not previously been examined here and had no prior knowledge of the study. Half of each of the examined and nonexamined groups was offered £1 ($2) to reply. Each of the four groups was matched

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for sex, I.Q. (where available), and school attended. The number in each group and the experimental treatment are given in Table 1. The type of ocular pathology and distance visual acuity were approximately equally distributed throughout the four groups. Modal distance acuity was in the 6/36 to 6/60 range. The questionnaire was 25 pages long. The type selected was IBM Bookface in upper case lettering and with 10 pitch spacing. The necessary high contrast was achieved by use of a Rank-Xerox 9200 photocopying process. The technique involved the following steps:

1. A covering letter was sent with the questionnaire explaining the purpose and value of the research, pointing out its relevance, and stressing the importance of everyone responding for the reliability of the results.
2. A follow-up letter, repeating the request for cooperation, was sent to those who did not reply.
3. A second follow-up letter with an additional questionnaire was sent to those who did not reply to the first follow-up.
4. Follow-up letters and their prompt timing were crucial. The appropriate time was determined with the aid of a graph, plotting response as a cumulative frequency against the number of days from the mailing of the questionnaires. As the response curve started to level off, the next follow-up letter was sent. The usual interval between mailings was 7–10 days.
5. Some investigators recommend a third follow-up letter or telephone call.
6. Hand-stamped envelopes were used on both out-going and return envelopes, since there was evidence that prepaid-franked letters yield poorer returns than hand-stamped mail.
7. Research shows that additional factors can facilitate higher response rates such as monetary incentive and previous personal contact by telephone, letter, or face-to-face contact.

The techniques are described in detail by Linsky[2] and Robin.[3]

RESULTS

The response rates for each group are given in Table 1. Time periods T_1, T_2, and T_3 correspond to the time of the first follow-up letter (after 9 days), second follow-up letter (after a further 10 days), and final response (after a further 23 days). Seventy-eight completed questionnaires were received from 85 subjects, giving a response rate of 91.2%.

Results were analyzed using a chi square test for 2 independent samples; where the sample size was insufficient, Fisher's exact probability test was used.[4] Analysis showed only four statistically significant results. Prior to period T_1, the response from the individuals who had been examined and who also received a financial incentive was significantly higher ($p < 0.05$) than the response from those who received an incentive only. Additionally, the former group responded significantly better ($p < 0.005$) than those who were neither examined nor received an incentive to reply. These differences were also maintained between T_1 and

TABLE 1. Number of replies received from four groups over three time periods.

Group	Number of Possible Replies	Replies Received at Time Periods					
		T_1		T_2		T_3	
		Number	%	Number	%	Number	%
Incentive + examination	17	15	88.2	17	100	17	100
No incentive + examination	18	12	66.7	15	83.3	17	94.4
Incentive; no examination	26	15	57.7	20	76.9	23	88.5
No incentive; no examination	24	10	41.7	16	66.7	21	87.5
Total	85	52	61.2	68	80.0	78	91.2

T_2 ($p < 0.05$ and $p < 0.025$, respectively). No significant differences were found by T_3.

DISCUSSION

A high return rate of mailed questionnaires can be achieved by using the technique described in this paper. Even with subjects who have great difficulty dealing with printed material, over 90% returned a lengthy questionnaire. The overall return rate increased from 61-91% of the sample by the use of follow-up letters. The higher response rate means that the researcher can have more confidence that the respondents are representative of the sample initially contacted.

The results suggest that in the long term, neither financial incentive nor prior contact encouraged the respondents to reply. Indeed, a return rate of 87.5% was achieved from individuals who were neither examined nor offered an incentive to reply, but a response rate of only half of this (41.7%) was achieved before follow-up. This suggests that the crucial factor is properly administered follow-up techniques.

These results testify to the utility of mail survey techniques which warrant serious consideration by clinical researchers as a cost-effective means of data collection.

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Research Notes

Employment Problems of Partially Sighted School-Leavers: Methods of Obtaining Information

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Michael Wolffe

Partially sighted school-leavers are expected to compete for employment with their sighted peers. Unfortunately, employment in the United Kingdom, as in other parts of the world, has become increasingly difficult for school-leavers to find. It is hardly surprising, therefore, that partially sighted adolescents experience a high level of job failure and unemployment.

The study reported in these Research Notes is part of a larger research project aimed at identifying factors that affect the occupational success or failure of partially sighted school-leavers in their first year of employment. Ophthalmic and psychological factors are being investigated, since it is thought that both interact to affect occupational success. One such factor is the relationship between visual ability and job ability—a complex relationship, since it is thought that ability to use residual vision is independent of distance visual acuity (Bier, 1960; Colenbrander, 1977; Genensky, 1976).

To study these various aspects, it is necessary to collect information from partially sighted adolescents about their range of occupational experiences. Clinical information is being obtained while the subjects are in their final year at school. Approximately one year after the individuals leave school, information is sought on occupational status, number of jobs held, satisfaction with the present job, and other psychological factors.

This article is not concerned with the results of the larger study, which has yet to be completed, but outlines the methodological difficulties of collecting psychological and biographical data on the population of interest and reports on methods of overcoming these difficulties. The results noted here have important implications for the collection of information from similar clinical studies.

Methods of Data Collection

The acquisition of valid psychological and biographical information seems, on the surface, to present considerable difficulties. One method—that of conducting personal interviews—is expensive and time consuming. The other viable alternative, a self-completed mail questionnaire, which involves reading and answering many detailed questions, is usually considered inappropriate for the partially sighted. In addition, mail questionnaires typically yield low response rates even with the normally sighted (Goode & Hatt, 1952), the return rate being between 20 percent and 70 percent. Conclusions from survey data are likely to be valid only if a high response is achieved. Nevertheless, the economies of mail-questionnaire surveys are considerable and the social science literature has shown that there is a variety of techniques that can yield good response rates. These techniques, developed by social scientists, are little known in other fields.

One technique is to contact the sample before sending the questionnaire. A review of 12 studies reported an increased response rate with prior contact (Linsky, 1975). Usually such contacts are by telephone, letter, or earlier personal contact. They serve to identify the researchers, discuss the purpose of the study, and request cooperation. In the present study, approximately 40 percent of the sample had already been examined by one of the authors. We decided to investigate whether the variable of prior contact was important in improving the response rate. If it proved to be valuable, the policy in the remainder of the research would be to contact those individuals with no prior knowledge of the study.

In some studies, incentives have been offered to subjects with the aim of increasing the number of responses. Financial incentives are common, but others such as the gift of turkeys or lipsticks have also been used (Greenberg & Manfield, 1957). A review of 17 studies concluded that prepaid monetary incentives yield large increases in the response rate and that the larger the monetary incentive, the greater the increase in response (Armstrong, 1975).

The promise of a reward does not have as strong an effect as a prepaid incentive, but can be more cost effective, since it involves payment only to respondents and not to all who are sent the questionnaire. Thus we decided to investigate whether an increased response rate would be obtained as a result of offering financial incentives to the sample under study. Costs would be kept to a minimum by promising to pay only those who returned a completed questionnaire.

Other social-survey techniques are well established and have been consistently shown to increase response rates. These include sending a covering letter with the questionnaire and two or three subsequent follow-up letters spaced at appropriate intervals. These techniques were also used and are described in detail in the article.

Sample

The sample consisted of 89 partially sighted individuals, aged 17–20 years, who had left schools for the visually handicapped during the previous academic year. Thirty-five subjects, drawn from one school, had been examined by one of us on a number of occasions during the previous academic year. They were fully conversant with the purpose of the study. The remaining 54 subjects, taken from six schools, had not previously been examined and had no knowledge of the study.

The subjects previously examined were divided into two groups (Groups 1A and 1B) consisting of 17 and 18 subjects, respectively. The remaining subjects were similarly divided into two groups (Groups 2A and 2B) each with 27 subjects. Each group was matched by sex and, when possible, intelligence quotient. Groups 2A and 2B were also matched for previous school attended. Groups 1A and 2A were offered a financial incentive of £1 ($2) to reply. The type of ocular pathology and distance visual acuity were about equally distributed throughout the four groups. The modal distance acuity was in the 6/60 to 6/36 [20/200 to 20/120] range.

Questionnaire

The questionnaire was 25 pages and long consisted of two parts. The type selected was IBM Bookface in upper-case letters with 10-pitch spacing. The necessary high contrast was achieved with the Rank-Xerox 9200 photocopying process. The format had previously been discussed with teachers of the visually handicapped, and the questionnaire was subsequently tested on four partially sighted subjects aged 19–22 years. Appropriate modifications were made at each stage.

The first part of the questionnaire, which was completed by all subjects, sought biographical information and contained two psychological scales. The second part was divided into three sections containing questions on employment, unemployment, or further education. Subjects were asked to complete only the section that corresponded to their appropriate occupational or educational status.

Use of Social Survey Techniques

The survey techniques are described in depth, since a major purpose of this article is to communicate these methods to other researchers and recommend their use to obtain good response rates from a priori unpromising samples. The use of financial incentives and personal contacts is the object of investigation and is reported later in these Notes.

An explanatory covering letter was enclosed with each questionnaire mailed. The letter stressed that the research was being conducted for a governmental department, that the research was important, and that the cooperation of subjects would aid future visually handicapped school-leavers. Prepaid envelopes were enclosed with each questionnaire. Handstamped envelopes were used both on outgoing and return envelopes, since there is evidence that prepaid metered mail yields poorer returns than handstamped mail (Kephart & Bressler, 1958).

The most crucial aspect of the procedure was the use of follow-up letters. To determine the exact timing of these letters, a graph was plotted showing the number of responses, as a cumulative fre-

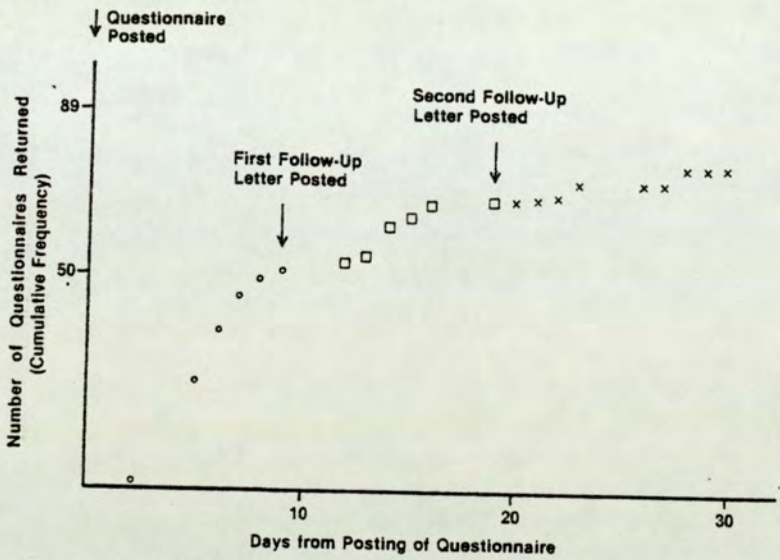

Figure 1. The effects of follow-up letters on response rate.

Table 2. Significance Levels of Chi-Square Analysis of Differences in Response Between the Four Experimental Groups at T_1 Prior to First Follow-up Letter

Group		*1A*	*1B*	*2A*	*2B*
Examined & Incentive	*1A* >	—	NS	$<0.05^a$	$<0.005^b$
Examined	*1B* >		—	NS	NS
Incentive	*2A* >			—	NS
Neither	*2B* >				—

[a] Significant ($p < 0.05$) at T_2.
[b] Significant ($p < 0.025$) at T_2. All values nonsignificant at T_3.

quency, against the number of days from the mailing of the questionnaire (see Fig. 1). At the point at which the response curve became asymptotic, a follow-up letter was sent to all the nonrespondents. This letter produced more returns, and the process was repeated for the second follow-up.

The first follow-up letter was mailed to those subjects who had not replied nine days after the first mailing; it again stressed the importance of everyone responding and the value of the research to other partially sighted school-leavers. The second follow-up letter, with an additional questionnaire ("in case you have lost the original questionnaire"), was sent to the remainder of the subjects ten days after the first follow-up letter. Some investigators recommend a third follow-up by letter or telephone. However this was not done in this study because of the high response rate after the second follow-up letter.

Results

The response rates for each group are given in Table 1. They are presented and analyzed in terms of three time periods: T_1, T_2, and T_3, which correspond to the time of the first follow-up letter, second follow-up letter, and final response.

Statistical analysis was performed with a chi-square test for two independent samples; when the sample size was insufficient, Fisher's Exact Probability Test was used (Siegal, 1956).

Discussion

Of the total of 89 questionnaires mailed initially, 78 completed questionnaires were received, giving an overall response rate of 87.6 percent. An additional four questionnaires from Groups 2A and 2B were returned uncompleted. (In the period since the collection of the clinical material, three subjects had left their recorded address and one subject had become totally blind.) These questionnaires have been omitted from the analysis in Tables 1 and 2.

The effect of financial incentive on response rate can be seen in Table 2. The financial incentive offered in the study did not significantly increase the response from the subjects irrespective of whether they had previously been examined (Groups 1A and 1B) or had not been examined (Groups 2A and 2B).

The effect of prior contact can also be seen in Table 2. The results show that of the individuals receiving an incentive (Groups 1A and 2A), those previously examined (Group 1A) responded significantly better in the first time period ($p < 0.05$) than those who received only an incentive (Group 2A). This difference was maintained in the second time period. Previous examination, however, did not significantly increase the response from those individuals who were not offered a financial incentive to reply (Groups 1B and 2B).

These results suggest that the combination of the two factors of prior contact and financial incentive may have enhanced the response rate. Further evidence for this hypothesis can be seen in Table 2. Those individuals who had been examined and who received financial incentive (Group 1A) responded significantly better than those who had neither financial incentive nor prior knowledge of the study (Group 2B) during the first and second time periods ($p < 0.005$ and $p < 0.025$, respectively).

It can be seen from Table 2 that no values of chi square were significant for the final time period. Indeed, Table 1 shows that a return of 87.5 percent was achieved from the individuals in Group 2B who were neither examined nor given an incentive to reply. This implies that a high return could perhaps have been achieved without either incentive or prior examination. Certainly, combining financial incentive with prior examination expedited the return of the questionnaire. The rate of response is most important in reducing the administrative inconvenience and cost of sending follow-up letters.

Conclusions

The overall returns, ranging from 87.5 percent (Group 2B) to 100 percent (Group A) were high compared with the usual response rates to mailed questionnaires in general populations. In retrospect, the reasons for the high response rate are not difficult to find. The concerted application of a set of procedures such as those used here has been shown to yield mail response rates of 70–75 percent in large general population samples (Dillman, 1972). The difference between these figures and ours can probably be accounted for in the nature of the sample. Although many of the partially sighted respondents must have had difficulty completing a lengthy and complex questionnaire, their interest in the subject matter probably encouraged them to persevere. Other studies have shown that strong interest in a topic under investigation can increase response rates to as much as 86 percent.

There are important implications of these findings for research with other clinical samples. The findings show that with appropriate social survey techniques (rig-

Table 1. Number of Usable Replies Received from Four Groups over Three Time Periods

Group	*Total Number of Possible Replies*	*Replies Received at Time Periods*					
		T_1		*T_2*		*T_3*	
		Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1A	17	15	88.2%	17	100%	17	100%
1B	18	12	66.7	15	83.3	17	94.4
2A	26	15	57.7	20	76.9	23	88.5
2B	24	10	41.7	16	66.7	21	87.5
Total	85	52	61.2	68	80.0	78	91.2

orous use of follow-up letters, suitably worded letters, hand-stamped mail, incentives, and personal contact) high response rates can be achieved. Mailed questionnaires thereby become a cost-effective means of collecting high-quality data.

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Evaluation of RSA Program for Blind and Visually Handicapped Persons

The Rehabilitation Services Administration (RSA) has announced that the evaluation study entitled *Evaluation of RSA Program for Blind and Visually Handicapped Persons* has been completed by JWK International Corporation. The final report consists of: 1) Executive Summary Report, 2) Utilization Seminar Report, 3) In-Depth Study Report, 4) National Report, and 5) Individual State Reports. What follows is the Executive Summary Report.

This study, conducted by JWK International Corporation for the Rehabilitation Services Administration (RSA), was undertaken to assess the effects that the organizational and administrative structures of vocational rehabilitation (VR) agencies have upon the delivery of services to blind and visually handicapped clients. All State VR agencies serving blind and visually handicapped clients were included in the study. The data obtained from a telephone survey of these agencies were used to group these agencies by type of administrative structure. This categorization of State agencies facilitated an assessment of the resource, management, program, and outcome variables associated with effective and efficient provision of services to blind and visually handicapped clients. This study also explored the relationships among the components of the VR system for blind and visually handicapped persons: the State VR agencies, RSA regional offices, and RSA's Bureau for the Blind and Visually Handicapped.

All questionnaires were developed by JWK staff with the advice of the project's Advisory Committee. Members of this committee actively participated in all phases of this study. A utilization seminar was held to review study conclusions and formulate recommendations.

These conclusions were drawn from the study findings:

- Blind clients are served better in specialized caseloads
- Length of time in the VR process and cost of services are related
- Visually handicapped clients are as satisfied with VR services as other handicapped clients
- There appears to be a lack of communication among the three components of the VR system
- There appears to be confusion concerning the essential functions of RSA regional offices and the Bureau for the Blind and Visually Handicapped
- The type of administrative structure of State VR agencies has only a slight relationship to program outcomes
- And there is no evidence to indicate that any one type of agency is more cost effective than another.

The following recommendations were suggested by project staff and approved by the Utilization Seminar participants:

- Blind and visually handicapped VR clients should be served in specialized caseloads of only blind and visually handicapped clients
- The role of the RSA regional offices and the Bureau for the Blind and Visually Handicapped should be clearly defined regarding provision of technical assistance and policy interpretations to State VR agencies serving blind and visually handicapped clients
- Communication among the three components of the VR system serving blind and visually handicapped clients should be improved
- In-service training should be available to rehabilitation counselors and to regional office staff
- The reports produced by this study should be disseminated by the National Rehabilitation Information Center
- The assumption that combined agencies are more cost effective should be seriously questioned
- And further research, study, or demonstration projects should be undertaken that would focus upon the rehabilitation process for blind and visually handicapped persons.

RSA will be making an initial distribution of these reports to the various State vocational rehabilitation agencies that serve blind and visually handicapped clients. Anyone interested in obtaining copies of these reports may do so by contacting the National Rehabilitation Information Center (NARIC), 4407 Eighth Street, N.E., Catholic University, Washington, D.C. 20017, telephone (202) 635-5822. Copies will be available in print or tape cassettes. A nominal fee will be charged for handling and processing.

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