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PARTIALLY SIGHTED CHILDREN:

THE

VISUAL PROCESSING OF WORDS

AND

PICTURES.

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ABSTRACT.

Reading is normally by eye and by ear, but what happens if eyesight is severely impaired? The hypothesis put forward in the first part of this thesis is that partially sighted children adopt a predominantly nonlexical word recognition and production strategy. This is likely to be because of the reading tuition they receive, which emphasises individual letters and letter patterns in words in relation to pronunciation.
This study explores the word and picture processing abilities of a small group of partially sighted children, using a series of experimental tasks.
Surprisingly, the analysis of oral reading errors in Study 1 revealed that the partially sighted children were using the same salient graphic cues as young fully sighted readers were normally found to be using.
Further experiments using lexical decision tasks were carried out in Study 2 to investigate more closely the strategies used by partially sighted and matched fully sighted children in relation to lexical and nonlexical processing. Although there was clear evidence of nonlexical processing on the part of partially sighted children, there were also signs of lexical processing, too. Additional evidence was provided by their spellings presented in Study 3. The investigations described here suggest that the compensatory reading tuition experienced by the PS children led to a dominant nonlexical processing strategy, though not to the exclusion of lexical processing. Impaired eyesight was not associated inevitably with poor reading and spelling levels.
The second hypothesis is that impaired eyesight is associated with poor visual recognition and recall of pictures, because of difficulty in accurate identification and slow processing. However, under the favourable conditions provided, which included a relatively lengthy exposure time, this was not entirely the case. The ability of the PS children to recognise pictures was remarkably good. Greater difficulty by them with the recall of pictures suggested partial specification of internal representations.

These studies were set alongside comparable work with blind children. They contribute to the very sparse literature on PS children and confirm that these children can overcome severe visual handicap to present a profile of skilled accomplishment.

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CHAPTER 1

A FRAMEWORK FOR RESEARCH WITH PARTIALLY SIGHTED CHILDREN.

1. INTRODUCTION.

The main purpose of this thesis is to examine some aspects of word recognition, spelling and picture processing by young partially sighted (hereafter PS) children being taught to read by a method which emphasises individual letters and letter patterns in relation to their pronunciation. The underlying thinking is that visual impairment and/or tuition method may bias the reader/speller towards the use of one kind of processing rather than another.

This thesis builds on the work of Lansdown (1973). It concerns the same age range (5/6 years to 9/10 years) and studies solely the cognitive processes of PS children. In this first section particular attention is paid to reading and spelling, and in the second section, emphasis is on picture processing.

A working definition of partial sight for present purposes (see Appendix 1 for a fuller definition) is partial sight sufficient to warrant education in a special school, but where the pupils learn to read and write print and not Braille.

1.1. PREVIOUS RELEVANT UK RESEARCH CONCERNING PS CHILDREN.

The research literature specifically concerned with ability and the educational attainments of PS children is sparse. This could be because the number of known children in England with partial sight is small, a conservative incidence, derived from numbers in Special Schools, being in the region of 2.45 PS children per 10,000 of the fully sighted child population (D.E.S. 1983). It could also be because PS children are a heterogeneous group, visually as well as in other respects. Additionally, unlike the population of blind children whom they outnumber, PS children are educated now predominantly in mainstream schools. There, if their needs are adequately met, they merge into the general school population.

A comprehensive piece of research into the visuoperceptual performance of PS children in relationship to reading and spelling, is that of Lansdown (1973). In that study he reviewed the relevant literature up to that date in the U.K. and the U.S.A. as it related to partial sight and school attainment. Of the twelve studies he reviewed, only four were from the U.K. Two of these were small studies (Lansdown, 1967, Carroll and Hibbert, 1973). Lumsden (1934) carried out a national survey commissioned by the Board of Education into the educational status of partially sighted children. The Fine Report (1968) was also a large educational survey of blind as well as PS children and focused on incidence, aetiology and provision, rather than detailed cognitive functioning.

These four studies, together with those from the U.S.A., presented a picture of poor academic performance in school by PS children. This was confirmed by the Vernon Report (1972), a U.K. government enquiry into The Education of the Visually Handicapped.

Reynell and Zinkin (1975) and Reynell (1978), writing after Lansdown, reported their developmental studies of blind and partially sighted children from birth to six years. Their method was observational, centred around standard key tasks or behaviours. They charted the motor and cognitive development of visually impaired children in relationship to that of sighted children of the same age, but identified particular behaviours such as exploration of the environment or reaching to sound, which were especially important to the visually impaired child. They found evidence of a delay in some areas of language development, particularly naming objects, but essentially Reynell's research concerned a younger age group than that studied by Lansdown, or than is the focus of this thesis.

Because of the dearth of relevant and recent research literature concerning young PS children, the method adopted here has been to review Lansdown's findings in detail, in the theoretical context in which his study was set, and then to address the major question his thesis raised:'how it can occur that PS children, who start from a position of visuoperceptual delay at the age of six, can learn to read and write as well as their fully sighted (hereafter FS) peers by the age of eight ?'

Following this initial literature review, each Study is also introduced by a short review, drawn appropriately from reported studies of FS children.

1.2.LANSDOWN'S INITIAL SURVEY (1973).

The work for this first survey was started in 1969 and involved approaches to five PS schools in the London area.The proposition under investigation was that PS children performed poorly in school. The aim in the initial study was to test hypotheses derived from this proposition in as general a way as possible, with a view to studying a smaller sample in more detail later.

1.2.1.LANSDOWN'S RESEARCH CONTEXT.

Lansdown took the work of Vernon (1957, 1971) and of Gibson (1962, 1965) as reference points for studying the visuoperceptual functioning of PS children, though both Vernon and Gibson stressed that reading and spelling were complex skills which demanded much more than visuoperceptual competence. The ability to perceive the distinctive features of letters and words was only a part of that process.

Studies of that era, to which Lansdown referred, looked, for example, at backward readers and found that they had difficulties in the visuoperceptual sphere. However, older, backward readers are not the same qualitatively as young six year old, beginner readers. Moreover, little account was taken of teaching methods in such studies, so although Lansdown's thesis started in that vein, and although the initial survey seemed to reach similar conclusions, his main study was very different. It demonstrated quite clearly with very carefully matched samples of children, that good reading can be accompanied by delay in visuoperceptual processing.

1.2.2.ONE INITIAL HYPOTHESIS.

An initial hypothesis was that partial sight loss led to a lowering of performance in the sphere of visual perception and that this was associated with poor academic performance.

1.2.3. METHODS AND PROCEDURES USED IN THE INITIAL SURVEY.

136 PS children in the age range 7 - 11 years 11 months were available from three day special schools for PS pupils. Of those, 107 girls and boys were tested; those having secondary handicaps which severely affected their learning capacity were omitted.The children were divided into two groups, 'simple' - PS with no secondary handicap, and 'complex' - PS with a secondary handicap. Visual acuity was between 6/24 and 3/60. The children were tested in their own schools on standardised tests and no control groups were included. Statistical analysis allowed for comparisons of the PS against standard norms, and of the 'simple' PS group against the PS 'complex' group, as well as school by school comparisons.

1.2.4.CONCLUSIONS FROM THE INITIAL SURVEY.

Focusing on the one hypothesis mentioned in 1.2.2., the results revealed a significant partial correlation between scores on the Frostig Developmental Test of Visual Perception and the Burt Word Reading Test, when ability, measured on the Vocabulary subtest of the Wechsler Intelligence Scale for Children (WISC), was held constant.

This result meant that, despite average ability as measured on the WISC Vocabulary subtest and the English Picture Vocabulary Test (EPVT), all PS groups in all three schools revealed perceptual delay. This delay was accompanied by delays in reading and spelling on the part of all PS subjects in two schools and by the 'complex' PS group in the third school. However, the 'simple' PS group from the third school scored almost at an average level on the tests of reading and spelling, despite this perceptual delay. It is true, of course, that their mean WISC Vocabulary subtest score was 11 - slightly higher than that of the other two 'simple' PS groups.

There was support for Lansdown's hypothesis that in the age range 7 - 11 years 11 months, delays in visuoperceptual development were associated with delays in acquiring reading and spelling skill. However, the anomalous finding from one school threw into question whether or not PS children generally perform poorly in school. Some clearly did not.

1.2.5.LIMITATIONS AND UNANSWERED QUESTIONS.

No comparisons with FS pupils were undertaken in this initial survey. The sample was drawn from three special schools and was not necessarily representative of PS children as a whole. The sample was heterogeneous, as PS children with a secondary handicap formed the 'complex' group. Some of the tests were old, or, such as EPVT, unsatisfactory for use with PS children. The results from one of the three schools were better than those from the other two and this, too, raised doubts about the generalisability of the findings. These considerations all influenced the design of the main study.

1.3.LANSDOWN'S MAIN STUDY (1973).

One major aim of Lansdown's main study was to draw a representative sample of the PS child population, so as to be able to test hypotheses and provide findings which were generally applicable to that population. He made many improvements in design and sampling, in the choice of tests and in their administration.

1.3.1. THE MAIN HYPOTHESES.

Lansdown's first hypothesis stated:

'That partial sight does not result in a significant concomitant educational handicap.'

His fifth and last hypothesis stated:

'That there is no significant relationship between the results of tests of accuracy and speed of visual perception and those of reading and spelling.'

The remaining three hypotheses concerned comparisons between PS and FS children in their speed and accuracy of discriminating 2 D forms and in their reading and spelling attainments.

1.3.2. METHODS USED IN THE MAIN STUDY.

Lansdown's aim was to assemble a sample from the entire national PS child population, using a random sampling technique. First, he sent a questionnaire to all schools for the PS in England and Wales. The response rate was high (76%) but not complete. One key school was unable to participate, and boarding pupils (40% of the 76%) were felt likely to differ educationally from day pupils. He decided to work with the six day schools in the London and Home Counties area. These had sent a 100% response to the questionnaire and also accounted for as many as 45% of the total number of PS children in England and Wales. Theses six schools provided a pool of 62 potential subjects in the age groups 6, 8, and 10 years. These girls and boys were all of average ability and had no secondary handicaps. Visual acuity was within a wider range than in the initial survey, so that PS children whose visual acuity was a little better than 6/24 could be included, as is now customary within the definition of partial sight, for purposes of registering as partially sighted. By means of a random sampling technique, with stratification by size of school, 10 pupils were assigned to each of the three age groups. The sample of FS children was drawn from the mainstream schools nearest to the special schools and was matched on age, ability and social class.

There were changes and improvements in the battery of tests:

- newer reading and spelling tests replaced some of the previous ones:
- measures of ability were improved:
- the range of perceptual tasks was altered.

Ability in the Main Study was measured by the WISC Vocabulary and Similarities subtests and Raven's Coloured Matrices.

The three tests of visual perception in the initial survey all required a motor response. Lansdown commented that the Benton Test of Visual Retention was lengthy and found to be tedious by the PS subjects. The Frostig DTVP was also lengthy. These two tests and the shape copying were replaced by the Bender Visual Motor Gestalt Test which requires the copying of visual designs from printed examples. A second perceptuomotor task was introduced - the measuring of perceptions in response to the Mueller-Lyer illusion figure.

Three new, specially devised visuoperceptual tasks were introduced:

- shape matching
- letter matching
- matching letter-like forms

In each case the task was to match the target figure with the appropriate stimulus, and the target was either a single or a triple figure.

Speed of processing was viewed as important and was measured in four ways:

- the speed of drawing a line.
- the speed of completing a sentence.
- the speed of button pressing.
- the speed of completing the matching tasks.

1.3.3. PROCEDURES.

The pilot studies led to some modifications in the arrangements for timing, to prevent what Lansdown described as 'grabbing' on the part of the PS children. When timing was automatic, the PS seized the first possible solution and had no opportunity for self correction. The result was the recording of a high number of avoidable errors. When timing was by hand operated stop watch, the children could self correct and make their considered choice, before the timer was stopped.

The pilot tests also showed that on some tasks, there was a steep initial practice effect. In view of this, the first three scores were regarded as practice trials and not included in the final result for those tests.

Statistical analysis allowed for direct comparisons of performance between the PS and FS groups.

1.3.4.CONCLUSIONS OF THE MAIN STUDY.

Significant differences in performance on the visuoperceptual tasks between the PS and the FS groups, were accompanied by equivalent performance on the attainment tasks by the same PS and FS children, who were of average ability.

Whereas, in the initial survey, there was a partial correlation between delay in the visuoperceptual sphere and delay in reading and spelling on the part of the PS, here, the nature of the relationship was different In the Main Study, PS and FS children could read and spell at a comparable level, (see Table 1), but the PS were significantly slower and less accurate than the FS at single shape matching, measuring and copying designs.

Table 1. A Comparison of the Reading and Spelling Attainments of Matched PS and FS Groups.(Lansdown,1973)

	PS	FS	
	n=30	n=30	
mean age	8y 7m	8y 7m	
Neale Reading Age			
accuracy	8y 3m	8y 6m	
comprehension	8y 7m	8y 5m	
rate	7y 11m	8y 5m	
Daniels & Diack			
Spelling Test	21	20	average items correct

Lansdown's fifth hypothesis, set out in 1.3.1. was not upheld, but his first hypothesis was upheld. Partial sight does not result in a significant concomitant educational handicap.

1.3.5.LIMITATIONS OF THE MAIN STUDY.

Lansdown's very carefully selected PS sample was not a national one and was drawn from day pupils in special schools only. Matching PS and FS pupils using available intelligence tests is problematic (see 1.4. below). Both these factors could be considered to be limitations to the study.

1.3.6.LANSDOWN'S PARADOX AND THE UNANSWERED QUESTION.

Lansdown did not analyse raw scores statistically at each separate age level, for he considered the numbers in the sample to be too small to do so. Many of the differences in raw score were clearly not statistically significant, but in one or two cases the error level was almost twice as great as elsewhere. For example, at the age of 6 years, the PS subjects produced almost twice the number of shape matching errors than the 6 year old FS children. This large difference was not present at the age of 8 years. The same was so for the letter matching errors. The PS 6 year olds made nearly twice as many errors as the 6 year old FS children, but by the age of 8 years, this large difference had gone. On one of the reading tests, the 6 year old PS children could read fewer than half the number of words that the FS 6 year olds could read. By the age of 8 years, both groups were reading equally well. Such a difference was not present with spelling at 6 years of age.

The paradox, then, which Lansdown presented, was that at 6 years of age, PS children of average ability were less accurate than FS children of the same age and ability at shape matching, letter matching and reading. But by the age of 8 years, the PS and the FS were reading and spelling at the same level.

The question which Lansdown did not address, except in passing, was, what learning processes occurred between the ages of 6 and 8 years to bring about these changes?

It is the purpose of this thesis to clarify the implications of the early visuoperceptual delay on the part of the PS children and to explore the strategies which are available between the ages of 5/6 and 8/9 years to yield the level of attainment which Lansdown found at the latter age. Attempts to predict reading ability from early visuoperceptual capability or to correlate the two, lead to no further advances in our understanding of the learning abilities of PS children, nor of the cognitive processes involved in reading.

1.4. SOME ISSUES CONCERNING MEASURES OF ABILITY OF PS CHILDREN. AND MATCHING PS AND FS SUBJECTS.

One of the drawbacks of Lansdown's first survey was that no direct comparisons were made with FS children, and his PS sample was heterogeneous. These two limitations were rectified in the Main Study, but the methodological difficulties inherent in measuring the ability of PS children, and matching these measures with those of FS children, remained.

If, as Reynell and Zinkin (1975) demonstrated, the young PS child below the age of six displayed some language delay, particularly in the sphere of vocabulary acquisition, then the use of a Vocabulary test at a later age should be undertaken with caution. Scores on such a test were likely to be an underestimate of ability.

Tobin (1978) quoted studies by Tillman (1967), Tillman and Osborne (1969) and Smits and Mommers (1976) looking at the performance of blind and sighted children on the various subtests of the Wechsler Intelligence Scale for Children (WISC).

Tillman's studies in the U.S.A. were of a large sample of blind and sighted children in which the inclusion of scores for auditory memory (WISC Digit Span subtest) increased the IQ scores of the blind and made up for low scores by the blind on the WISC Similarities and Comprehension subtests.

Smits and Mommers in Holland compared the WISC Digit Span scores of large groups of blind and sighted children and found that the mean auditory memory scores of the blind were higher than those of the sighted. They stressed that the blind and the sighted did not have the same WISC profile.

Smits and Mommers examined the Digit Span scores of blind children without residual vision and those with residual vision.These would be closest visually to the PS children under consideration here. They found that blind children without residual vision had higher mean scores on the Digit Span subtest than both blind children with residual vision and sighted children. However, blind children with residual vision also had slightly higher mean scores on this subtest than the sighted, but lower scores than the blind.

These findings must throw a little doubt on the use of WISC Vocabulary and Similarities subtests as measures of verbal ability for the PS for matching with an FS control group. The authors above advised that in computing an IQ for blind subjects, it was desirable to include the Digit Span score and then to prorate the total Verbal subtest scores. It is likely that the same advice could usefully be followed in the case of PS subjects.

In the Studies in this thesis similar difficulties were encountered in the measuring of the IQ of the PS subjects. The British Ability Scales (Revised Edition, Elliott 1983) were used as having been standardized recently in the U.K. However, the standardization sample of these Scales did not include partially sighted children so individual scores must be interpreted with caution. Subtests used included tests of reasoning (Matrices, Similarities), spatial imagery (Block Design Level, Block Design Power), short term memory (Recall of Designs, Recall of Digits, Visual Recognition), retrieval and application of knowledge (Word Definitions).

A further difficulty arose in the matching of PS and FS subjects by reading age. Early observations for this series of studies revealed that young PS children made a slow start with reading, even though they were of average ability and were receiving appropriate tuition. Thus, in the early years, their reading ages might be lower than expected. In some cases this slow reading progress persisted for several years. An 8 1/2 year old PS child of average ability with a reading age below chronological age might be progressing satisfactorily and along recognised lines. An FS child in this position, however, might have specific word processing difficulties. Matching PS and FS children on reading age was, therefore, likely to be problematic.

1.5.READING AND PARTIAL SIGHT.

There is no inevitable reason to think that PS children will find the reading of print more difficult than do FS children - except that print is an entirely visual medium. It is true that print is being mapped onto an already existing language competence on the part of the PS child - but, nonetheless, print is visual and it is known to consist of many small featural differences which many FS children have difficulty in distinguishing.

There are two ways of comprehending what the impact might be on a PS beginner reader of having letter images which might differ from those of the FS beginner reader in terms of clarity and stability. One way is to study the physiological processes of the eye and the way in which the flutter of patterns on the retina becomes electrical impulses transmitted to the cortex by the optic nerve. The other way is to study the psychophysics of normal and low vision reading, looking, for example, at the two interacting subsystems for transient and sustained vision, reflected in spatial frequency analysis (Stein, 1991, Lovegrove, 1991).

Legge et al (1985) commented as follows: 'In recent years, a great deal has been learned about basic sensory mechanisms of pattern vision, but we still know next to nothing about the roles played by those mechanisms in important everyday tasks like reading.' And with regard to low vision readers: 'Very little is known about the effects of visual impairment on reading.'

Much of their article on low vision reading concerned adult rate of reading, and in this context the authors examined the effects of blur, or spatial frequency, contrast and sample density on reading speed. Spatial frequency, measured in bandwidths or cycles per character, ranges from 0 through 5, and allows for the increasing resolution of the detail of various letters. These authors considered that 2 cycles per character were necessary for normal, accurate letter recognition. Contrast is measured on a scale from 0 to 1, low contrast being at measures nearest to 0. This dimension was important, for it was established that the light scatter in cases of cataract diluted image contrast. Sample density gives a measure of the amount of the viewed object which has to be sampled for recognition to occur. Four densities of dot matrix revealed differences in identification. The normal eye required a matrix with a density of 11 x 11 samples per character, whilst for the low vision reader a matrix density of 13 x 13 samples per character was more appropriate.

Legge et al (1985) also studied character size and window width, or number of letters in view, in relationship to speed of reading. All these aspects of the psychophysics of reading are of more relevance than the Snellen high spatial frequency measures of acuity, on which registration as partially sighted is based.

What Legge et al made clear was that although the physiological working of the visual system may be understood, the understanding of vision as it related specifically to reading, was less so. Although the total understanding of how impaired vision affected reading was also not clear, there were two aspects which did affect speed of reading: the first was whether central vision was intact or not, the second was whether the visual media were clear or not. The effect of damaged central vision, as in retinal aplasia, was to reduce reading speed, so, too, was the effect of cloudy media, as in cataract.

For adult or skilled readers, speed is important. This is not so for children and beginner readers. Indeed, it may be an advantage initially for reading to be slow.

1.5.1. CLOSED CIRCUIT TELEVISION.

Variations in print character size, contrast polarity, luminance and image resolution are obtainable by use of a Visualtek closed circuit television (CCTV). This system consists of a TV monitor with a trolley beneath it, on which the printed text rests. Individual controls allow for quick individual adjustment by the reader along each dimension (see Appendix 2).

Tobin (1985) demonstrated that reading by use of this CCTV system was slower for the PS child than reading without it. Most can and do read using their own individual low vision aids. In the case of the beginner readers, however, or those still in tuition, the slowness of reading speed associated with the CCTV could be regarded as an advantage in learning to process words accurately.

1.5.2.PARTIALLY SIGHTED CHILDREN READING.

The Committee chaired by Vernon, appointed in 1968 to look into the Education of the Visually Handicapped, reported in 1972 and commented as follows on the reading attainment of PS children in England and Wales:

'The most frequent general observation was that reading standards among PS children were significantly lower than standards among sighted children. Like blind children, PS children are likely to fall well below the reading speeds of sighted children, but the PS child may also be slow to master the basic techniques of reading.'

Lansdown (1973) demonstrated that lower standards on the part of the PS were not inevitable. Despite this, the general observation made in the Vernon report has some validity. The presence of partial sight sight does have educational implications. If the PS reader is taught inappropriately, without sufficient attention to his or her specific requirements, then the literacy standard achieved will be low.

There are some practical arrangements to be made when planning the reading tuition for a young PS beginner reader - seating, lighting, print size, the clarity of the layout of the book, the quality of the pictures and the content of the text. But, less well appreciated, is the need for an understanding of issues to do with the time required by the PS child to process visually presented information, to do with fatigue, together with the teaching method which will best capitalise on the PS child's strengths. These might be in the sphere of linguistic competence and phonological awareness, both of which might minimise the impact of impaired vision.

Early drawing and scribbling are not intrinsically rewarding to the young PS child. Incidental learning of visual material is less likely to occur. The PS child has to be taught intensively, specifically and methodically. This is a very different starting point from that of the FS child.

Lansdown's research focused on some aspects of visual perception. The underlying assumption was that some information being passed through the visual system was inaccurate and might yield later difficulties when it came to be reused. A comparable approach by Barraga (1964) showed how young visually impaired children could be taught to improve their visuoperceptual skills. These principles were incorporated into the Look and Think materials (Chapman, Tobin, Tooze and Moss, 1989) for use with blind and PS children in their infant and junior years of schooling.

The emphasis in this thesis is on the processes which come to bear on the sensory perceptions, not just on the perceptual information itself. So, in the case of the visual processing of pictures, which forms the second part of the thesis, both visual recognition and visual recall memory processes are studied in respect of PS children.

1.6.MODELS OF READING.

Three conceptual models inform this thesis: two will be described here briefly for later reference, and one relating to picture processing is presented in Chapter 6.

Ellis (1984) presented a comprehensive model to account for the dual processes involved in seeing or hearing a word and saying it (see Figure 1). This model was based on the very extensive body of literature then available.

A model for both the direct and the phonically mediated recognition, comprehension and naming of written words (Ellis, 1984).

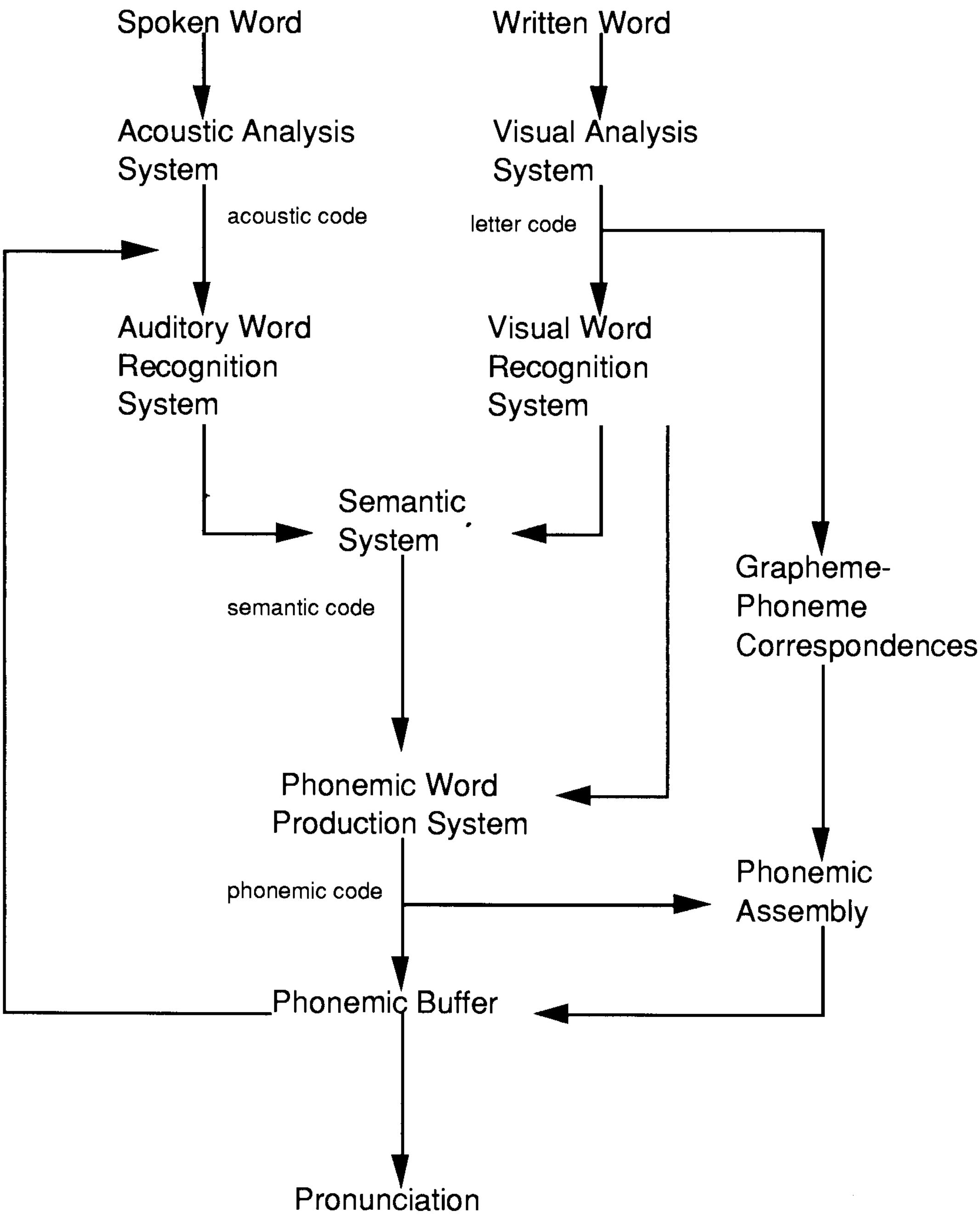

Figure 1

The model is based around the concept of two processing routes - the lexical and the nonlexical, the lexical process being shorter, more direct and faster than the nonlexical one. Reading by eye is accomplished by means of the lexical route, which leads quickly and directly into the semantic system. Reading by ear is achieved by the nonlexical route which contains a grapheme - phoneme correspondence unit. Access to the semantic system for words processed by this route is through entry to the acoustic system - in other words, the printed word is converted into acoustic form and enters the auditory word recognition system.

In this model, decisions about a word's authenticity can be taken on the basis of whether a letter code or an acoustic code exists in the recognition systems. There is some controversy about the lexicon. Ellis (1984) depicts two lexical systems, one for auditory word recognition, the other for visual word recognition, both of which access the semantic system. These contain word recognition units which contain all orthographic and phonological specifications of words. Others might just depict one comprehensive lexicon.

There is also disagreement about the two separate processing routes for the written word. Glushko (1979) maintained that this dual route model was inadequate to account for observations that the two traditional systems, the lexical (word specific) and the rule based (orthographic), worked together in the use of analogy. He used the term word mechanisms not routes, and spoke of a unitary process of activation, so that there could be activation of orthographic and phonological information from various sources to enable a reader to pronounce, for example, 'love' and 'move' or 'leaf' and 'deaf'.

One advantage of Ellis' dual route model is that it allows various groups to be located within it - those who read without phonology, those who read by relying heavily on phonology, those who read without accessing the semantic store. For the purposes of this thesis, it is the early stages of processing which are involved, namely the stage of lexical decision, leading either to entry to one of the word analysis systems or to an exit from the process, if the letter string is detected to be a nonword. One of the issues addressed here, is whether this group of PS children make predominant use of the nonlexical route. This bias might arise either because of the teaching received, which stressed grapheme - phoneme conversion, or it might arise because sight impairment might be associated with impairment of the direct visual lexical route, or for both reasons. Causality for the bias, if it exists, cannot, however, be determined here.

1.7. THE PROCESSING OF WORDS.

One attempt to conceptualise the lexicon was that of Ehri (1978, 1979, 1980) She took the word, not the letter, as the central unit, and took as the starting point, its early identity in a child's speech: this identity had a semantic, a phonological and syntactic form. To this was added, in the course of learning to read and write, an orthographic identity and a morphological identity (see Figure 2). The pre-existing lexical awareness developed through the spoken language had to be given concrete visual form. This process of amalgamation occurred as the child mastered reading and spelling.

A Model of Linguistic Competence (Ehri, 1978)

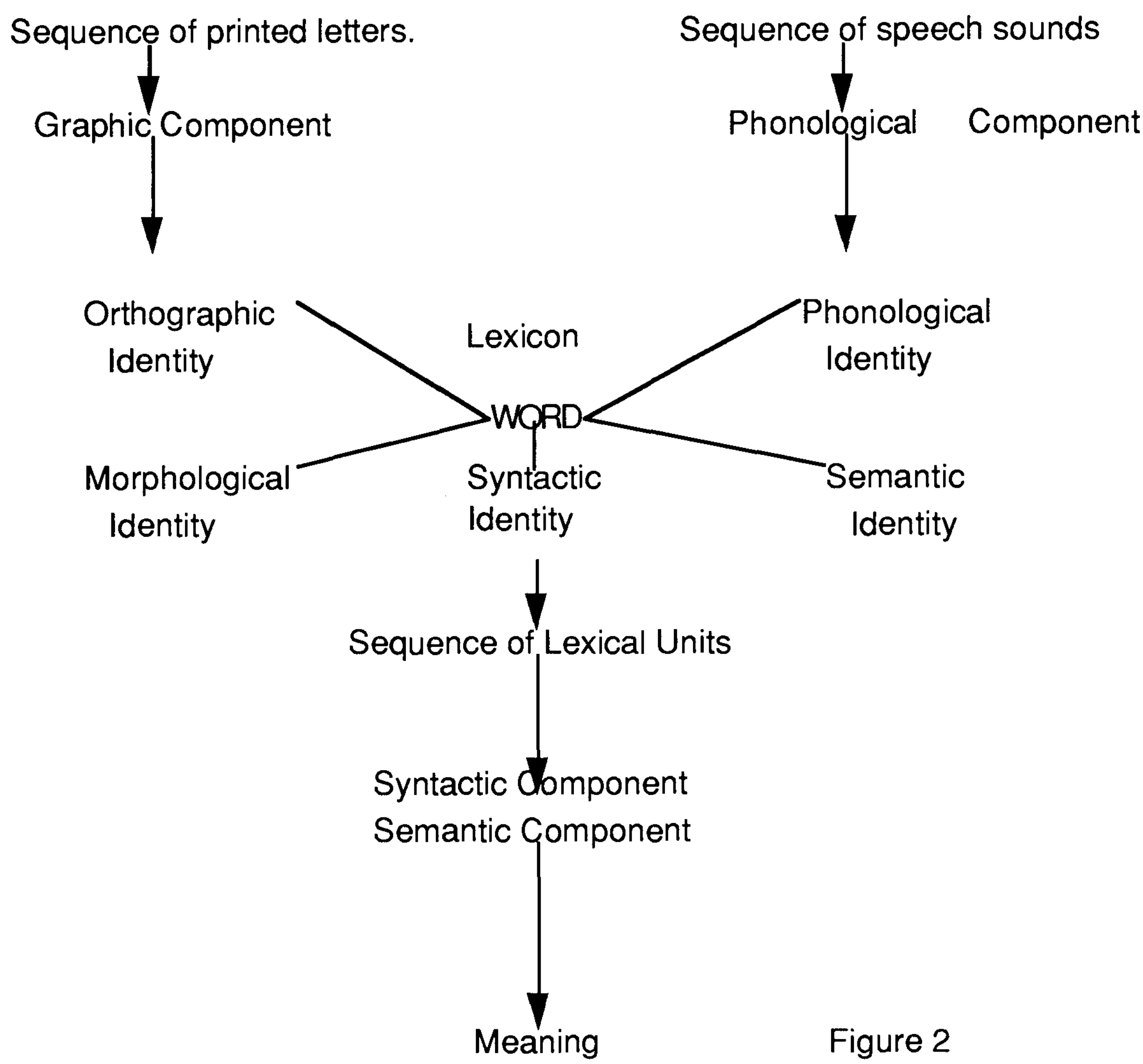

Figure 2

Ehri stressed the importance of the visual image of the word: this visual image was built up by learning spelling patterns and by experience of working with the visual form of the word. The process of acquiring the visual image was partly induced and partly explicitly taught.

Support for Ehri's view came from spelling experiments with 6 and 7 year olds, in which superior spelling followed from hearing the word and seeing the correct version, or hearing the word and imaging to it. In both cases, two codes were generated, the sound of the word and its visual image.

The visual image was central for Ehri in printed word learning: so, too, were memory processes rather than perceptual ones. In other words, she stressed the gradual learning and building up of these visual word images which incorporated not only the linguistic and orthographic specifications already mentioned, but the semantic ones, too.

1.8.SUMMARY.

In this Chapter has been outlined, in brief, the position of the young PS child as he or she approaches the task of learning to read. On the one hand is the general educational observation (Vernon Report, 1972) that this task is a difficult one and that the standard attained may be low. On the other hand, comes the finding (Lansdown, 1973) that for the young PS child of average ability, this low achievement is not inevitable. What is missing is a detailed account of the learning strategies of the PS child and how these compared with those of an FS child of the same age and ability.

The literature on PS children presented earlier in this Chapter indicates that PS children will enter the first stage of reading with a language delay affecting language structures and vocabulary, and with a visuoperceptual delay affecting the speed and accuracy of the recognition of shape. The extent of the language delay is unlikely to affect the early stages of reading or of picture processing, but the delay in visuoperceptual development is likely to have clear consequences. Lansdown has defined this difficulty. He has described the starting point of the 6 year old PS child. He has also described the endpoint - the attainment of the 8 year old PS reader. But he has not described the available processing strategies which enabled that endpoint to be reached.

Published literature up to the present describes the problem in detail, but the solution only in broad outline. In Chapter 2 an attempt is made to redress this position, for in it is presented the reading of a group of PS children in the age range 5/6 - 8/9 years of age.

The focus of the Study is on the number and types of word substitutions or oral reading errors made by the young PS readers and on the types of cues they use to solve the task of word reading.

The study of misreadings, or of partially correct readings, is based on the premiss that the child is using purposefully any available information and experience to solve the problem before him. It provides ' a window on the reading process'. (Goodman and Goodman, 1977). A partially correct word reading is thought to provide the adult with insights, not available from the correct reading, about what information sources the child is, or is not, using. This knowledge can then be used diagnostically by the adult to refine the teaching of the child or to understand more of what stage the child has reached in the reading process.

Also provided in Chapter 2 is a brief mention of the teaching method and the materials used for this group of PS children, for both the method and the type of materials will affect the word substitutions made by the readers.

This method of studying the learning style of young PS readers has an advantage over simply measuring reading and spelling levels on standardised tests. It is dynamic. It provides particular information about the strategies that the teacher and child are using. These implicit strategies can be made explicit and so reused, if successful.

The focus in Study 1, is on the problem solving strategies used by young PS readers and on the misreadings which reveal these. An attempt is made to compare these young PS readers with comparable FS readers, and to see whether the underlying shape matching difficulty of the PS does have any educational implications in the sphere of reading. For it is these which are the concern of this thesis. Further chapters report a systematic investigation of the word and picture processing abilities of these children.

CHAPTER 2

THE WORD SUBSTITUTIONS MADE BY PS CHILDREN.

2.INTRODUCTION.

If a child has difficulty in matching shapes, one implication might be that the child's ability to match and discriminate words will also be inaccurate.That ability is a necessary part of processing by the visual lexical route. Increasing perceptual accuracy, as well as a memory for what has been seen before, are both required at the early logographic stage of reading. Inaccurate discriminations of words might lead to the generation of words, in response to the printed target word, which are nearly correct but not quite. Such miscues, misreadings or misidentifications have been studied widely for the information they provide about the unlearned and taught strategies of the young reader. As PS children are less accurate and slower than FS children at shape matching, the first hypothesis is that PS children make more errors than do FS children in discriminating visually similar words. A high number of their readings might be misreadings. These oral reading miscues might prove to reveal a lower level of graphic similarity to the target than miscues of FS readers of the same age. Study 1 was designed to investigate this issue.

First, the misreading performance of PS children was compared with relevant studies of FS children reported in the published literature.This required a qualitative analysis of reading behaviour along selected dimensions such as graphic similarity and the use of salient visual cues in recognising words.

Next, the performance of PS readers was studied against the broader backcloth of previously observed strategies used in the reading process. This enabled a view to be taken of any areas where difficulty may be experienced unless compensatory strategies were introduced. This aspect was explored further in Study 3.

2.1.RELEVANT LITERATURE CONCERNING ORAL READING ERRORS.

2.1.1.GENERAL.

Miscue analysis (Goodman 1969) provided researchers into the reading process with a powerful new tool, and in the 1970s this was put to use with young readers. Despite its usefulness, however, both Donald (1980) and Leu (1982) pointed to methodological difficulties. For example, there were several different taxonomies of miscue. Moreover, until Weber (1970) and Soderbergh (1971) produced their statistical methods for comparing miscue and target, it was difficult to quantify data. Comparisons between studies were difficult to make.

2.1.2.AGES SAMPLED.

Despite this, it was clear that in the 1970s, there were ongoing studies in the USA, England and Scotland, of children in the earliest stages of reading. Reading research had entered the classroom and could use the materials available there.

2.1.3.CONTENT OF STUDIES.

This, of course, had its difficulties, too. Weber (1970) commented that without control over the materials, conclusions were difficult to reach. Barr (1972,1974-75) criticised Biemiller (1970) for taking no account of the impact of method of instruction on type of miscue. She worked initially with very tightly controlled materials and with children just before they had received any reading tuition in school. Studies across continents were still difficult to compare because of the different ages from which education in school was compulsory, and also because of the differences in teaching methods and materials. However, from the studies, it was possible to discern those where teaching was principally 'phonic' (Elder,1971, Barr, 1972, 1974-75,Cohen, 1975) and those where it was not (Barr, 1972,74-75, Burke, 1976, Francis, 1977,1984, and Campbell 1986).

There was a general search to establish stages or phases in the type of miscue produced by the young reader. These miscues reflected the strategies being used:

- drawing on previously learned print words.
- using context.
- using existing language competence.
- using salient letters or word length as cues.
- using more complex letter- sound correspondences.

Use of one of the taxonomies of miscue type or Weber's Graphic Similarity Index (GSI) enabled shifts to be detected from one strategy to another as reading skill developed (Biemiller, 1970, Cohen, 1975) or as a reflection of tuition (Elder,1971, Barr, 1972).

2.1.4.SUMMARY OF FINDINGS FROM PREVIOUS STUDIES.

A consensus developed from those studies that young readers in various countries brought similar strategies into use when trying to master print :

- they had first of all their own language competence and this guided their syntactic, grammatical and semantic choice of word (Weber,1970).
- however, print words initially were kept separate from spoken words, and for those taught initially by sight word methods, initial choice of word almost always came from their store of learned print words.
- this was not so for those taught to use letter- sound decoding. This method seemed to lead them to tap into their own spoken store, and their selection of a miscue might well not come from their print, but from their speech store (Barr 1974 -75)
- salient visual cues used to aid the word recognition process in the earliest stages were predominantly the first letter, and then the first and the last letters (Francis, 1984, Campbell, 1986). Increasing numbers of letters in common were shared by target and substitute. Weber (1970) included word length in the calculation of the GSI.

- as reading improved, so did the closeness of miscue and target, yielding a higher GSI, up to a reading level of 7 years (Francis, 1984). In Francis' study, there was then a further increase, amongst those with a reading age above 7 years, in generation of misreadings with no letters in common with the target. Even in Burke's study of older readers of 7, 8 and 9 years, miscues were being made which yielded a modest GSI, as though this type of word substitute did not just fade away. There was perhaps a balance, or trade off, between speed and accuracy.

- note was taken that phonic tuition first gave rise to a period of non-response and to the production of nonwords or nonsense (Barr 1972, 1974-75, Cohen, 1975). Some maintained that this means of instruction paid less attention to meaning and led to slower reading for a time (Elder, 1971) .

2.2.STAGES OR STRATEGIES IN THE DEVELOPMENT OF THE READING PROCESS.

Biemiller (1970) demonstrated stages in the reading process in the first year of tuition, from 6 - 7 years, a progression from a position of use of contextual information, to one of nonresponse, as the first strategy was replaced by the taught one. Finally, came a stage of response, in which there was evidence of both syntactic and phonological influence in the quality of the word substitutions. In the present study, it was not so much these shorter time spans which were in focus, but changes which took place more broadly over several years of reading acquisition.

Reading consists of an interaction between the use of strategies brought to the task by the readers and those strategies which are taught to them. There is an issue concerning their openness to using strategies other than their own, and there is also the issue of whether they are indeed taught to use any other than their own strategies. Enquiry continued to focus on when and how children became aware of orthographic features and structure.

Two broad areas were examined. The first was exemplified by the four stages in the reading process, set out by Marsh et al (1981), or by the steps and phases depicted by Frith (1985), in a model which she stated was speculative. The second concerned what children actually saw when they recognised a word, whether those salient graphic cues changed in influence as reading became more fluent, and whether the young readers' strategies altered or developed.

In considering a stage or phase model, it could be reasoned that the stages only appeared because of the tuition the children received. The strategies described by Frith did not necessarily occur in the sequential order presented in the model for all children. (see Seymour and Elder, 1986). Several authors (Francis, 1990, Ehri and Wilce, 1985) maintained that children made use of several available strategies even in the early stages of reading, and it was instruction which biased them to favour any one rather than another.

The purpose here of noting general stages in the reading progress of FS children is to relate the observed late start made by PS children to such a framework. The PS children in these Studies were taught to read from the outset in a manner which favoured use of grapheme- phoneme decoding and letter - sound patterns within words. Barr (1972) and Cohen (1975) both noted that there was a period of nonresponse in the early phase of phonic reading tuition whilst the young reader incorporated this new source of cue into an existing repertoire of reading strategies, so it seemed possible that the late start made by young PS readers might be understandable in those terms, rather than by associating a late start directly with impaired eyesight. But there had also to be a means of understanding how PS children could read and write as well as FS children at the age of 8 years. Attention was paid to the increasing refinement of phoneme awareness during the period from 6 - 8 years (see Seymour & Evans, 1991, Figure 3).

The second line of enquiry concerned an analysis of what it was that enabled a young reader to recognise a word, and whether those early cues gave way to different ones as reading became more fluent. At the two theoretical extremes was the idea that a word was recognised as a whole by its overall shape, or alternatively, that it was recognised letter by letter. Both these extremes have been refuted experimentally. Instead, partial salient cues were identified, such as the use of the first letter and last letter (Marchbank and Levin, 1965, Williams et al, 1970). There was some evidence that first grade children only gradually made use of the last letter and that this was observable first in their recognition of short three letter words. Differences were found between the cues used by children and by adults. Word shape was not found to be a useful salient cue, nor was word length, except by the youngest readers. Barron (1980) pointed out that the strategies used by children and adults in experimental word recognition tasks depended on the nature of the task and the level of processing required. For example, word length was important in a naming task but not in a lexical decision task (Frederikson and Kroll, 1976).

These findings about the use of salient graphic cues gave rise to an examination of their use by young PS readers in Study 1. One question was whether they were gaining and using information about underlying orthographic features in the same way as were FS children.

2.3.IMPLICATIONS.

The focus of Study 1 is only on the logographic and alphabetic strategies used for word recognition as defined by Frith (1985), for, if as Lansdown demonstrated, the young PS reader comes to the task with a difficulty in shape matching, it seems likely that the logographic stage will prove a difficult one. Fine and accurate discriminations between visually similar words may be hard to make. This difficulty should not persist at the alphabetic stage where phonic tuition can give the child strategies for the sequential analysis of each word.

Some care must be taken in viewing the stages described by Frith and by Marsh et al. The sequential ordering could lead to the idea that if one stage is not accomplished then later ones will be placed in jeopardy, or that difficulty at one stage implies impossibility. Difficulty should only indicate that compensatory strategies may be needed, different from, or over and above, those generally available.

The child brings his or her own strategies to the task. Barr (1974-75) showed that these individual strategies generally yielded to the taught strategies by the end of the first year of tuition. In this case, it is a question of careful selection of reading strategy to match the individual reader's requirements.

2.4. STUDY 1. THE ORAL READING ERRORS OF PS CHILDREN.

2.4.1.INTRODUCTION.

The purpose of Study 1 is to examine the oral reading miscues of a class of 10 PS children, aged 5 - 8 years, over the period of the final 7 months of a school year, the first year of a longer study of the same children. The reading tuition provided emphasises grapheme - phoneme correspondences and letter patterns in words in relationship to pronunciation. The reading materials are designed for eclectic teaching.

ANALYSIS OF READING TUITION (see Appendix 3).

The data on reading tuition method was listed under four main headings:

1. Independent child strategy (e.g. sounding out or naming letters, self-correction) requiring no teacher intervention.

2. A child initiated attempt to read which brought an intervention from the teacher. (e.g.attempts to sound out or pronounce a word).

3. Teacher initiated strategy, requiring a response by the child (e.g.sounding out a word, spelling a word, providing a rhyme or analogy, word cueing).

4. Independent teacher strategy, requiring no response other than repetition by the child (e.g. providing a word, praising, giving instructions).

MAIN EXPECTATIONS.

The main expectations of this Study are that, because of their shape matching difficulty:

1. There will be an increase, over the time of the study, in the mean graphic similarity index (GSI) for each subject, as reading attempts more closely resemble the target word and as other processing strategies enable each subject to overcome the shape matching difficulty.
2. There will be a noticeable increase in the GSI in step with increased reading level.
3. The word substitutions made by the PS subjects will reveal a lower graphic similarity to the target words than those made by FS subjects.
4. The PS subjects will make a higher number of word substitution errors than FS readers of the same age: their reading will be inaccurate.
5. There will be a clear decrease in the number of word substitutions in line with an increase in reading age.
6. There will be a decrease in the number of substitutions made by each individual over the time of the study, as reading improves and attempts give way to accurate reading.
7. High use of both first and last letters as salient graphic features will be positively correlated to high reading level.
8. High use of the first letter only as a salient graphic cue will be negatively correlated to high reading level.
9. Word length will not be correlated significantly to reading level.
10. The use of a final letter alone as a salient cue will not be correlated significantly to reading age.

11. Word substitutions having all letters but one in common with the target will be correlated significantly with high reading age.

12. Word substitutions with no letters in common with the target will be correlated significantly with a low reading age.

13. Lack of identification of apostrophes will not be correlated with reading age.

Before embarking on any investigations of the reading or spelling processes of PS children, it was necessary to carry out a preliminary study to test their ability to participate in such a Study.

PILOT STUDY FOR STUDY 1.

THE IMMEDIATE RECALL OF VISUALLY PRESENTED DIGITS.

N.Ellis (1991) found in a longditudinal study of 40 children, aged 4 3/4 to 6 1/2 years, that their Visual Digit Span, together with their ability at phoneme segmentation, syllable segmentation, sound blending and letter knowledge, was a good predictor of reading age.

This Pilot Study was carried out to determine that the PS subjects could see discrete digits and could reproduce them verbally in order. This ability seemed basic to the process, not only of reading, but also of spelling, which is the focus of Chapter 4.

This task required PS subjects to look at an array of digits for 3 seconds at a time, and then, with the stimulus removed, to say the digits in the correct order, as seen.

Digits have the same properties as letters and so the array of digits could resemble the array of letters in a word.

Two print types were used for the digits - Helvetica 36 point and Souvenir 24 point. Digits were printed in Kroy lettering, positioned centrally on postcard sized paper. These were presented individually for optimal viewing.

Number of digits for each stimulus increased stepwise from 1 - 11. There were three examples of each length of digit array at each print size. Maximum lengths achieved ranged from 4 - 9 digits.

Length of visual digit span correlated with reading age tested at the time (Spearman's $r = .71$, $p < .05$, one tailed test).

Each subject could tackle the task sufficiently well to take part in the following series of studies.

2.4.2.METHOD.

SAMPLE.

10 PS children, 5 boys and 5 girls, took part in Study 1. At the outset, their ages were 5 years 8 months - 8 years 7 months, with a mean age of 7 years 1 1/2 months (s.d.1 y 1m). Their mean reading age was 7 years 1 month (s.d. 1y 6m). 9 of these children formed one class, one girl joined it a little after the start of the study. The 6th subject listed had not yet reached the stage of word recognition so did not contribute to any of the statistical analyses for Study 1 (Full details of the sample are provided in Appendix 4).

The school was an all age (2 1/2 - 17 year) school, especially designed and equipped for PS pupils, drawing on a large urban and suburban catchment area. Pupils entering the school did so on the basis of a rigorous multidisciplinary assessment, which established that the primary reason for their attendance there, was to follow a programme of study specifically to meet the needs of partially sighted learners.

Details of the visual status of the 10 PS children are in Appendix 5. An 11th child is also listed, the youngest at 5 years 6 months. She took part in all the later studies which form this thesis, but at the time of Study 1, was not receiving formal reading tuition. The same 11 children listed took part in all the later Studies.

DATA COLLECTION.

The data collection consisted of weekly tape recordings of reading sessions carried out by the class teacher and individual pupils, using the school basal reading scheme, Ginn Reading 360. There were 308 samples of reading taken, each averaging three minutes in duration. This constituted a sample only of the total reading tuition provided over the period of the Study.

The Ginn reading scheme has 12 levels and at the outset readers were positioned on levels 2, 3, 5, 6 and 8 (Details in Appendix 6).

None moved beyond level 8 during the Study, but most moved up further on the reading scheme with time, so that there were reading samples from each level up to 8 by the end of the Study. There was one subject who was at the letter learning stage and so used an alphabet book, not part of Ginn Reading 360.

DATA ANALYSIS.

The tape recordings were transcribed by the author, following the format used by Campbell (1986) (Two examples are provided in Appendix 7). Two types of word analysis were made:

1.**Word substitutions.**

The number of words of text read by each child was counted, with note taken of additions to and omissions from the original text. The word substitutions, including self corrections, made by each child, were listed and each one scored on the Graphic Similarity Index (Weber, 1970) (See Appendix 8).

2.Salient Graphic Features.

Note was taken whether the word substitute and target shared first letters, first and last letters or last letter only, word length or had one letter only different, or no letters in common. Attention was also paid to whether the apostrophe in the word had been identified. This was included because punctuation was difficult for the PS readers to see.

The Weber Index has an advantage over the Goodman & Goodman Taxonomy (1965, 1969) used by Burke (1976) in that it is more precise. It is also more appropriate for this age group than the one used by Francis (1977), devised by Soderbergh for a younger child. The Weber Index has been used in studies with children of six and older, for whom it was designed. The calculation includes credit for relevant features of salient letter recognition, such as the beginnings and endings of words, word length, single and double letters in common, in both forward and reverse order.

The indices obtained using the Weber GSI cannot be directly compared with those of Soderbergh, nor Goodman & Goodman, as the figures obtained with Weber take account of some different graphic features.

2.4.3.RESULTS.

Table 2. Data from four separate studies of partially sighted and fully sighted children with regard to misidentifications and graphic similarity.

	PS sample Present study n = 9	FS sample Weber, 1970 n = 21	FS sample Francis, 1984 n = 48	FS sample Campbell, 1986 n = 2
Mean age.	7y 11/2m	6.3y	5 - 6 y	6y 7m and 6y 10m
Mean misidentifications as % of total text read.	8% includes self correction	-	12.25%	9.39% and 9.97% includes self correction.
Mean Weber GSI.	417.3	High(fast progress) Group 407.9 Low(slow progress) Group 269.5 Whole Class 350.8	-	421.6 and 401.

These figures do not yield to further statistical analysis.

The data demonstrated that the PS children obtained a mean GSI which was comparable to that of younger FS children than they. The mean number of misidentifications the PS children produced when reading, was also low, compared to the numbers produced by the comparison groups of younger FS children. This suggested the PS were reading carefully, but that, when misidentifications occurred, letter by letter similarity between substitute words and their targets was only modest. However, it was the quality of the error which was the more important issue.

Table 3. The mean Graphic Similarity Index score for each PS subject, and the number of word substitutions made by each PS subject, as a percentage of the total words read. Subjects are listed in order of reading ability.

	Mean GSI	% of Word Substitutions
Subject 1(High reading ability)	552.2	2.6%
Subject 2	508.7	2.5%
Subject 3	506.2	5.4%
Subject 4	496.8	5.3%
Subject 5	389.6	4.2%
Subject 6	291.9	8.6%
Subject 7	341.4	9.2%
Subject 8	340.2	22.3%
Subject 9 (Low reading ability)	328.8	11.7%

There was a significant positive correlation (Spearman's $r = .9$, $p < .01$,one tailed test) between the reading ability of the PS subjects, measured on the Salford Sentence Reading Scale or BAS, and the level of the GSI.

A correlation carried out between the mean GSI and the chronological age of the PS subjects did not reach significance.($r = .47$, $p > .05$, one tailed test)

There was a significant negative correlation between reading ability (up to Reading Age 9 years 3 months) and percentage of word substitutions ($r = -.9$, $p < .01$)

An analysis of the correlation between chronological age and number of word substitutions did not reach significance.($r = -.1$, $p > .05$, one tailed test).

A separate analysis was carried out for each subject to determine whether there was a change in the number and quality of word substitutions between the first and the second parts of this Study. No significant change was found. In several cases, there was a decrease in the mean GSI between part one and part two.

Table 4. The salient graphic features shared by the word substitutions and the target words.Subjects are listed in reading age order with Subject 1 having the highest reading age and Subject 9 the lowest. Figures provided represent a percentage of each child's total word substitutions.

	1st letter same	Same end letter	1 letter different	1st & last same	Zero letters same	Length same	No apostro- -phe.
1.	32	15	46	39	4.5	30	9
2.	46	8	37	25	6.3	27	14
3	34	8	31	35	5.6	35	6
4.	42	11	26	28	5.3	27	7
5.	45	16	25	13	5.3	47	2
6.	52	7	26	4	25.9	37	4
7.	52	9	12	5	18.5	23	10
8.	56	5	13	13	9.1	39	10.5
9.	51	5	15	12	14.6	39	10

There was a significant negative correlation between high reading age and use of the first letter only as a salient feature in choice of word substitute (Spearman's $r = -.8$, $p < .01$, one tailed test), and between high reading age and number of word substitutions which have no letters in common with the target word ($r = -.68$, $p < .05$, one tailed test).

There was also a significant positive correlation between reading age and the use of both first and last letter in selection of a word substitute ($r = .75, p < .05$, one tailed test) and between reading age and the number of word substitutes which differed by only 1 letter from the target ($r = .9$, $p < .01$, one tailed test). The correlation between high reading age and the presence of the same last letter as the target word reached significance ($r = .6$, $p \leq .05$, one tailed test)

The correlations between
- high reading age and word length ($r = -.43$)
- high reading age and lack of response to apostrophes ($r = -.13$)
did not reach significance ($n = 9$, $p > 0.05$,one tailed test)

2.4.4.DISCUSSION.

The purpose of Study 1 was to analyse the oral reading of PS children against the background of the tuition they were receiving.

Two aspects of the children's reading were examined in detail:
1.The word substitutions they made.
2. The salient graphic features they used in the selection of their word substitutions.

The findings of Study 1 were:
1.The PS subjects in Study 1 produced word substitutions which resembled those of younger FS children in terms of GSI (see Table 2).

2.As a group, the PS produced fewer word substitutions than FS subjects, (see Table 2). However, Table 3 revealed wide variations in number of word substitutes produced by the individual members of the PS group.

3. As the reading level of the PS subjects improved, the number of word substitutions decreased, and the GSI increased.

4.The PS children read at least 50% of the total text words accurately and smoothly. However, when looking at the quality of the relatively small number of misidentifications, it seemed that the mean Graphic Similarity Index of PS children could reflect their shape matching difficulty as well as reflecting the range of reading ability within the PS group. GSI increased as reading age improved, but despite the skill of the older PS readers, the GSI did not reach complete identity with the target words, as though a residual difficulty prevented complete accuracy.

5.With regard to the salient features being used, the less skilled PS readers relied significantly on the first letter of a word, and had significantly more word substitutes which shared no letters with the target. This bore out expectations derived from studies of young FS readers.

The more skilled PS readers relied significantly on first and last letters in common, and had a significant number of word substitutes which differed from the target by only one letter. This, too, bore out previous findings that after the first letter, the last letter was the next most salient, as being the carrier of important morphemic information, for example, about tense or number.

The correlation between high reading age and a match between the last letter of the word substitute and its target also reached significance, although it was noticeable here, as in other studies (Weber, 1970), that there was much less reliance on the final letter than on the first one. Word length, on the other hand, although not correlated significantly with reading age, was used substantially by all the PS readers.

6.The results showed that the PS generally had difficulty in seeing the apostrophes in words. This did not relate to age nor to reading age.

The general purpose of Study 1 was to see how the visuoperceptual delay described by Lansdown (1973) affected reading performance. Three aspects have been considered in the Study and will be discussed below:

a) the nature of the word substitutions made.

b) the graphic features used.

c) the effect of the reading tuition provided.

WORD SUBSTITUTIONS.- Sounds versus the Visual Index.

Because of the reading instruction provided for these PS children, the hypothesis was that they would have a bias towards using grapheme-phoneme decoding as they read, and that their misreadings would reflect this bias. The evidence provided so far does not differentiate between the use of aural and visual cues.

The tape recorded data provided evidence that the PS children were often not just looking at a word and reading it from sight, but were sounding it out. Many word substitutes arose from full or partial decoding achieved in this way. Obviously the graphic form of the letters always has to be seen first, and then it is a question of whether the visual array on its own achieves a lexical match or whether grapheme-phoneme decoding is required. Because of their strategy bias, these young PS readers were quick to provide sounds to use in conjunction with what they saw. But the question is whether they ultimately used sounds instead of what they saw. This is difficult to demonstrate, although there were some occasions when this seemed to be the case. 'Peas' was read as 'peace' and 'tall' as 'tail'.

Unlike previous reports in which the FS children received similar instruction to that provided here, very few of the PS word substitutions were nonwords. Moreover, although there was not a complete record of what each child's print reading store comprised, and some of the children were quite experienced readers, there were very few words which were clearly drawn from outside the expected print repertoire. Some examples were the use of 'panther' instead of 'parrot' and of the names 'Fred' and 'Bill' instead of 'Ted' and 'Ben'. The presence of word substitutes with no letters in common with the target was evidence of a child's reliance on its spoken word store rather than on what was seen on the page. Here such reliance was evident amongst the less skilled readers. Mostly, the children kept very close to the printed text and this is probably reflected in the high number of word substitutes which differed by only one letter from the target print word.

All the PS readers made considerable use of word length as a cue, and it might seem that this was evidence of visual information in use, however, it could also be argued that in a sequential letter-sound analysis of a word, a young reader was also aware of length or number of syllables in the match between target and substitute.

The overall conclusion from examining the word substitutes was that it was not possible to deduce exactly which strategy was being used predominantly. Much letter-sound decoding occurred, but this seemed not to be at the expense of reliance on what was seen. Phonic tuition can mistakenly be viewed as being concerned principally with sounds. A main element of this type of tuition, seen here, consisted of specifying the visual components of each word. Each was analysed and specified visually and phonologically.

SALIENT GRAPHIC FEATURES.

The second focus of analysis in Study 1 was the type of graphic features used by the PS readers in selecting a word substitute. Here, as in other studies, the same salient graphic features were used:

-first letter,first and last letter, last letter, zero letters in common.

The younger, poorer readers made more use of the first letter as a salient cue. Or, they provided a word with no letters in common with the target. This latter strategy was noticed in previous studies, in which the younger readers maintained the story line with one of their own words, if the printed one was not known or could not be recognised by use of any of their available strategies. The finding here of an overall decrease in such word substitutes as reading improved, at first sight seemed to differ somewhat from the finding of Francis (1984) with younger children. In her study, in the age range 5 - 7 years, there was first a decrease in the number of such 'zero' word substitutes as reading improved, but then there was an increase from reading age seven. For her the better readers generated word substitutes both with a high number of letters in common and with none at all. Here, the better PS readers were held closely to the printed text. A subject by subject analysis of word substitutes with zero letters in common with the target showed that in this Study too, between parts one and two, the readers who started with a reading age of 5 - 6 3/4 years eventually increased this type of 'zero letter match' word reading response. So first, the beginner readers decreased their 'guesses' based on maintaining the storyline, but then they increased them again, perhaps as their reading speeded up.This occurred at a stage when they were struggling to make use of letter-sound decoding.

The better readers made more use of first and last letters to aid their generation of a word substitute. In a smaller number of instances, the word substitutes and targets shared the last letter in common.This, too, was noted in Weber's study (1970) and that of Francis (1984).

A number of word substitutes differed from the target by only one letter and this was found particularly amongst the better readers. This could reflect their underlying shape matching difficulty and, if true, would mean that PS readers would persistently appear to be inaccurate readers. On the other hand, it could reflect a trade off between speed and accuracy. As their reading speed increased, so their accuracy, when reading aloud, decreased. This idea was borne out by the fact that there was a tendency for the GSI of word substitutions to decrease in the second half of the Study as compared with the first half. As fluency developed, reading became faster, and a little less accurate.

THE EFFECT OF THE METHOD OF READING TUITION.

In this Study the teaching method emphasised individual letters and letter patterns in relation to pronunciation, the reading materials provided a range of printed words, whose written form was predictable or unpredictable from the spoken form. (Venezky, 1970)

In addition to the strategies brought to the task by the child, (sounding-out, self correction, partial sounding out), there were also the teacher initiated strategies.

These were of several kinds:
-spelling a word.
-sounding it out.
-breaking a word up into smaller parts.
-a mixture of all these until the child could find the correct version of the word. Or -
- providing prompts or cues which enabled the child to go back to the point of error and try again.

This kind of cueing was of two kinds:
-the first, was to return to the last word the child had read correctly, reread it with a query, as though to ask: 'What comes next ?'.
-the second way was to say 'no' immediately an incorrect word was read, so that the child was required to reread from that point on.

4.2% of total text words were read by means of teacher initiated strategies.

These teacher initiated strategies were a form of modelling for the child of how to approach the reading of new words. This modelling was accompanied by verbal instructions (see Appendix 3).

These instructions were of three kinds:
-to look at the letters, the position of the letters, to look at parts of words.
-to sound out letters, to break a word up, to put it together again, to spell the word.
-to reflect on whether the word was new, or had been read recently.

There was a fourth type of instruction, too, which consisted of instructions not to guess, not to read too fast, and very gradually to put over the idea that not all words could be read successfully by analysis of the sound correspondences of individual letters or letter clusters.

As in other studies, the word substitutions revealed the use of graphic cues. The number of word substitutes was modest but was accompanied by other successful or partially successful strategies, such as sounding out and self-correction.

There was very little evidence of nonresponse, except on the part of the youngest reader. The fact that PS pupils begin to read later than their FS peers may, however, count as nonresponse and is commented on further in Chapter 4.

There were very few nonwords generated. Each reader, except the youngest generated a few, but the total number was much less than 1% of the total text words read. The reason for this may be reflected in the description given by Barr (1978) of how nonwords or nonresponses come about. They arise in the abortive attempt to find a match between the child's attempt at phonemic assembly of the printed word and the match for that word in the child's aural vocabulary.

When listening to a child trying to sound out a word, that 'sounded out' version was often far from the target - particularly as in this Study, when the reading materials were not specifically designed for phonic tuition. Often the teacher had to help the child with partial sounding out.The teacher's version was moulded to the target word because the teacher knew what that word was and could subtly make the component letters sound like it in a way that was not possible for the beginner reader.

If the child were left to read uninterrupted, then many of these 'sounded' attempts would be nonwords or nonsense. However, in this Study, the tuition and the reading were very tightly controlled. With a few exceptions, incorrect versions were not allowed to pass but help continued until the correct version was achieved.

Barr (1978) maintained that even eclectic teaching in the early stages of reading, did not lead the child to develop parallel strategies, but rather one dominant one, which was progressively refined. Here, only one strategy was taught, yet it is interesting that the cues used even by the youngest, least competent readers, of first and/or last letter shared, were the same cues used by Wiley's (1928) and Francis' (1984) subjects following sight word tuition. Barr's (1972) starting point was to ask whether tuition method made any difference to the child's strategies. It seems that it does, but there are nonetheless commonalities both of cue and of error type.

CONCLUSION.

In terms of the dimensions of interest in this Study, there is clear evidence from the literature of an increase in graphic similarity between target and substitute word as a function of reading level (Francis, 1984). This was true also for the PS children here. As reading level increased, there was an accompanying increase in the level of graphic similarity between the target and the substitute. Clearly the children, although being taught exclusively in a manner which emphasised letters in relation to their pronunciation, were using a visual strategy in reading. Age was not a significant factor, and although word substitutions decreased significantly with reading age, there was no such decrease between the first and the second halves of the Study. This suggests that such a drop in word substitutions is a slow and gradual process over years rather than months.

Study 1 has provided a qualitative account of the reading performance of a group of PS subjects over a period of over half a year. Its limitation is the impossibility of making direct comparisons with a comparable group of FS children on specific word processing tasks.

The purpose of Study 2 is to enable such comparisons to be made by means of selecting a carefully matched control group of FS children and by tight control of the word stimuli. By so doing, and by giving both PS and FS subjects the same tasks, a clearer picture will be gained both of the precise impact of the taught strategy based on letter-sound analysis, and of the underlying shape matching difficulty of the young PS readers.

CHAPTER 3

WORD RECOGNITION IN YOUNG PARTIALLY SIGHTED CHILDREN.

3. INTRODUCTION.

The method of studying the implications of an underlying shape matching difficulty used in Study 1 was a naturalistic one. The reading behaviour of 10 PS children was tape recorded as it occurred in a classroom setting and was then analysed for the presence of particular features. Studying word substitutions in this way has the advantage that words are read in context. Any word substitution could have been generated for a variety of reasons - grammatical or semantic acceptability, graphic similarity to the target or indeed for all three reasons. In other words, information was being used by the child from a variety of sources to enable a new or not very familiar word to be identified.

Printed text has various levels of orthographic structure both at word and sentence level. The young reader comes to the reading task with relatively well developed spoken language competence so can readily apply implicit syntactic and semantic knowledge to the reading of sentences. It has been recognised (Francis, 1977, Pring and Snowling, 1986) that young children make maximum use of context, and Biemiller (1970) even warned that there was a danger of the young reader dwelling too long in the contextually bound phase, as a result of helpful picture cues. Reading individual words precisely requires different skills.

Some of the authors of work reported in Study 1 used word lists (Barr, 1972, Francis, 1977) in order to minimise contextual influence and to look specifically at the child's analysis of the graphic features of the word on its own. Francis compared context reading with reading lists of the same words and found that young readers made more errors on the lists of words than when these same words were in familiar context. It was always the familiar book sentences which were read with fewest errors. Two variables were altered here. One was the use of word lists to remove syntactical context, the other was to use both reconstructed sentences and word lists to alter and reduce meaning in various ways. The familiar sentences, in which meaning and syntactical structure were retained, were read with fewest errors. Taking words out of context overall produced most errors as the child was left to rely only on single word recognition strategies. There was no tendency for the 'novel' sentences, in which the original meaning was retained, to yield less error than the 'mixed' sentences, in which meaning was new, so syntactical structure was clearly playing an important part.

Study 2 turns to a more controlled examination of how PS children process words. Single words and nonwords with varying orthographic structures were compared for ease of recognition - illegal letter strings, legal nonwords, pseudohomophones, true words spelled predictably in terms of English letter - sound correspondences and true words with unpredictable spelling. By using individual words in lists, any help provided by the syntax or semantics of the context is removed. Not only was it clear from Study 1 that a naturalistic study of the oral reading errors of PS children left some of the source of influence confounded, but it also left unanswered in detail, how PS compared with FS children of the same age in their word processing capacities.

One purpose of Study 2 is to address the comparison of PS and FS performance by means of a series of 5 separate experimental studies.

3.1.THE RESEARCH FRAMEWORK.

The use of word lists and a lexical decision task removes the word recognition task from major semantic and syntactical influence. The task must then be accomplished by means of other properties within the individual word stimuli.
The early observation that a word could be identified as fast, or faster, than an individual letter opened the search for the crucial unit of identification. Amongst those features which have been examined experimentally are: the orthographic structural hierarchy, word length, word frequency, word visual appearance, pronounceability, regularity, single letter positional frequency, bigram and trigram frequency, the primary influence of the strategy or the word stimuli in determining response. Henderson and Chard (1980) summarised this literature, but each aspect will be mentioned briefly here, in order to set the five Experiments of Study 2 in context.

One early issue was whether a crucial factor in word recognition was the word's visual familiarity. Mixing case would alter visual appearance.McLelland (1976) found that mixed case did slow down fluent readers, though the hierarchy of orthographic structure remained intact. The impact of this alteration of visual appearance was not to do with letter size, for Coltheart and Freeman (1974) found that mixed case, when all letters were the same size, impaired word recognition though readers did not know why. Pring (1980) presented regular and irregular words and legal nonwords in alternating case and used a lexical decision task. She found that there was not a significant difference in reaction times when this was done as compared with when the words and nonwords were unaltered. It seemed that this form of visual alteration did not impair the lexical process significantly, though subjects were slightly slowed down in task performance.

A different way of altering visual appearance was to use vertical or zig-zag print. Seymour and Elder (1986) found that this reduced the reading ability of young 4 1/2 - 5 1/2 year old readers, but did not abolish it completely.
Word perception, then, seemed to rely on visual appearance to a certain extent. Word length and shape were also considered as potentially significant factors. Word shape was too crude and general for usefulness. Parallel processing could adapt to varying word lengths, though word length affected reaction times for naming, but not for the lexical decision task (Frederikson and Kroll, 1976).

Word frequency was consistently found to be an influential factor, and Henderson and Chard (1980) demonstrated that children as young as 6 - 7 years old recognised high frequency words faster than low frequency ones. Bruder (1978) found that high frequency words were more affected by case alternation than low frequency ones. They reasoned that this was because high frequency words were more likely to be in the readers' sight vocabulary and that any hindrance to fast fluent reading would impair those words rather than ones which had to be decoded more slowly.

Pring (1980) matched word stimuli on frequency, length and part of speech, and then used regular and irregular words and various types of nonword to investigate the dual process model of word recognition (Ellis, 1984. Fig.1.) The basic idea was that the direct visual lexical process would lead to successful recognition of both regular and exception words, but that the slower nonlexical process, working perhaps in parallel, could also be successful for the correct identification of regular words and pronounceable nonwords. The nonlexical strategy was slower because it included a grapheme - phoneme conversion (GPC) stage. This was thought to mean, first, a parsing of the grapheme display into functional spelling units and then, the assigning to each of one phoneme. Coltheart et al (1979) outlined the difficulties of this parsing task.

On this basis, it seemed possible that a naming, or reading aloud task, for which a phonological code had to be generated, would tap nonlexical processing, whereas a lexical decision task, which did not demand a phonological code, would tap the lexical process. Additionally, Seymour (1986) described the early visual analysis of all incoming print by a specialist grapheme processor, whilst Pring (1980) pointed out that a phonological code may be accessed subsequently in the internal lexicon, even when a lexical process is used. It appeared from this that processing was probably not solely by one strategy or another, but rather by means of both, working cooperatively or in parallel.

Experimental work was carried out which attempted to determine when either lexical or nonlexical processing might be used. One issue, for example, was whether subjects could select one processing strategy rather than the other, or whether processing occurred automatically in parallel. Results were not clear cut (see for example, Stanovich & Bauer, 1978 and Pring,1980) Pring summarised the position and moved the enquiry forward. One question she asked was whether nonlexical processing contributed to lexical decision performance.

Coltheart et al (1979) found in a Pilot Study, when regular and irregular words were presented in a block, that regular words were always pronounced faster than exception words. However, when regular and exception words and nonwords were randomly mixed and a lexical decision task used, this was not the case. They concluded that in the lexical decision task, processing had not involved recoding visually presented words.

Pring (1980) repeated this experiment, using the same word stimuli and a lexical decision task, but blocks of regular words and nonwords, or irregular words and nonwords. She argued that this form of presentation might lead the subjects to select a nonlexical process for the regular word list, so favouring the recognition of regular word stimuli. However, the results demonstrated that this did not happen. No regularity effect was found, and it seemed that the nonlexical process was not being used, though it could have been selected.

Stanovich and Bauer (1978) found that using both a naming task and a lexical decision task, subjects responded, in both cases, faster to regular words than to exception words. This suggested that both processing routes were being used and that subjects were working slowly and carefully enough to allow information from nonlexical processing to influence their responses. In order to affect processing by the lexical route only, they used a response deadline technique, by which subjects had to respond too fast to allow time for nonlexical processing to influence the outcome. When this occurred, they found no regularity effect either in the reaction times or error rates. Fast responses demanded use of the lexical process, by which both regular and irregular words are identified equally well.

Other means were used to affect one or other form of processing. One argument was that altering the visual appearance of a word to make it less familiar might deter lexical and favour nonlexical processing. If a lexical decision task were used and if the word stimuli were rendered unfamiliar by use of alternating case, the subject might be forced to use nonlexical processing, which could be effective for regular but not irregular words. If this were so, a regularity effect should emerge under these experimental conditions. Although Baron and Strawson (1976) had found that use of alternating case did make a difference in a naming task, Pring, like Coltheart et al, (1979) found that there was no regularity effect when visual appearance was altered in this way in a lexical decision task. It seemed that the visual disruption caused by use of alternating case was not sufficient to deflect from use of lexical processing and that it might just slow subjects down in the construction of the initial graphemic code by the specialist processor.

Pring (1980) then used a more selective type of visual disruption, aimed not just at altering visual familiarity but also at destroying the visibility of the GPC processing units, the functional spelling units (FSUs) This was aimed at moving subjects away from nonlexical processing. That being so, it could be regular words which were most affected if they gained any benefit from nonlexical processing. Not only might there be a deterioration in word recognition when FSUs were disrupted, but leaving FSUs intact and thus parsed ready for the GPC, might confer an advantage, particularly on regular words.Pring did not find a regularity effect through enhancing the FSUs and leaving them intact, but she did find that disrupting FSUs produced a significant difference in word recognition. This disruption was particularly damaging for regular words.

A more convincing demonstration of the effect of disrupting FSUs was provided by use of pseudohomophones (Pring 1980,1981). Most consider that the pseudohomophone effect occurs because of the nonlexical processing of these nonwords. These particular nonwords are hard to reject because, once in phonological form, they have a lexical entry. Pring argued that if the FSUs of pseudohomophones were left intact, the pseudohomophone effect should occur, but if the FSUs were disrupted, processing would be carried out lexically, and so the pseudohomophone effect should disappear. This was indeed what occurred and Pring concluded that the effect of disrupting the FSUs was to slow down the construction of the phonological code, so favouring lexical processing. The same occurred when words were used.

Those with intact FSUs were processed significantly faster than those with disrupted FSUs. The effect was achieved not just by altering the visual appearance of the word, but by attacking selectively the FSUs. This experiment established the psychological reality of FSUs. By use of intact FSUs to alter visual appearance, lexical processing was slowed down, and nonlexical processing allowed to play a part in decision making. By use of disrupted FSUs, nonlexical processing was slowed down, thus favouring lexical processing. A crucial unit of word identification had been identified, as well as a means of tapping one form of processing, rather than another.

The pronounceability of a word or pseudoword was another candidate for examination in the search for the critical aspects of word perception. Martin (1982) maintained that the reason pseudohomophones gave rise to many errors and were slow to be rejected was not an outcome of phonological processing, but could be because they looked like true words. She took two types of pseudoword - pronounceable, legal nonwords, and pseudohomophones. Fast lexical decisions had to be taken within a time limit, so preventing the response issuing from nonlexical processing. The slower, nonlexical, phonological processing would have been impossible in the time. Under these circumstances, there was both a legal nonword and a pseudohomophone effect. Both types of nonword were harder to reject than illegal letter strings, and this suggested that there was a visual quality of 'word-likeness' which was being detected and which did not depend on pronounceability.

Single letter and bigram positional frequencies were found to be influential factors, even with young readers (Henderson and Chard, 1980). Letter strings with low single letter positional frequencies or low bigram frequencies were easier to reject, than letter strings with high single letter positional frequency or high bigram frequency. These authors also manipulated the presence or absence of vowels in those decisions and found that they were secondary in importance. The 8 - 10 year old subjects only appeared to consider the presence or absence of a vowel to aid their decision in the case of the high frequency letter frequencies. With the low frequency letter frequencies they had sufficient information for rejection from the consonants alone. Other research data on the relevance of bigram and trigam frequencies, Henderson & Chard found to be inconclusive and concluded tentatively, that it was probably the difference between zero frequency and non - zero frequency which was crucial in word perception.

Finally, there was the study of Baron and Strawson (1976), in which adults, who were found to have a preference for visual processing, they named 'Chinese',or for phonological processing,they named 'Phoenicians'. There have been many studies also which indicated that it was the task which determined the strategy, and that adult readers could exercise choice over which processing method they used, depending on the word stimuli they encountered (Davelaar et al, 1978).

No one aspect of word recognition provided a full explanation of observed results, but Henderson and Chard (1980) ended their review with two possible codes:

- a robust phonological code, which did not discard orthographic information.
- a robust lexical code.

These two codes can be seen reflected in the dual route model (Figure 1). But, a dual route model was still regarded by some as inadequate (Glushko, 1979, see 1.6).

In the 5 Experiments which form Study 2, similar variables are used to those reported above, to examine the factors which influence the word recognition of PS children. The particular value of studying how PS children process words is twofold. First, because of impaired vision, they may be impaired in their use of lexical processing. Second, the form of reading tuition the children of this study received, influenced them towards the use of a nonlexical strategy. In both respects, they are children who are biased towards one form of processing rather than another.

3.1.1.FURTHER PROCESSING CONSIDERATIONS.

A child of 5 or 6 approaches reading with his or her existing language competence, a knowledge of spoken words, of sentences, ways of asking questions, of referring to the past or future, and a quickly growing repertoire of syntactic and semantic forms. But the reception of print is not the exact counterpart of the reception of speech (Ehri, 1978). Whilst the pronunciation of a word in English does resemble the graphic code of the printed form, there are often quite marked differences between discrete phonemes and graphemes, depending on context and dialect. The printed word, however, is consistent in spelling wherever it appears and whoever reads it. Moreover, each printed word has clear boundaries, represented on the page by spaces. Clauses, sentences and intonation are marked by punctuation.

The young child's language competence does not then prepare him entirely for the mapping of a discrete printed word onto its spoken counterpart. Evidence from Francis (1977) suggested that for the young reader, the printed word did not necessarily act directly as a logograph either, immediately conveying meaning wherever it was positioned, much as a picture might, or as street signs do. The printed form had to be processed and analysed in order to attain its full identity. This was particularly difficult if the word was in a word list, so deprived of semantic context and syntactic structure, but it was also moderately difficult out of a familiar context, and in a 'novel' or 'mixed' sentence.

It has already been suggested that there may be two available processing routes for receiving the written / printed word, both issuing from the inevitable initial visual analysis (see Figure 1).The first is the direct visual lexical process, the second is the longer, slower, nonlexical process which requires that graphemes are converted into phonemes. By this longer route, the printed word is transformed into phonological form and entered into the auditory analysis system.

One question which arises is whether the individual reader uses both, or just one of these routes for the word processing tasks - reading aloud, lexical decisions or reading for meaning.The visual, lexical process can be used successfully for both regular and exception / irregular words but not successfully for legal or illegal nonwords, as these have no lexical entry. The phonological, nonlexical process can be used successfully for regular words and for legal, pronounceable nonwords. Such pseudowords, which either look or sound, like true words, such as 'spol' or 'ile' get past the early Visual Analysis System (see Figure 1) and are then processed as though they were true words. They are difficult to reject because of their similarity to true words.

Illegal nonwords should be processed relatively rapidly by the fluent reader, as their orthographic irregularities will stand out early on in processing It is a matter for consideration as to when children acquire knowledge of this level of orthographic structure. Presumably, the young reader must have some direct experience of printed English words before being able to deduce which letter strings are not permissible, but Henderson and Chard (1980) found that even 6 -7 year olds could make the distinction between permissible and non- permissible letter strings.

If the nonlexical process is used, it is likely to be indexed by a regularity or a pseudohomophone effect. If the lexical process only is used, no such effects would be seen.

A pseudohomophone is a nonword such as 'bloo' which looks wrong, but which sounds like a true word with a lexical entry. Pseudohomophones may acquire phonological codes from a nonlexical procedure and then access a representation in the lexicon. This leads to an error and to the pseudohomophone effect.

If the lexical processing route is fast, direct and visual, the question arises as to whether PS children can use it? Will their fundamental shape matching difficulty reduce its effectiveness as a fast and accurate word processing route ? There was some evidence in the first part of Study 1 that when PS children were reading very slowly, they could achieve reasonable accuracy, but that in the second part of the Study as their reading speeded up, their accuracy decreased. The mean GSI of individual PS readers fell, denoting lower compatibility with the target text word. Additionally, there was no sign in Part 2 of the Study of a disappearance of word substitutes with zero letters in common with the target. Indeed, there was a small increase in the case of several PS readers. This increase in zero - compatibility word substitutes was most evident amongst the less skilled readers who were still struggling with letter - sound correspondences. It seems a possible explanation that in the light of weak lexical processing, and initial difficulty in mastering a nonlexical strategy, these inexperienced readers fell back onto use of context to provide a best fit word substitute.

The focus of Study 2 is on the earliest stage of the word recognition process. The studies are positioned at the access point to the visual or auditory input lexicons, the access codes to which are either graphic or phonological.This is a stage before semantic factors are involved in word recognition. Reading aloud can be achieved in a number of ways, both lexical and nonlexical, depending on the stimuli. Lexical decisions, however, demand that the words are in the lexicon and therefore potentially with their meanings.

3.1.2.THE LEXICON.

The existence of an internal lexicon, or dictionary store, was first proposed by Treisman (1960,1961). Ehri (1978) has elaborated the nature of the store by specifying the various identities of each word: the syntactic, semantic, morphemic, phonological and orthographic properties. All these properties have to be amalgamated by the reader in order to be able to derive the full lexical richness of the word (see Figure 2).

3.1.3. THE LEXICAL DECISION TASK.

This task requires the subject to make a word / nonword decision. It does not demand naming, nor the generation of a phonological code, though it can only prevent this occurring by, for example, very fast presentation rates. The task, in the studies reported in this chapter, requires the detection of different orthographic structures in words and nonwords. These structures are reflected by regular, predictably spelled words or by irregular, unpredictably derived ones, and by legal or illegal letter strings / nonwords. Such structures should be visible from the graphic array.The relative ease or difficulty with which these can be identified and a decision taken, is normally recorded in terms of the speed and / or accuracy of the decisions. The task does not demand naming at this early processing stage, but if a phonological word decoding strategy should be chosen before a lexical decision is taken, this strategy, with some stimuli such as with pseudohomophones, will lead to many errors or to slow decision taking.

The decision as to whether a letter string is a word or not, does not constitute reading. It is simply a decision as to whether a letter string warrants full processing. It is not a question of which processing route should be used, but whether or not the letter string should be rejected.

Performance on this task reflects a subject's graphic knowledge and probably also his or her word awareness. It should also reflect whether a predominantly lexical or nonlexical strategy is being used. For example, it has been possible to identify adult brain damaged subjects whose phonological processing capacity was impaired and who could use only a lexical strategy (Patterson and Marcel, 1977). Their lexical decisions revealed no pseudohomophone effect, no confusion arising from the phonological properties of the stimuli. With normal subjects, if lexical processing is used, there will also be no difference in recognition between regular and irregular words, and no pseudohomophone effect. If the subjects, however, use a nonlexical strategy, this will be revealed by a regularity and a pseudohomophone effect.

Two sets of measures are associated with the lexical decision task:
- firstly, speed of response.
- secondly, number and type of error.

Issues to do with the relative speed of processing will not be pursued here, as speed of response is inappropriate in tasks used with PS subjects. Lansdown (1973) found that PS children were significantly slower than FS children on all timed tasks. Moreover, he obtained a clear demonstration of accuracy being sacrificed by PS children, whenever they tried to respond at speed.

In Study 2, it will be the number and nature of the errors which will be analysed when a particular selection of words and nonwords is presented for lexical decision.

There is little relevant research evidence which makes use of the lexical decision task with young readers.(Barron, 1980). However, Henderson and Chard (1980) reported a study with 6 - 7 year olds and 8 - 10 year olds using a lexical decision task. The word stimuli varied according to whether they were high or low frequency. The nonwords varied according to whether the letters were high or low in positional frequency, and whether there were vowels present or not.. Both groups identified the high frequency words best and both groups were quickly able to reject the nonwords with low letter positional frequency. This study revealed that even 6 - 7 year old children were making use of letter frequencies as a basis for deciding if a word was a true word or not, and that the frequency of the orthographic structures used affected an affirmative decision for words, and a fast rejection decision for nonwords.

In the case of young Braille readers, who use a sequential tactual code, Pring (1982, 1984) has used the lexical decision task to establish the existence of phonological processing under certain particular circumstances. However, her subjects were older than those in this study and so had greater reading experience to bring to the lexical decision task.

3.2. WORD RECOGNITION AND BEGINNER READERS.

A distinction should be made between beginner readers and fluent adult readers.

Most experiments using lexical decision tasks to explore access to the lexicon, have used fluent adult readers. These are readers who can tap all five word identities specified by Ehri (1978, see Figure 2), who are aware of the properties of words, and so can return to look at their constituent parts. Such readers read at speed, they sample text, they use cues from all possible sources, (graphic, syntactic, semantic etc), they have spare attentional capacity because of the use of automatic networks, which have been built up through reading experience.

Ehri (1978) made the distinction between implicit knowledge and word awareness or consciousness. The young reader comes to the task of decoding print with much implicit knowledge of the language but with little explicit awareness of the properties of letters, words and sentences. Francis (1977), for example, found that an additional error category had to be created for 5-6 year old beginner readers who, instead of the required word, read a word which lay adjacent to it in the text, as though they had not realised the exact boundaries of the required text word. Several authors (Barr, 1972, 1974-75, Francis, 1984) commented on the fact that beginner readers, taught by sight word methods, when faced with an unfamiliar word, would choose and say a word from their printed word store, not from their larger spoken word store, as though the spoken words could not be a resource pool for printed words.When a word is printed in vertical position, some beginner readers will show surprise that in that format it can still be a word.

The level of awareness required to carry out a lexical decision effectively is important. First , there is a time when anything which looks like a letter string is taken to be a word. Then comes an awareness that not all strings of letters are necessarily words. They do not always look right. Gradually, there is the implicit awareness that some clusters of letters are never found together in English orthography, so can be rejected immediately.

In the earliest stages of learning to master print, if the idea of a nonword has been achieved, the young beginner reader is likely to make a lexical decision on the basis of whether the word is familiar or not. So potentially, many words will be rejected as if nonwords. They are nonwords on the basis that the child cannot recognise them. There may not have been sufficient experience of printed letter clusters to decide reliably whether certain letter combinations can legally occur in the language or not (though see Henderson & Chard, 1980).

Although the lexical decision task does not demand naming, a child may be at the stage of tuition when grapheme - phoneme decoding is being encouraged, so a lexical decision may be made mistakenly on the basis of whether the child can pronounce the word or not, whether the decoded word sounds resemble a spoken word or not. Often the decoding attempts of the young reader are very far from the 'word', and so many words are rejected as nonwords, or even nonwords accepted as words, on the basis of underdeveloped blending skills.

For the young reader, then, the ability to carry out the lexical decision task accurately marks an important step towards fuller awareness of the potential properties of the word.

3.2.1. WORD RECOGNITION AND PARTIALLY SIGHTED CHILDREN.

Study 1 included an outline description of the reading tuition provided for the PS children in this sample (see Appendix 3). The method described encourages use of a nonlexical processing strategy. If this strategy only is used for word recognition, there will be a regularity effect and a pseudohomophone effect. Theoretically, words and illegal nonwords should be identified equally easily, if subjects are sufficiently word aware to be able to make lexical decisions on the basis described above.

In the case of all young readers, both the capacity to make an informed decision, and the ability to process the letter array adequately, may be underdeveloped. The correct outcome of the lexical decision can be adversely affected in both ways.

In the case of PS children, the predominant tuition in the use of a nonlexical processing strategy encourages the young reader to draw on auditory and articulatory aspects of his/her existing spoken language in relation to the printed word. It also stresses the precise visual specification of each letter within the word. There will have been no deliberate attempt to build up a small store of familiar 'sight' words, although such a store inevitably builds up through repetition and automatisation, even with a teaching method which emphasises letter - sound correspondences. Thus, when faced with unfamiliar letter strings, PS children are not likely to restrict their lexical decisions just to their known print set.

Using the strategies available to them and because of their training to attack unfamiliar words with this nonlexical decoding strategy, it seems likely that PS children will attempt to decode nonwords, as they do words. If they find they cannot meld the sounds into a heard word, they are likely to reject it as a nonword. The PS children are not as likely to rely on graphic information alone, as might fully sighted children.

3.2.2. ARE PS CHILDREN NONLEXICAL READERS ?

One implication of Study 1 is that the reading tuition method adopted for PS children, as well as their impaired eyesight, drives them away from a lexical processing strategy to the use of the nonlexical one. The expectation is that they will be nonlexical readers. This is a supposition. There is as yet no proof that PS readers either do or do not use some lexical processing. It is difficult to determine exactly what is seen by the PS reader. Study 1 revealed the difficulty of determining whether the salient cues being used by PS readers were predominantly graphic or phonological. This distinction might be made more easily with controlled word and nonword stimuli. If lexical processing were being used, then true words, whether orthographically predictable in terms of English spelling or not, should be equally well identified. If, however, it is predominantly nonlexical processing which is being used, words which are written consistently and predictably should be identified more accurately. On the other hand, pseudohomophones which sound like words but are nonwords, would create many errors. If lexical decision performance revealed a strong regularity and a marked pseudohomophone effect, this would support the notion of major use of nonlexical, phonological processing

As nonlexical processing makes use of letters or clusters of letters represented by phonemes, as its processing units, so the functioning of that route will be damaged and reduced if those functional spelling units (FSUs) are disrupted. Similarly, as lexical processing is visual and designed to process whole words, so its functioning will be damaged and reduced by format distortion. The lexical strategy is the only one which can process irregular / exception words adequately, and so disturbing the normal processing of this route is most likely to impair the correct recognition of irregular / exception words.

If the PS readers are not using only a lexical strategy on its own, then disturbing its functioning should have little effect on regular words. If they are using a lexical strategy at all, then disturbing it is most likely to affect recognition of irregular words.

To investigate whether PS children are nonlexical readers, five separate experimental Studies were devised.

3.2.3.PILOT STUDY 2, EXPERIMENTS 1- 5..

Before continuing with the word processing tasks described in Study 2 and the analysis of reading and spelling progress described in Study 3, a pilot study of phonological awareness was undertaken.

Use of a nonlexical word recognition strategy depends on the ability to detect and analyse discrete sounds in words and to associate these with letter patterns. Before trying to determine whether PS readers use this strategy in making lexical decisions to printed words and nonwords, it was important to test their ability to analyse discrete sounds in spoken words. The lexical decision task, of course, does not demand phonological processing, but the question at present is simply aimed at determining whether or not these children could use phonological processing.

Success on a similar battery of 7 nonrhyming tests , with children of average age 6 years 2 months, was found to be predictive of successful first grade reading levels. (Stanovich, Cunningham and Cramer, 1984)

SUMMARY OF PILOT STUDY 2.

The mean age of the PS children (n =11) at the time of testing was 7 years 5 months (s.d. 1 year 1 month) with an age range from 5 years 11 months to 8 years 11 months.

The purpose of carrying out this Pilot Study was to determine that all children had sufficient phoneme awareness with regard to their spoken language to be able to use their phonological system for word recognition and production.

A battery of 10 phoneme awareness tests was created based on those of Stanovich et al (1984) but using word stimuli drawn from the writing, reading and spoken word stores of the PS children. Each of these 10 tests was scored out of 10, so that the maximum score was 100 for good and explicit phoneme awareness. Each test focused on one aspect of phoneme awareness - such as stripping the initial consonant and saying the remaining word 'p - ink' or identifying the word in a set of 4 which did not begin with the same letter as the other 3 - 'man, ice, monkey, music.'

The results obtained yielded a mean score for each PS subject in the group of 69 out of a maximum of 100 (s.d. 25).

Three children scored at or near ceiling level on all 10 tests. No subject was unable to achieve at all.

The results confirmed that all subjects had the capacity, to a greater or lesser extent, to hear discrete sounds in words and to analyse words for component parts. This signalled that the auditory analysis system was functioning well enough for the children to be able to undertake the task of mapping the printed word onto this system by means of the nonlexical processing strategy. (Full details of the tests are provided in Appendix 9.)

3.3. EXPERIMENT 1.

AN INVESTIGATION OF THE LEXICAL ROUTE AND FORMAT DISTORTION.

3.3.1.INTRODUCTION.

This experiment was designed to investigate the effect of using vertical print on the correct identification of words and nonwords. In addition, regular and irregular words were used in an effort to discover whether a nonlexical strategy had been adopted.

If the lexical route specialises in processing visual gestalts, and if vertical print disrupts these, then the use of vertical print should reduce reading to near zero if only lexical processing is being used. Moreover, no difference between the recognition of regular and irregular words would be predicted.

Seymour and Elder (1986) found that word recognition skill was not totally abolished when 4 1/2 - 5 1/2 year olds were required to read familiar words in vertical or in zig-zag form. Nonetheless, 'the general trend in the data was for distortion to depress the level of correct responses whilst preserving the variation among the individuals found for reading normal words.' The better readers lost little by distortion, the average readers lost up to a third of correct reading, whilst the poor readers lost over half. They also noticed a trend, as reading improved, for a progression towards the establishment of an abstract and flexible system. They pointed out one subject of interest who was relatively unsuccessful at acquiring a sight vocabulary and who gave evidence of a preference for phonological reading. This subject did not make this progression to a more flexible approach to the vertical and zig-zag words. In the first study this subject's loss by format distortion was a third and in the second, later study, it was higher. i.e. the use of lexical processing, which was in any case not a strength, was reduced still further by format distortion. For this young FS subject, format distortion at a time when phonological decoding strategies had not been taught, was clearly damaging to reading performance.Such an FS subject might in some ways resemble the young PS subject, using lexical processing, but with difficulty.

The main hypothesis under consideration in Study 2 is that PS readers are nonlexical readers.This is investigated in the following way in Experiment 1:
Distorting print format affects the efficiency of lexical processing. If the PS do not use the lexical route, then such distortion will have little impact on their word recognition. If the PS are using lexical processing at all, then the impact is most likely to be seen in the lowered recognition of irregular words which are normally processed only by the lexical route.

If the PS are nonlexical readers, then this would show in the presence of a regularity effect. The regular words would be recognised correctly more often than irregular words.

The FS are likely to be more affected by the distortion of the lexical route. They are likely to use both strategies, but principally the faster lexical one. Any disturbance to this processing will reduce the correct recognition of both regular and irregular words.

If the PS and FS children have reached a sufficient level of word awareness, there should be no significant difference in the correct recognition of both words and nonwords. They should be able to reject nonwords very readily.

3.3.2. METHOD.

SUBJECTS.

The 11 PS children (6 girls and 5 boys) were all pupils at a school for visually impaired children.They were of average ability (mean IQ 103 s.d.13) They were aged from 7 - 10 years, with a mean age of 8 years 6 months (s.d. 1 year 1 month). Their mean reading age was 7 years 10 months (s.d. 1 year 6 months) with a range from 5 years to 9 years 10 months.Full details of their visual status are provided in Appendix 5.

The matched control group consisted of 11 boys and 11 girls whose average age was 8 years 4 months (s.d. 1 year) with a range from 6 years 11 months - 10 years. They were of average ability as rated by their teachers or as tested on the British Ability Scales. Their mean reading age was 8 years 6 months (s.d.1 year 2 months) with a range from 6 years 5 months - 10 years 6 months. Each PS child had 2 matched FS controls.

The method of reading tuition adopted in the school for visually impaired children was predominantly one in which letters and letter patterns were learned in relation to their pronunciation. The method used in the mainstream primary school, from which the FS sample was drawn, was a 'mixed' one, emphasising predominantly neither recognising words by sight, nor letter - sound associations, but using both these and other strategies. Matching by reading age was accomplished by testing individually the reading of all FS children in the relevant age groups, some 100 in all, in the mainstream primary school.

Each PS child was matched with two FS control children, according to age, gender, reading age and ability (though see 1.4).

(Full details of the subjects are provided in Appendix 10.)

MATERIALS.

20 regular and 20 irregular words, all 5 - 6 letters long, were selected from the reading store of the PS children, and 40 legal nonwords of matched length were created. Words selected from the PS store were the highest frequency available, mostly AA or A in the Thorndike-Lorge Word List. Half of the regular words and half of the legal nonwords were typed horizontally in random order onto a sheet of A4 paper, so, too, were half of the irregular words and half of the legal nonwords.The remaining half sets of words and nonwords were typed vertically onto sheets of A4 paper - also in random order.The second set of word stimuli was created by changing the orientation of the first set of horizontal words to vertical position and the vertical words to horizontal position. Each set of words was rerandomised before being typed onto A4 paper.

The word stimuli were presented, in randomised order, in blocks - Set 1 comprising only regular words and nonwords interspersed, Set 2 comprising only irregular words and nonwords interspersed.

In the choice and description of regular and irregular words, a definition of regularity has to be adopted and definitions used in the literature differ in their degree of severity.

Indeed, in his analysis of English orthography, Venezky (1970) stated: 'Until we have discovered all existing patterns, we cannot be sure that any one pattern is regular or irregular.' He advised against use of these terms but instead suggested a classification on the basis of whether spelling to sound patterns were predictable or unpredictable from the graphemic, morphemic or phonemic features of the word they were in. Predictable patterns would be either invariant, having virtually no exceptions, or variant, having predictable rule-bound variations. Unpredictable patterns consisted of all other letter patterns.

A strict and narrow definition of a regular word was set out by Freebody and Byrne (1988):

1. Each letter in the word must represent its most common sound.

2.There should be no silent letters.

3.There should be no digraphs representing single phonemes, such as 'ch'.

Words with silent letters are regarded as irregular, so both 'wave' and 'have' would fall into that category, so would both 'comes' and 'makes'.

Their aim was to intensify the difference between regular and irregular words and their definition resembles Venezky's requirement for a predictable invariant word.

In this series of Experiments, the criterion used for distinguishing between regular and irregular words was as follows:

'Regular' words were those which could be deduced or predicted by use of the commonest letter - sound correspondences. This included use of a silent - e to lengthen the preceding vowel, the use of digraphs, such as '-ch', to denote common phonemes, and the use of certain double consonants in medial and final position. This definition included both Venezky's subgroups of variant and invariant predictable words.

'Irregular' words were those whose written form could not be predicted from the spoken form, such as 'high' or 'books'.

The stricter definition of a regular word used by Freebody and Byrne was not adopted for the following reason. The word stimuli were all drawn from the PS store, some words contributed by each child. There were not enough of such strictly regular words from that source, if common words containing 'silent - e', such as 'like' or 'make', or containing digraphs such as 'ch' or 'sh' in 'chop' or 'shop' were omitted.
(Full details of the word stimuli are provided in Appendix 11a.)

APPARATUS.
All children worked at a Visualtek Closed Circuit Television (CCTV). The stimulus material was placed on the moveable display trolley beneath the screen to be illuminated and enlarged.

DESIGN.
The dependent measure was the number of correct lexical responses, both in rejecting nonwords and accepting words.
There was 1 between subject factor, **group** (PS and FS), and there were 3 within subject factors factors, **stimulus** (words and nonwords), **position** (horizontal and vertical) and **regularity** (regular and irregular words).Vertical and horizontal presentation was counterbalanced over days.

PROCEDURE.
Each subject worked individually on the task, in a secluded area of the classroom. Each was told individually that the task was to view each word and to put a tick against

it, if it appeared to be a genuine or true word, and a cross if it looked like a 'pretend' word, a word that 'had been made up'.

There were 5 practice trials, followed by the first set of experimental tasks, with a break of at least a day between the presentation of sets one and two of the experimental tasks. Each set comprised one horizontal list of word stimuli and one vertical list.

3.3.3.RESULTS.

Table 5. The means and standard deviations for the correct recognition of regular and irregular words (max 20 per cell) in Experiment 1, in a lexical decision task to investigate the impact on lexical processing by PS and FS children of distorting print format.

	Horizontal		Vertical	
	Regular Words	Irregular Words	Regular Words	Irregular Words
PS mean	15.5	15.4	14.3	11.9
s.d.	3.5	3.6	2.0	4.1
FS mean	17.7	17.3	14.5	14.6
s.d.	2.2	1.9	3.2	2.9

ANOVA SUMMARY TABLE (Table 5)

Source.	d.f.	F.	p.
A (Group)	1	4.7	*
B (Position)	1	35.25	**
C (Regularity)	1	1.5	
A x B (Group x Position)	1	0.33	
A x C (Group x Regularity)	1	1.8	
C x B (Position x Regularity)	1	0.34	
A x B x C (Group x Position x Regularity)	1	3.7	
Error terms			
A x subjects within groups	31	19.3	
B x subjects within groups	31	7.3	
C x subjects within groups	31	5.3	
B x C x subjects within groups	31	3.7	

* $p < .05$ ** $p < .01$

The ANOVA of Table 5 with 1 between subject factor (Group) and 2 within subject factors (Position and Regularity) revealed that the PS children performed overall at a lower level of accurate identification than did the FS children ($F_{1,31} = 4.7, p < .05$).
There was a significant difference in the correct recognition of words in horizontal and in vertical position, those in vertical position being less well identified ($F_{1,31} = 35.25$, $p < .01$).

Regular and irregular words were recognised equally well.

None of the interactions gave rise to significant differences, though there was some indication that the PS might have particular difficulties with irregular words when presented vertically.

Table 6. The means and standard deviations for the correct identification of legal nonwords in Experiment 1 (max 20 per cell), in a lexical decision task to investigate the impact on word and nonword processing by PS and FS children of distorting print format.

	Horizontal. legal nonwords.	Vertical. legal nonwords.
PS mean	12.3	13.3
s.d.	4.6	4.1
FS mean	14.0	13.75
s.d.	4.7	4.5

ANOVA SUMMARY (Table 6).

Source.	d.f.	F.	p.
A (Group)	1	.45	
B (Position)	1	.079	
A x B (Group x Position)	1	1.065	
Error terms			
A x subjects within groups	31	37.9	
B x subjects within groups	31	4.98	

* p< .05, ** p< .01

The ANOVA of Table 6 with 1 between subject factor (Group) and 1 within subject factor (Position) revealed that PS and FS children identified legal nonwords equally well. Moreover, there was no difference in their correct identification whether the nonwords were in horizontal or vertical position.

3 3.4.DISCUSSION.

The results of Experiment 1 show that turning horizontal words to vertical position renders them harder to identify correctly.This was true for both regular and irregular words, and for both PS and FS children. Distorted format did not differentially affect irregular words significantly more than regular ones, nor PS children significantly more than FS children. Regular words were not identified significantly better than irregular ones.

Overall, the PS children were able to complete this task significantly less well than the FS children, despite the fact that the true words had been drawn from their reading store. This was not so in the case of nonwords. Here, both PS and FS performed equally well, and it made no significant difference to the correct recognition of nonwords, whether they were in horizontal or in vertical position. Inspection of the mean scores shows that when regular and irregular words were in horizontal position, the PS like the FS, recognised both equally well. It is true that the PS recognised fewer correctly than the FS at the outset. In vertical position, the PS dropped only slightly in the correct recognition of regular words, as though their sequential decoding strategy stood them in good stead. However, they were very badly affected in their recognition of irregular words, when these were in vertical position. This indicated that the PS were using a lexical strategy and that any interference with it, affected them very adversely. In the case of the FS, they were equally affected in their recognition of regular and irregular words in vertical position, as though they were using a lexical strategy for both.

In the case of nonwords, these are rejected before they are subject to either lexical or nonlexical processing, and so interfering with the lexical route, as here, should not affect their correct identification. This was, indeed, so.

There was little support in Experiment 1 for the notion that the PS children were using solely or principally nonlexical processing. Distorting print format did lead to lowered recognition, by them, of both regular and irregular words, and although this result did not reach significance, it was the irregular words in vertical position which caused the PS children most difficulty. This was the expected effect of distorting format and thereby the smooth functioning of the lexical route.

Inspection of the mean scores in Tables 5 and 6 reveals that both PS and FS children had difficulty in recognising nonwords successfully. Part of this difficulty in Experiment 1 could arise from the fact that the nonwords were legal nonwords. More is said of these in Experiment 3. However, there is also a suggestion from these results that there was some difficulty with the lexical decision task itself, which requires quite a substantial implicit knowledge of English orthography.

In carrying out this Experiment, the FS children had at least two word recognition strategies available. The regular and irregular words were presented in blocks, interspersed with the nonwords. They could have selected a different strategy for each block. Their equally correct recognition of both regular and irregular words, whether in horizontal or vertical position, may reflect their access to two strategies. Alternatively, they could have used just the lexical process for identifying both types of word, and the lexical process must then be regarded as very flexible to tolerate the rotated print.

The PS children had one principal, explicit, taught, strategy, usually found to be successful for regular words. Their mean scores in Table 5 reflect this bias in the lexicon, induced by teaching, towards regular words. However, that is not to say that they could not recognise irregular words. They did so, possibly by use of lexical processing, which for them, was considered less effective because of the underlying shape matching difficulty associated with impaired eyesight. Their difficulty with this inferred lexical processing was clear when print was vertical and irregular words had to be identified.

In conclusion, the results of Experiment 1 do not support the hypothesis that PS children rely solely on nonlexical processing and on their principal taught strategy. This is clear from their performance with both regular and irregular words, as well as from the effect of the horizontal and vertical positioning of the print.

3.4.EXPERIMENT 2.

AN INVESTIGATION OF THE PROCESSING OF PSEUDOHOMOPHONES.

3.4.1.INTRODUCTION.

An alternative way of looking at PS reading is to ask only about phonological processing. Using pseudohomophones in a lexical decision task is a useful method to adopt.

Experiment 2 was designed to investigate further the idea that PS children are nonlexical readers. If this is so, then there should be evidence of a clear regularity and pseudohomophone effect.

A pseudohomophone is a nonword such as SNOE, which sounds like a word but which looks different from the conventional spelling. The alternative spelling is, nonetheless, consistent with English spelling convention. The predominant theoretical view is that pseudohomophones cannot be identified via the lexical route. However, via the nonlexical route, a phonological code can be derived which can be used both to read aloud and to gain access to the meaning of the homophones. Such nonwords cause difficulties if they enter the nonlexical processing route, for once transformed into phonological form they can gain access to the lexicon. Only when a visual check is carried out are they discovered to be fakes. They create many errors and are slow to be rejected.

The pseudohomophone effect should be more marked than customary and should show in a significant difference between PS and FS readers, with PS readers showing a larger regularity and pseudohomophone effect than FS readers. A large pseudohomophone effect shows in the low rate of correct identifications, whilst a large regularity effect shows in the high level of recognition of regular words.

If the PS and FS subjects are sufficiently word aware to make good lexical decisions there should be no difference in their correct recognition of both words and nonwords.

3.4.2. METHOD.

SUBJECTS.

As for Experiment 1.

MATERIALS.

4 lists of words were prepared: 2 for List 1 and 2 for List 2. All sets of words were used twice.

Presentation One.

List One	**List Two**
10 regular words & 10 irregular words	10 regular words & 10 irregular words
20 pseudohomophones	20 illegal nonwords

Presentation Two.

List One	**List Two.**
10 regular & 10 irregular words	10 regular & 10 irregular nonwords
(as for Presentation 1)	(as for Presentation 1)
20 illegal nonwords	20 pseudohomophones

The regular and irregular words came from the reading vocabularies of the PS children. The words selected from this source were those with the highest frequency, all rated AA in the Thorndike-Lorge Word List. The pseudohomophones were from Pring (1984). Words and nonwords were 4 - 6 letters in length.(Full details of the word stimuli are provided in Appendix 11 (b).

APPARATUS.

Each subject worked at the Visualtek CCTV. The lists of words were placed on the moveable trolley beneath the screen for illumination and enlargement.

DESIGN.

The dependent measure was the number of correct lexical responses, both in rejecting nonwords and in accepting words.

There was 1 between subject factor **,group,** (FS and PS) and there were 3 within subject factors, **stimuli,** (words and nonwords), **regularity** (regular and irregular words,) **nonwords** (pseudohomophones and illegal nonwords).

The design was a split plot .

PROCEDURE.

The task was a lexical decision task.Each child was instructed individually to tick each word which he or she judged to be a genuine or true word, and to put a cross against each word which looked fabricated, 'as though it had been made up'. 5 practice trials were followed by the experimental trials, either List 1 or List 2, with a break of at least a day between lists.

3.4.3.RESULTS.

Table 7. The means and standard deviations for the correct identification in Experiment 2 of regular and irregular words (max 40 per cell) in a lexical decision task exploring lexical and nonlexical processing by PS and FS children.

Subjects.		Regular words	Irregular words.
PS	mean	32.4	28.7
	s.d.	5.4	8.5
FS	mean	36.9	36
	s.d.	3.3	4.6

ANOVA SUMMARY (Table 7)

Source.	d.f.	F.	p.
A (Group)	1	10.45	**
B(Regularity)	1	5.3	*
AxB (Group x Regularity)	1	2.6	
Error terms			
A x subjects within groups	31	49.01	
B x subjects within groups	31	10.3	

* p< .05 ** p < 01

An ANOVA of Table 7 with 1 between subject factor (Group) and 1 within subject factor (Regularity) revealed that there was a significant difference in the performance of the PS and FS on this task ($F_{1,31} = 10.45$, $p < .01$), the mean scores of the PS being lower. The difference in the recognition of regular and irregular words also reached significance ($F_{1,31} = 5.3$, $p < .05$).

Table 8. The means and standard deviations for the correct identification in Experiment 2 of nonwords (max 40 per cell), in a lexical decision task to investigate the processing of pseudohomophones by PS and FS children.

	Pseudohomophones.	Illegal Nonwords.
PS means	16.9	26.8
s.d.	9.1	11.08
FS means	23.2	30.4
s.d.	8.5	9.17

ANOVA SUMMARY(Table 8)

Source.	d.f.	F.	p.
A (Group)	1	2.3	
B (Nonword stimuli)	1	40.58	**
A x B (Group x Nonwords)	1	1.024	
Error terms			
A x subjects within groups	31	157.5	
B x subjects within groups	31	26.62	

* p< .05 ** p< 01

An ANOVA of Table 8 with 1 between subject factor (Group) and 1 within subject factor (Nonword stimuli) revealed that PS and FS subjects identified both pseudohomophones and illegal nonwords equally well. There was, however, a significant difference between the correct identification of pseudohomophones and of nonwords ($F_{1,31} = 40.58$, $p < .01$). The illegal nonwords were recognised at a much higher level of accuracy than were the pseudohomophones.

3.4.4.DISCUSSION.

In this Experiment, there was a significant difference found between the recognition of regular and irregular words. Overall, the mean scores of the FS children in the recognition of words, but not nonwords, was significantly higher than that of the PS children.

There was a significant difference in the identification of pseudohomophones and of illegal nonwords, the pseudohomophones proving difficult to reject by both PS and FS children.

The correct identification of pseudohomophones by PS children was markedly low, as expected, but the interaction did not reach significance.

Again, the mean scores found in Table 7 showed the FS children processing both regular and irregular words equally well, whilst the PS were more successful in processing regular words.

The correct identification of illegal nonwords was not quite as good as that of words, and this suggests some lack of explicit word awareness on the part of both PS and FS children.

In Experiment 2, there was a significant regularity effect, and there was a significant pseudohomophone effect. This provides support for the fact that the PS make use of nonlexical processing, but the claim still cannot be sustained that this is the only processing strategy they use, nor that they differ significantly from the FS children in their strategies.

3.5.EXPERIMENT 3.

AN INVESTIGATION OF THE PROCESSING OF PSEUDOHOMOPHONES AND LEGAL NONWORDS.

3.5.1.INTRODUCTION.

To the fluent reader, pseudohomophones sound right and legal nonwords look right. Many experimenters have maintained that the presence of difficulty in rejecting pseudohomophones reflects the use of nonlexical processing.

Martin (1982), however, suggested an alternative view, namely that the pseudohomophone effect arose because these nonwords looked like words. In other words, in her view, the effect arose because of the word's visual appearance, and not because of its phonological components. She made the general criticism of experiments in this sphere that proximity of the nonword to a word was often not rigorously measured nor controlled. She maintained, therefore, that legal nonwords were likely to be as difficult to reject as pseudohomophones on this basis, for they were nonwords which look like words. They were pronounceable, they conformed to English orthography, but they were letter strings which had no lexical entry.

It is only in this third respect that legal nonwords differ from pseudohomophones, which do have a phonological entry in the lexicon. Unlike illegal nonwords, legal nonwords and pseudohomophones are letter strings which have to be processed because they look sufficiently like words to require processing.

In her own Experiment, the recognition of legal nonwords and pseudohomophones visually matched to words of comparable frequency was examined. Subjects were required to respond fast, within a time limit, so precluding full nonlexical processing, but allowing for lexical processing. There were no significant differences in reaction time between legal nonwords and pseudohomophones, but both took longer to process than did illegal nonwords which were visually more distant from the appearance of the words. Martin took this as evidence that both pseudohomophones and legal nonwords could be processed by the lexical route, and that the pseudohomophone effect could be a visual not a phonological effect.She supported this with a similar finding from an adult aphasic subject. Difficulty in rejecting pseudohomophones did not then, necessarily, in Martin's view, constitute firm evidence of the use of nonlexical processing.

In Experiment 3, children were not timed, so were able to use either strategy. The dependent measure was not reaction times but correct recognition rates. The experiment was carried out to investigate the processing of legal nonwords by PS and FS readers, in comparison to their processing of matched pseudohomophones and matched illegal nonwords.

Presence of a regularity effect would be evidence of the use of a nonlexical strategy. If PS children are using only this strategy, then a greater effect would be expected on their part than on the part of the FS.

If a lexical strategy was being used and Martin's results were to be replicated under the different test conditions, then the visually matched legal nonwords would be identified with as much difficulty as the pseudohomophones.

If the nonlexical route was being used, then pseudohomophones would be more difficult to reject, particularly by the PS.

3.5.2.METHOD.

SUBJECTS.

As for Experiment 1.

MATERIALS.

4 lists were prepared for Set 1. They were composed as follows :

LIST 1	LIST 2	LIST 3	LIST 4
10 regular	10 regular	10 regular	10 regular
10 irregular	10 irregular	10 irregular	10 irregular
20 pseudohomophones	20 legal nonwords	20 pseudohomophones	20 illegal nonwords

All words and nonwords were 3 - 6 letters long, and there were equal numbers of words and nonwords of each length.A legal or illegal nonword was carefully matched for visual appearance to each pseudohomophone..

The 4 lists for Set 2 consisted of the 4 sets of regular and irregular words above but randomly arranged with a different set of nonwords from Set 1, taken from the four available sets of nonwords. The setting of the nonwords in a different word list context for Set 2 was to prevent a particular set of words from creating a response bias.

The words were all drawn from the reading store of the PS and were those available with the highest frequency, mostly rated AA or A in the Thorndike-Lorge Word List.The three matched types of nonword were from Besner and Davelaar (1983).

The pseudohomophones each had at least two meanings in English, and the pseudohomophones and legal nonwords were very closely matched for appearance and length.The legal nonwords differed from the pseudohomophones mostly by just one letter - sufficient to make them pronounceable, but not to have a homophonic counterpart. The illegal nonwords, too, were very closely matched with the pseudohomophones: they were matched in length and differed only by one or at most two letters, sufficient to make the nonword unpronounceable and to eliminate the similarity to homophonic words.

(Full details of the word stimuli are provided in Appendix 11(b))

APPARATUS.

Each subject worked at the Visualtek CCTV. The lists of words were placed in turn on the moveable trolley beneath the screen for illumination and enlargement.

DESIGN.

The dependent measure was the number of correct lexical responses, both in rejecting nonwords and accepting words.

There was 1 between subject factor, **group**,(PS and FS) and there were 3 within subject factors, **stimuli**,(words and nonwords), **regularity**,(regular and irregular words), **nonwords**, (pseudohomophones,legal nonwords, illegal nonwords).

PROCEDURE.

Each subject worked individually on the task. Each was told that the task was to view each word and to put a tick against it, if it appeared to be a genuine or true word, and a cross if it looked like a fabricated, 'pretend' word, a word which had been 'made up'.

Five practice trials were followed by one of the Experimental trials, with a break of at least a day between trials.

3.5.3 RESULTS.

Table 9. The means and standard deviations for the correct recognition of regular and irregular words (max 80 per cell) in Experiment 3, in a lexical decision task for further investigation of lexical and nonlexical processing by PS and FS children.

	Regular Words	Irregular Words
PS mean	66.4	62.2
s.d.	12.85	12.89
FS mean	76.14	74.5
s.d.	5.8	6.5

ANOVA SUMMARY (Table 9)

Source	d.f.	F.	p.
A (Group)	1	11.34	**
B (Regularity)	1	7.3	*
A x B (Group x Regularity)	1	1.7	
Error terms			
A x subjects within groups	31	157.8	
Subjects within groups	31	14	

* $p < .05$ ** $p < .01$

An ANOVA of Table 9 with 1 between subject factor (Group) and 1 within subject factor (Regularity) revealed a significant main effect by group (F 1,31 = 11.34, $p < .01$), and by word stimuli.(F 1,31 = 7.3,$p < .05$) The regular words were identified at a higher level by both PS and FS children, although overall the correct identifications of the FS children were higher than those of the PS.

The interaction effect did not reach significance.

Table 10. The means and standard deviations for the correct identification in Experiment 3 of nonwords (max 40 per cell), in a lexical decision task for the further investigation of the processing of pseudohomophones and legal nonwords by PS and FS children.

	Pseudohomophones	Legal Nonwords	Illegal Nonwords.
PS means	20.86	22.09	25.36
s.d.	7.6	8.3	13.1
FS means	23.25	24.27	31.09
s.d.	10.7	10.45	12.6

ANOVA SUMMARY (Table 10).

Source.	d.f.	F.	p.
A (Group)	1	.76	
B (Nonword stimuli)	2	21.9	**
A x B (Group x Nonwords)	2	1.48	
Error terms			
A x subjects within groups	31	339.04	
Subjects within groups	62	19.6	

* $p < .05$ ** $p < .01$

An ANOVA of Table 10 with 1 between subject factor (Group) and 1 within subject factor (Nonword stimuli) revealed that PS and FS subjects recognised nonword stimuli equally well, but there were significant differences in the correct identification of the 3 types of nonword.($F_{2,62} = 21.9$, $p < .01$).

A Newman - Keuls analysis of the differences between these nonword stimuli revealed that there were no significant differences in recognition between the pseudohomophones and the legal nonwords, but there were between the illegal nonwords and both the pseudohomophones (studentised range, d.f. 3,66, = 10.04, $p < .01$) and the legal nonwords (studentised range, d.f. 2, 66, = 8.04, $p < .01$).

3.5.4.DISCUSSION.

In this Experiment, regular words were recognised significantly better than irregular ones by both PS and FS children. Both pseudohomophones and legal nonwords were more difficult to reject than illegal nonwords. Overall, FS children were significantly better than PS children at recognising words, but not nonwords. The PS were worse at identifying pseudohomophones than were the FS children but a significant difference was not demonstrated - indeed FS as well as PS children had difficulty in rejecting both pseudohomophones and legal nonwords.

The difficulty in rejecting both legal nonwords and pseudohomophones could have arisen from use of a lexical strategy, as Martin suggested, on the grounds that both sets of nonwords looked like words. However, both sets of subjects actually found greater difficulty in rejecting the pseudohomophones, and although this difficulty did not reach significance, it indicates that the pseudohomophones were more likely to have been processed by the nonlexical route, where the fact that they sound like true words does lead to errors.

It is true, too, that legal nonwords can be processed by a nonlexical strategy. But they should not then cause so much trouble as pseudohomophones, as they have no lexical entry. They should be easier to reject. An alternative account, though, might involve the humility effect. This arises when a young subject can pronounce a legal letter string, but thinks it is a word which he or she has not yet learned, rather than a nonword. This would then result in legal nonwords being found difficult to reject .

The very low and variable recognition of illegal nonwords, particularly by the PS subjects, suggests uncertain orthographic knowledge by some of the members of both groups.

The evidence in Experiment 3 as to whether the PS were, or were not, using predominantly a nonlexical strategy was inconclusive, so a further way of influencing the processing of the nonlexical route is attempted in Experiment 4.

3.6.EXPERIMENT 4.
AN INVESTIGATION OF THE EFFECT OF DISRUPTING FUNCTIONAL SPELLING UNITS.

3.6.1.INTRODUCTION.

The next two Experiments set out to manipulate the two processing routes differentially. If the lexical route depends on the visual similarity of a word to its lexical entry, then altering the visual appearance should affect recognition. Using alternating upper and lower case letters in words is one way of altering the appearance of that word. Coltheart & Freeman (1974) used alternating case, but same size letters and found that this did interfere with adult reading, although the adult readers did not notice what had been done to the print. However, the first Experiment has already shown that the processing system can withstand quite gross distortions by turning whole words by 90^{0}. Moreover, Pring (1980) found that simply altering word appearance by alternating case reduced the speed and accuracy of word recognition only slightly in a lexical decision task. The system can withstand disruptions to the format which just affect visual appearance, but words can be segmented in other ways than use of alternating case. Pring (1981) found that selectively disrupting or leaving intact the functional spelling units of words, of pseudohomophones and of legal nonwords, did affect the recognition of those word and nonword stimuli significantly. It was the selective use of intact or disrupted FSUs which had an impact and which could lead to use of either a lexical strategy if FSUs were disrupted, or a nonlexical strategy if FSUs were intact.

A functional spelling unit (FSU) is a cluster of letters which belong together to represent a sound. Apart from the vowel sounds, for example, there are the regularly found digraphs: ou-, au-, ea-, ai-, oo-, ee-, ay-, oy-, uy-. There are consonant clusters, such as - ch, -sh, -ck, th-, -dg, -ng and there are double letters following short vowels. There are suffixes and inflections, such as -s, -ion, -ed, -er, which have particular grammatical functions. Each word can be parsed into such functional spelling units, including the word stem and then any prefix or suffix; e.g. th/i/ck/ or j/u/dg/i/ng/

By parsing regular words and then either leaving the functional spelling units (FSUs) intact, or destroying them, one can either enhance the recognition of regular words or reduce this recognition. The same is true, too, for pseudohomophones and for legal nonwords, both of which, though nonwords, may be processed as words. Parsing irregular words and assigning a phoneme to these parsed letter clusters is difficult, as Coltheart et al (1979) pointed out. The pseudohomophone effect is thought by most to arise because of use of nonlexical processing. Pring (1981) demonstrated that if the FSUs of pseudohomophones are disrupted, so as to discourage nonlexical processing, then the effect disappears.

If the consistent spelling units or letter clusters are the processing units of the nonlexical route, then disrupting them should affect regular words that contain them, more than irregular words.

If the PS are making major use of a nonlexical strategy, disrupting FSUs will prove more damaging to their correct recognition levels of words than to those of the FS.

If legal nonwords are processed by a nonlexical strategy, then disrupting their FSUs should also reduce correct recognition.

3.6.2 METHOD.

SUBJECTS.

As for Experiment 1.

MATERIALS.

A total of 20 regular and 20 irregular words, 5-6 letters in length, were selected from the reading store of the PS children.Those with the highest frequency, from this source, were selected, mostly rated AA or A in the Thorndike - Lorge Word List. In addition, 40 nonwords (some from Pring, 1984) were created which were pronounceable, and so legal. They were 4-6 letters in length. There were 4 lists for Set 1 and 4 for Set 2. Each list consisted of 10 regular **or** 10 irregular words, and 10 nonwords per list, arranged in random order.

(Full details of the word stimuli are provided in Appendix 11 (c)

Set One.

LIST A 1	LIST B1	LIST A 2	LIST B2
10 irregular	10 irregular	10 regular	10 regular
10 nonwords	10 nonwords	10 nonwords	10 nonwords
intact	disrupted	intact	disrupted.

Set Two - words and nonwords as above.

disrupted	intact	disrupted	intact.

One list consisted of words and nonwords in which the words had been parsed into their spelling units and these were then kept intact, even though the words and nonwords were typed in alternating upper and lower case letters.

The second list also consisted of words and nonwords which were parsed, but the spelling units were then deliberately disrupted by use of the same number of upper and lower case letters as in list one.

APPARATUS.

Each subject worked at the Visualtek CCTV. The lists of words, typed on A4 paper were placed each time on the moveable trolley beneath the screen for illumination and enlargement.

DESIGN.

The dependent measure was the number of correct lexical responses, both in rejecting nonwords and in accepting words.

There was 1 between subject factor, **group**, (PS and FS) and there were 3 within subject factors, **stimulus** ,(words and nonwords), **regularity**,(regular and irregular words) and **FSU** (intact or disrupted).

The design was a counterbalanced one with regard to the use of intact and disrupted FSUs.

PROCEDURE.

Each subject was individually instructed to tick any word which seemed to be a true word, and to cross any which seemed to have been fabricated, a 'pretend word, which had been made up'.

Five practice trials were followed by the Experimental trials, with a break of at least a day between lists.

3.6.3.RESULTS.

Table 11. The means and standard deviations for the correct recognition of words in Experiment 4 (max 20 per cell), in a lexical decision task to investigate the impact on lexical and nonlexical processing by PS and FS children of disrupting FSUs.

	Intact Regular Words	Intact Irregular Words	Disrupted Regular Words	Disrupted Irregular Words
PS means	15.8	14.3	14.7	14.5
s.d.	4.3	2.9	2.8	3.5
FS means	17.3	16.6	15.7	15.8
s.d.	2.5	2.5	3.2	3.6

ANOVA SUMMARY (Table 11)

Source	d.f.	F.	p.
A (Group)	1	2.09	
B (FSUs)	1	9.73	**
C (Regularity)	1	3.7	
A x B (Group x FSUs)	1	1.4	
A x C (Group x Regularity)	1	1.24	
B x C (FSUs x Regularity)	1	2.2	
A x B x C (Group x FSUs x Regularity)	1	0.14	
Error terms			
A x subjects within groups	31	32.98	
B x subjects within groups	31	3.29	
C x subjects in groups	31	2.23	
B x C x subjects within groups	31	3.3	

* p< .05 ** p < .01

An ANOVA of Table 11 with 1 between subject factor (Group) and 2 within subject factors (FSUs and Regularity) revealed that there was a significant difference between the recognition of words with intact and disrupted FSUs (F 1,31 = 9.73, p< .01). However, none of the remaining main effects, nor interactions reached significance.

Table 12. The means and standard deviations for the correct recognition of nonwords in Experiment 4 (max 20 per cell), in a lexical decision task to investigate the impact on word and nonword processing by PS and FS children of disrupting FSUs.

	Intact Nonwords.	Disrupted Nonwords.
PS means	11.6	11.5
s.d.	5.5	5.7
FS means	14.4	14.5
s.d.	4.7	4.7

ANOVA SUMMARY (Table 12).

Source.	d.f.	F.	p.
A (Group)	1	2.3	
B (FSUs)	1	0.08	
A x B (Group x FSUs)	1	0.12	
Error terms			
A x subjects within groups	31	52.63	
Subjects within groups	31	.765	

* p< .05 ** p< .01

An ANOVA of Table 12 with 1 between subject factor (Group) and 1 within subject factor (FSUs) revealed that there were no significant differences either in the capacity of PS and FS subjects to identify nonwords, nor in the difference in correct identification when the nonwords had either intact or disrupted FSUs.

The overall pattern of the two groups in identifying the two types of stimuli were similar.

3.6.4. DISCUSSION.

In this Experiment, the appearance of words was altered in two ways : one was by keeping the FSUs intact, although using mixed case; the other was by disrupting the functional spelling units, using upper and lower case letters. This was undertaken with both regular and irregular words and with legal nonwords.

The results revealed no regularity effect nor group effect, but there was a significant main effect of disrupting FSUs.This was particularly evident in the case of regular words, though this damaging effect of disrupting the FSUs of regular words did not reach significance, as had been expected.

For the PS there was little impact on the identification of irregular words, whether their FSUs were intact or disrupted. This suggests lexical processing. For the FS, however, apart from the expected drop in recognition level when the FSUs of regular words were disrupted, there was also a slight drop when the FSUs of irregular words were disrupted. This was not expected, and suggests that altering the appearance of the irregular words, processed by a lexical strategy, does for them reduce performance a little.

As before, there was an advantage seen in the recognition of words as opposed to nonwords, but there was no difference in the identification of legal nonwords, whether the FSUs were intact or disrupted. This suggests that if they were mistakenly processed as words, they were being processed by a lexical strategy.

By using upper and lower case for both word formats - intact and disrupted, Pring (1980,1981) demonstrated with sighted adults, that it is not the altering of the appearance of the word, but the destroying of the working units of the nonlexical route, which has an impact on word recognition. She commented that ' if the FSUs were disrupted, the parsing procedure may find it difficult to select the appropriate FSUs.' Before reaching this conclusion, however, in respect of child subjects, the parsing used in Experiments 4 and 5 requires comment.

Pring (1980) argued that the great majority of English words could be divided into two groups, those whose spelling was predictable and those whose spelling was unpredictable from their sound. The first group was the largest and was subdivided by Venezky (1970) into a small invariant group and a larger variant one. Parsing might be based on a one to one correspondence between phoneme and grapheme: each grapheme might be one or more letters (for example 'ch' or 'tch') but the phoneme would represent the one sound as /ʧ /.

There are two problems with use of this phonetic system for parsing.The first is that translating from phoneme to grapheme requires a knowledge of English spelling and children are unlikely to have acquired this knowledge completely. Pring pointed out that regular or predictable words could be translated relatively easily by means of grapheme-phoneme translation, but unpredictable or irregular words, such as 'any 'or 'women' could not. Henderson and Chard (1980) pointed to the many options opened up by grapheme - phoneme conversion, but the even greater selection when translation was from phoneme to grapheme.

Parsing presents problems. In some cases , a letter is influenced by one much later in the word - the long vowel influenced by silent 'e' , for example, as in LATE. Here, it could be argued with reason, that -ATE is a spelling unit, not just the /eI/or the /t/ on its own, out of the three parsed units /l/eI/t/. Moreover, discrete letters sound slightly different depending on their context within words or at word boundaries (Ehri, 1991). A young child might hear the word 'dragon' as /dj/ae/gn/ unless he or she knew in advance how it was spelled.

In the parsing for Experiments 4 and 5, a pragmatic approach was used, based on children's spelling tuition. Double letters belong together, so do diphthongs, but more controversially, so too, do some consonant clusters, such as 'sw-' or '-ct' Functional spelling units, here, are based on those letters a child might learn to keep together as he or she learns to spell.

Because no unaltered words were included in this Experiment, it was not possible to determine whether in the case of these children, using mixed case to make FSUs either intact or disrupted, affected correct recognition by comparison with unaltered words. If the PS children were using a lexical strategy, albeit with difficulty, then it is possible that any visual alteration to the appearance of the word stimuli might have a particularly deleterious effect on recognition for them, irrespective of whether FSUs were intact or disrupted. This was investigated further in Experiment 5.

3.7.EXPERIMENT 5.

A FURTHER INVESTIGATION OF THE EFFECT OF DISRUPTING FUNCTIONAL SPELLING UNITS.

3.7.1.INTRODUCTION.

Experiment 5 differs from Experiment 4 in that amongst the stimuli are included words which have not been altered by mixed case, so as to be able to see whether, in the case of children, and the PS in particular, altering the visual appearance of the word, leaving the FSUs intact, affects word recognition.In the case of adults, it did not Pring (1980).

For the PS , it seemed likely that any alteration in the visual appearance of the irregular words would lead to reduced word recognition compared with unaltered irregular words. The supposition is, that if the PS reader is using the lexical route at all, it is probably only with difficulty.Their shape matching difficulty may mean that letters are confused and that there is little room for error. If the task is made harder by use of mixed case letters, this by itself will reduce word recognition. This might not be so for the FS readers who can tolerate some distortion of the letter array.

In the case of regular words, if the nonlexical route is used, an enhancement could be expected if the FSUs are intact, a drop in word recognition when the FSUs are disrupted, and a midway position being held by the unaltered regular words. Keeping FSUs intact may on the other hand not enhance processing, though disrupting them destroys it.

If the use of mixed case for the intact FSU condition affects lexical processing in the case of children, then the irregular words with intact FSUs should be identified less well than unaltered irregular words.

In this last Experiment are also included illegal nonwords, created by changing just one or two letters of the regular and irregular words, so as to render them nonwords.Words and illegal nonwords should be equally easy to identify correctly.

Illegal nonwords should be easy to identify and reject, so correct recognition should be high, on a par with word recognition rate. The aim, here, was to include illegal nonwords which bore a high visual similarity to the words, so as to be able to assess this recognition rate. The word recognition model of Rumelhart and McLelland (1981,1982) indicated the risk of false positive errors.

If the PS are only using nonlexical processing, then they will show evidence of the regularity effect, and of the effect of disrupting FSUs to a greater extent than do the FS, who are considered to be using principally lexical processing.

3.7.2.METHOD.

SUBJECTS.

As for Experiment 1

MATERIALS.

2 lists of words and nonwords were compiled, each consisting of 80 stimuli, randomly ordered. The words and nonwords were 4 - 6 letters in length, and the words, which had been drawn from the word store of the PS subjects, were the highest frequency available, mostly rated AA or A in the Thorndike - Lorge Word List. Each list of 80 items consisted of 10 regular and 10 irregular words, and 20 matched illegal nonwords, 10 regular words with intact FSUs and 10 regular words with disrupted FSUs,
10 irregular words with intact FSUs and 10 irregular words with disrupted FSUs.

The illegal nonwords were created from their matched regular or irregular unaltered words. 1, or at most 2, letters were altered to render the word illegal. On the first presentation, these were presented as unaltered words and on the second presentation as illegal nonwords, and vice versa. Similarly, in the first presentation, words were presented with intact FSUs and, in the second presentation, the same words were presented with disrupted FSUs and vice versa.

So, word and nonword stimuli, and intact and disrupted presentation, were counterbalanced over days.

(Full details of the word stimuli are provided in Appendix 11 (c))

APPARATUS.

Each subject used the Visualtek CCTV and the the lists were placed on the moveable trolley beneath the screen for illumination and enlargement .

DESIGN.

The dependent measure was the number of correct lexical responses, both in rejecting nonwords and accepting words.

There was 1 between subject factor, **group,** (PS and FS) and there were 3 within subject factors, **stimuli**, (words and nonwords), **regularity,** (regular and irregular words), **FSU** (intact or disrupted functional spelling unit).

PROCEDURE.

Each subject was instructed individually to tick any word which looked like a genuine or true word and to cross any one which looked as though it had been made up, a 'pretend word'.

5 practice trials were followed by the experimental tasks, with a break of at least a day between completion of List 1 and List 2.

3.7.3.RESULTS.

Table 13. The means and standard deviations for the correct recognition in Experiment 5 of regular and irregular words (max 20 per cell) in a lexical decision task to investigate further the impact on lexical and nonlexical processing by PS and FS children of disrupting FSUs.

	Intact regular	Intact irregular	Disrupted regular	Disrupted irregular
PS means	17.5	15.5	16.6	15.3
s.d.	1.8	3	2.8	3
FS means	17.9	16.8	17 .1	16.3
s.d.	2.6	2.6	3	3

ANOVA SUMMARY (Table 13)

Source	d.f.	F.	p.
A (Group)	1	0.72	
B (FSUs)	1	4.6	*
C (Regularity)	1	19.2	**
A x B (Group x FSUs)	1	.05	
A x C (Group x Regularity)	1	1.4	
B x C (FSUs x Regularity)	1	0.6	
A x B x C			
(Group x FSUs x Regularity)	1	.07	
Error terms			
A x subjects within groups	31	25.88	
B x subjects within groups	31	2.9	
C x subjects within groups	31	2.4	
B x C x subjects within groups	31	1.94	

* $p < .05$ ** $p < .01$

An ANOVA of Table 13 with 1 between subject factor (Group) and 2 within subject factors (FSUs and Regularity) revealed that there were significant differences between the recognition of the regular and irregular words.($F_{1,31} = 19.2, p < .01$) and between words with intact and disrupted FSUs ($F_{1,31} = 4.6$, $p < .05$) Generally, the PS recognised fewer word stimuli correctly, but the main effect of Group did not reach significance.

The interaction of FSU x Regularity did not reach significance, and this was unexpected, as it had been anticipated that the regular words would be more affected by the disruption of the FSUs than were the irregular words. None of the remaining interactions reached significance either. Regular words with intact FSUs were recognised better by both the FS and the PS , but for the PS, disrupting the FSUs of the regular words was more damaging. By contrast, for the PS and for the FS, there was no difference in the case of the irregular words , whether the FSUs were intact or disrupted

Two further analyses were carried out to compare unaltered words with those words in which the FSUs had been left intact or disrupted. The word stimuli used in Experiment 4 consisted of words in which the FSUs were either intact or disrupted, but in each instance, mixed case was used. It could be argued that this use of mixed case, in itself, altered the appearance of the word, regardless of the impact on the FSUs. Pring (1980) in fact, had found no difference with adult readers in the recognition of words if mixed case was used, but the FSUs were left intact. However, it is not clear that this is so for child subjects. In Experiment 5, therefore, unaltered words were included, in order to be able to make a comparison between an unaltered word and one in which mixed case was used for either intact FSU, or disrupted FSU.

Table 14. The means and standard deviations for correct recognition in Experiment 5 of unaltered regular and irregular words, and for regular and irregular words with intact FSUs (max 20 per cell), in a lexical decision task to investigate further the impact on lexical and nonlexical processing by PS and FS children of altering the visual appearance of words.

Table 14.	Regular		Irregular	
	Unaltered	Intact	Unaltered	Intact
PS means	17	17.5	15.3	15.5
s.d.	2.8	1.8	3.9	3.0
FS means	18.5	17.9	17.5	16.8
s.d.	2.2	2.6	2.4	2.6

ANOVA SUMMARY (Table 14)			
Source.	d.f.	F.	p.
A (Group)	1	2.49	
B (Regularity)	1	13.7	**
C (Word Form)	1	0.9	
A x B (Group x Regularity)	1	1.07	
A x C (Group x Word Form)	1	2.4	
B x C (Regularity x Word Form)	1	0.07	
A x B x C (Group x Regularity x Word Form)	1	0.01	
Error terms			
A x subjects within groups	31	20.9	
B x subjects within groups	31	4.1	
C x subjects within groups	31	2.74	
B x C x subjects within groups	31	1.7	
* $p < .05$ ** $p < .01$			

An ANOVA of Table 14 with 1 between subject factor (Group) and 2 within subject factors (Regularity and Word Form) revealed that there was a significant regularity effect ($F_{1,31} = 13.7$, $p < .01$), with regular words being recognised better than irregular ones, both unaltered and with intact FSUs.

The difference between the recognition of unaltered words generally and those with intact FSUs did not reach significance, nor did the difference between the recognition levels of PS and FS children. Pring (1980) suggested that the impact of intact FSUs might be to impair lexical processing slightly and so allow time for nonlexical processing to occur. This appears to have happened in this case, but not to the extent that there was a significant difference between unaltered words and words with intact FSUs. There was no enhancement effect achieved by leaving FSUs intact. However, Pring (1980) tried a second way of disrupting word recognition - namely disrupting FSUs.

The impact of disrupting the FSU of a word is predicted to be most marked for regular words, for it is these words which are processed best by the nonlexical route. If, as hypothesised, the PS children make most use of this nonlexical route, then it should be the PS children who show the greatest difference between unaltered regular words and regular words with disrupted FSUs.

Theoretically this difference should not exist in the case of irregular words, if they are processed by a lexical strategy.

Table 15. The means and standard deviations for the correct recognition in Experiment 5 of unaltered regular and irregular words and for regular and irregular words with disrupted FSUs (max 20 per cell), in a lexical decision task to investigate further the impact on lexical and nonlexical processing by PS and FS children of disrupting FSUs.

	Regular words		Irregular words	
	Unaltered	Disrupted	Unaltered	Disrupted.
PS means	17	16.6	15.3	15.3
s.d.	2.76	2.8	3.9	3.0
FS means	18.5	17.1	17.5	16.3
s.d.	2.2	3.1	2.4	3.0

ANOVA SUMMARY (Table 15).

Source.	d.f.	F.	p.
A (Group)	1	2.04	
B (Regularity)	1	13.25	**
C (Word form)	1	5.17	*
A x B			
(Group x Regularity)	1	0.95	
A x C			
(Group x Word Form)	1	1.67	
B x C	1	0.16	
A x B x C	1	0.017	
(Group x Regularity x Word Form)			
Error terms			
A x subjects within groups	31	23.28	
B x subjects within groups	31	3.13	
C x subjects within groups	31	5.24	
B x C x subjects within groups	31	3.03	

* $p < .05$ ** $p < .01$

An ANOVA of Table 15 with 1 between subject factor (Group) and 2 within subject factors (Regularity and Word Form) revealed that there was a significant difference on this task between the recognition of regular and irregular words ($F_{1,31} = 13.25$ $p < .01$), with the regular words being better recognised than the irregular ones, whatever the word format.

There was also a significant difference in the recognition of unaltered words, as opposed to those with disrupted FSUs ($F_{1,31} = 5.17$, $p < .05$). This supports the notion, put forward by Pring (1980), that it is the disruption of the FSUs which interferes with processing. Disrupting FSUs has a twofold effect: it alters visual appearance but it also slows down the ability of the nonlexical process to find the correct parsing units and to generate a phonological code. In other words, it prevents nonlexical processing and should lead to lower recognition, particularly of regular words.

Finally, the words and nonwords in this Experiment were very carefully visually matched. Normally, both words and illegal nonwords should be equally well identified.

Table 16. The means and standard deviations for the correct identification in Experiment 5 of regular words and nonwords (max 20 per cell), in a lexical decision task to investigate nonword recognition by PS and FS children.

	Regular Words	Nonwords.
PS means	17	10.5
s.d	2.8	7.2
FS means	18.5	14.8
s.d.	2.2	5.2

ANOVA SUMMARY (Table 16)

Source.	d.f.	F.	p.
A (Group)	1	5.2	*
B (Regular words and nonwords)	1	19.4	**
A x B (Group x Word/ nonword stimuli)	1	1.6	
Error terms			
A x subjects within groups	31	24.24	
Subjects within groups	31	18.42	

* p< .05 ** p< .01)

An ANOVA of Table 16 with 1 between subject factor (Group) and 1 within subject factor (Regular Word and Nonword stimuli) revealed that there was a significant difference between the groups on this task ($F_{1,31} = 5.2$, $p < .05$) The PS subjects were particularly bad at identifying the nonwords.

The difference between the regular word and the nonword stimuli was significant for both groups ($F_{1,31} = 19.4$, $p < .01$). The words were recognised at a higher level by both groups of children.

Table 17. The means and standard deviations for the correct identification in Experiment 5 of irregular words and nonwords (max 20 per cell), in a lexical decision task to investigate nonword recognition by PS and FS children.

	Irregular Words	Nonwords
PS means	15.3	10.5
s.d.	3.9	7.2
FS means	17.5	14.8
s.d.	2.4	5.2

ANOVA SUMMARY (Table 17)

Source.	d.f.	F.	p.
A (Group)	1	7.2	*
B (Irregular words and Nonwords)	1	7.5	*
A x B (Group x Word/ Nonword Stimuli)	1	0.676	
Error terms			
A x subjects within groups	31	21.78	
Subjects within groups	31	25.25	

* p< .05 ** p< .01

An ANOVA of Table 17 with 1 between subject factor (Group) and 1 within subject factor (Irregular word and Nonword stimuli) revealed that there was a significant difference between the groups in the identification of the irregular and nonword stimuli ($F_{1,31} = 7.2$, $p < .05$). Again, it was the PS who had great difficulty in identifying the nonwords accurately.

There was a significant difference by both groups in the correct identification of the irregular words and the nonword stimuli. In both cases, the irregular words were recognised better than the nonwords.($F_{1,31} = 7.5$, $p < .05$)

3.7.4. DISCUSSION.

The main purpose of Experiment 5 was to replicate Experiment 4 in the use of intact and disrupted FSUs, but to add some extra features.

The results showed that in Experiment 5, PS and FS were equally able to recognise regular and irregular words with intact or disrupted FSUs. There was a significant regularity effect and there was a significant effect of disrupting FSUs.

Pring (1980) reminded that disrupting FSUs had two purposes - one was to discourage the use of nonlexical processing, the second was to alter visual appearance as much as when FSUs were left intact. When FSUs were intact, this would slow down lexical processing and could allow nonlexical processing time to influence lexical decisions.

A comparison was made between unaltered regular or irregular words, and regular or irregular words presented with intact FSUs. It was considered that intact FSUs would favour nonlexical processing.

There was a significant difference in this comparison between regular and irregular words, signalling nonlexical processing, but not between unaltered words and those with intact FSUs nor in the interaction of regular words and intact FSUs. Although for the FS, in particular, use of intact FSUs did reduce word recognition level, this was not sufficient to reach significance.

The effect of disrupting FSUs was thought likely to encourage lexical processing. It was most likely to decrease recognition of regular words and, particularly when these were compared with unaltered regular words. There was a significant difference between unaltered words and those with disrupted FSUs, showing that for children as for adults, it is disrupting the FSUs which causes damage. However, both PS and FS subjects were affected, not just the PS.There was a significant regularity effect, but the interaction effect of disrupting the FSUs of regular words compared with unaltered regular words did not reach significance.

The results of prior Experiments revealed that PS and FS children generally perform equally well in identifying nonwords accurately. In this Experiment, words and nonwords were matched visually, the illegal nonwords differing only by one, or at most two, letters from the word. It seemed likely that the PS, in particular, would find this detailed visual discrimination difficult, and indeed, this proved to be so.

There was a significant group difference in the comparison of both regular words and nonwords, and of irregular words and nonwords. The PS were worse at identifying all forms of words and nonwords.

There were also significant differences found for both groups in the identification of regular words and nonwords and of irregular words and nonwords In both cases, it was the illegal nonwords which were identified worst.
Inspection of the means shows that the PS did have particular difficulty in identifying nonwords accurately, though this interaction did not reach significance.

SUMMARY.
In this Chapter, five Experiments were described, in which matched groups of PS and FS subjects were used to investigate the use by the PS of nonlexical and lexical word recognition processing strategies.

If both PS and FS readers were using the same processes in equal measure, then there should be no differences in the outcomes of the two groups in these Experiments.

One particular hypothesis being investigated was that impaired eyesight, together with the particular tuition received, might mean that PS readers might use only or mainly a nonlexical processing strategy for word recognition. This finding would be indexed by a significant regularity and pseudohomophone effect.

The first Experiment was the only one devoted specifically to investigating a lexical word processing strategy.It looked at the impact on word recognition of distorted print format. This proved deleterious to both regular and irregular words, suggesting that both PS and FS readers were using the lexical route, to some extent at least, for processing the two types of word.

In terms of the overall performance on these lexical tasks by the PS and FS children, there were significant group differences in three of the five Experiments. This could have arisen as a reflection of the slightly higher mean reading age of the FS group, for in each case, the FS obtained higher mean scores than the PS .

In each Experiment, both regular and irregular words were used in order to test the extent of phonological, nonlexical processing. These were mostly high frequency words. Henderson and Chard (1980) had found that readers as young as 6 -7 year old responded more quickly to recognise high frequency as opposed to low frequency words, though this age group also made more errors on the high frequency words than on the low frequency ones. Their high frequency list contained mostly regular, but also some irregular words In these Experiments, however, it was not speed, but accuracy which was measured. A regularity effect is often not found below the age of 10 years (Bryant, 1991) but here it was found in three of the five Experiments, in Experiments 2, 3 and 5. In the other Experiments, regular words were identified more accurately than irregular ones but the difference did not reach significance.

Illegal nonwords are generally easy to identify and reject at an early stage of processing. Experiment 4 showed that PS and FS children could identify illegal nonwords equally well, whether they had intact or disrupted FSUs. Experiment 5 revealed that when illegal nonwords look very like matched words, they are significantly more difficult for PS children to reject.

Experiments 2 and 3 investigated further the processing of nonwords. Pseudohomophones are a particular kind of nonword. They sound like words and so, if transformed into sound form by nonlexical processing, can give rise to error.

Experiment 2 showed this to be so. There was a significant difference in the correct recognition of pseudohomophones and of illegal nonwords by both groups of children.

It has been argued, however, that pseudohomophones are difficult to reject, not because they sound like genuine words but because they look like real words. If this is so, then legal nonwords, too, which look like words, should cause equal difficulty.

Experiment 3 showed this to be so. Pseudohomophones and legal nonwords were equally difficult to reject. However, inspection of the means shows that pseudohomophones were more difficult for both PS and FS to reject, and especially so for the PS , so that, although the results confirmed the idea that both legal nonwords and pseudohomophones might have been processed by the lexical route, nonetheless, the direction of the difference in correct identification still suggests, on the contrary, the use of the nonlexical route for processing pseudohomophones, at least by the PS.

In these two Experiments only error rates were being used, not processing time, as measures of difficulty. It seems likely that, if processing time were to be used, then pseudohomophones would take longer to reject, on the basis that they do, in fact, have lexical entries in their phonological form.

Experiments 4 and 5 investigated the impact of disrupting the functional spelling units of words.Significant differences were found between words with disrupted FSUs and those with intact ones, and inspection of the mean scores showed that the effect of disruption was more telling in the case of regular words.

A further comparison in Experiment 5 looked at the impact of altering visual appearance on word recognition. The difference between recognising unaltered words and those with intact FSUs was not significant. It was not so much whether the word was unaltered or had intact FSUs which counted, but rather, whether the word was regular or not. However, there was a significant difference between the recognition of unaltered words and words with disrupted FSUs.

If the PS had been using only the nonlexical route, then the expectation was that there would have been:

1) a consistent regularity effect.

2) a marked pseudohomophone effect.

3) an effect from disrupting the FSUs of regular words.

4) particularly poor recognition by the PS of irregular words.

5) little impact on the PS readers by distorting the visual format.

Some of these effects were seen in part:

a) there was a significant regularity effect.

b) there was a pseudohomophone effect, and it was marked on the part of the PS, though not significantly so.

c) there was a deleterious effect on accurate word recognition achieved by disrupting FSUs. However, the differential effect of this disruption specifically on regular words did not reach significance.

d) PS children did recognise irregular words less well than regular ones, but this interaction effect did not reach significance.

Moreover, by having matched FS control subjects, it was possible to see that the pattern of response by PS and FS children was very similar. For example, PS and FS subjects were equally affected by distorted print format in Experiment 1. The PS did not fail to identify irregular words, and there was not always a significant recognition advantage achieved by regular words.

Children will use any means of word processing available to them The conclusion, then, is that although the PS are taught to use nonlexical processing, they do also use lexical processing. This is likely to be affected by the underlying shape matching difficulty of the PS, and this is evidenced, for example, in the low recognition by the PS, of irregular words in vertical position.

During the course of Chapter 3, several methodological issues have been raised with regard to the carrying out of lexical decision tasks with young readers. These issues are the following:

First of all, to carry out a lexical decision task, there has to be available to the subject a sufficient knowledge of English orthography to know whether particular letter combinations are acceptable or not. This knowledge may not have been acquired by the youngest children in the study.

The issue of what constitutes regularity is important. For some, it is a strict definition. Each letter has a related sound, with no silent letters. For others, it is the rule- bound nature of the letter- sound relationship which matters. This means that for one, 'wave' and 'gave' would not be regular, whilst for the other, they would be. The failure to find a regularity effect consistently in these 5 Experiments could be, in part, because the children were using lexical processing, and it could be, in part, because the distinction between regular and irregular words was not sufficiently extreme for the purpose.

There are, in addition, difficulties in parsing words into their functional spelling units. The very short words used by children of this age, are often difficult to segment, other than letter by letter, and then there is little difference between those words with intact and those with disrupted FSUs. The word 'lots' can be segmented as /l /o /t / s/ and presented as LoTS or lotS or loTS but this provides very little opportunity for real disruption of the FSUs.

The argument explored in this Chapter was that PS children were predominantly nonlexical readers by virtue of their impaired sight and the reading tuition they have received. No causality can be demonstrated from these Experiments. But there is an alternative explanation for such a response bias, if it exists, namely that the origin of the bias resides in the word stimuli, not in the reader. One implication of such an approach is that it would not be the type of reading strategies a child was taught to use that mattered, but rather the range of word stimuli the child had encountered and stored in the lexicon. For it would be on the basis of these, that probabilities would be formulated. It is pertinent to recall, here, that the PS children in this sample, learned to read using materials with rich vocabulary content, not a reading scheme built only on regular words.

Despite these methodological difficulties, all the results obtained were in the predicted direction, though some did not reach significance. However, despite the trend of the results, and the demonstration of a regularity effect three times, a pseudohomophone effect twice and an effect from disrupting FSUs twice, nonetheless, the conclusion has to be that the young PS readers were using lexical, as well as nonlexical strategies. This arises from the fact that the PS children were able to read irregular words. They were significantly worse than the FS at reading words in three Experiments, but there was no significant Group by Regularity interaction to suggest that they were significantly worse than the FS at reading either regular or irregular words on their own, but rather both. For the PS, disrupting the FSUs of irregular words made little difference to recognition, and for them, turning irregular words to vertical position certainly reduced legibility but it did not reduce it entirely.

CHAPTER 4

THE SPELLINGS OF PARTIALLY SIGHTED CHILDREN.

4.INTRODUCTION.

The overall purpose of the first part of this thesis is to examine whether partial sight coupled with reading tuition which emphases individual letters and letter patterns in relationship to their pronunciation, biases the child to adopt one kind of word processing rather than another. If this were to be the case, the spellings of the PS child also should reveal evidence of such a bias. This Chapter examines the spellings of PS and FS children, to determine whether there are observable differences in written word production between the two groups.

Ellis' model (1984) of word recognition (see Figure 1), later including word production (Ellis and Young, 1988), showed two routes or processes whereby words could be recognised, including a connection with the speech processing system. Glushko (1979) demonstrated that this model was inadequate to account for the different speeds at which three types of word were recognised; exception words, such as 'have', regular and consistent words such as 'haze', and regular and inconsistent words such as 'wave'. He proposed a unitary activating system, which used analogy as well as other available word recognition mechanisms. Evidence of this unitary system was demonstrated experimentally by Sibbitt (1989) and from the writings of young children by Francis (1990). Both showed that given, for example, the spoken word; /w/ɔ:/k/t/, the written version might either contain the visually learned suffix '-ed', or the heard suffix '-t'. Either visual or phonological information could be tapped. If the conventional spelling was known directly or by analogy, the child was guided by what was known, not by what was heard. On the other hand, those who supported a dual route model for reading and spelling often cited the example of good readers who spelled poorly, or poor readers who spelled well. However, numbers of such persons were small and the statement, on its own, omitted a detailed analysis of the quality of the poor spelling.

One question which has been asked is whether spelling is just the reading process in reverse - the written production, rather than the reception of language. One major difference between spelling and reading is that reading involves the recognition of printed words, mostly already in the person's spoken language. Spelling demands the recall or reassembly of the printed word form in the presence of the overtly or covertly spoken word. Recall presupposes that at least one of the graphic features of the word is in store to be recalled. Correct, conventional spelling requires the recall of all letters in the correct order. Henderson and Chard (1980), also, drew attention to the divergence between reading and spelling which arises from the fact that there are many more phoneme - grapheme correspondences, than grapheme - phoneme ones.

4.1.PICTOGRAPHS AND WORD-SYLLABIC PHONOGRAPHY.

Ellis' model (1984) of word recognition suggested that the fluent adult reader could, potentially, recognise the full identity of a word in all its aspects (see Ehri, Figure 2) from the brief saccadic inspection it received. It was as though this abstract assembly of letters of the alphabet acted as a picture conveying its meaning directly without reference to the speech system. Some termed the word, processed in this direct lexical way, a logograph. The word in this sense of logograph functions as a pictograph.The term logograph might also be used even when a word had been more gradually recognised. When this gradual recognition had become so fast as to be automatic, the reading of such a word resembled that of the former logograph. In some cases, print uses signs, such as £,@ or k, to denote this direct visual access to meaning.

However, script is also speech derived, although there are those, noted above, who use the word logographic without implying any inherent reference to phonology. The difference between the two definitions may lie in a distinction between what is inherent in the speech derived written word, and the processes brought to bear in reading or writing that word. Frith (1985) used the term logographic strategy to denote the fast direct lexical recognition of a familiar word. Here, the properties of the word were merged with the act of processing. The definition of logographic became interchangeable with the term lexical.

Henderson (1972) presented a selection of descriptions of writing systems to show how the development from pictures to phonography occurred. He pointed out that Gelb (1963) used the term 'phonography' for full writing systems to remind readers that a word was a representative of a speech sound of whatever size - word-syllabic, syllabic or alphabetic. Henderson (1972) pointed out that others use the term logographic where Gelb used phonographic.Gelb's taxonomy of writing systems, in fact, did not show a direct line of descent from pictorial pre-writing systems to present day script.

The move away from literal pictorial representation arose from the need to record longer and more finely discriminated messages.There was a need for a more extended script. Finally, printing imposed it constraints, too. For example, German 'e' denoting a vowel change, was first printed above that vowel, and then, for greater economy of space, was reduced to the two dots of the Umlaut. Present day script is consequently an abstraction, a system of conventions to be mastered.

Script has two antecedents - units of meaning, formerly represented by pictographs, and spoken messages. The term logograph now usually refers to the former - a unit of meaning, mostly contained in one word, without necessary reference to phonology, and represented by a set of abstract signs.

4.2.RELEVANT LITERATURE CONCERNING CHILDREN'S SPELLING.

Various authors have observed the development of young children's writing and message sending - which begin with pictures and scribbles. From scribbles emerge circles, vertical and horizontal lines and the beginnings of letters. Early invented spelling consists of one letter standing for a word or syllable. Bissex (1980) provided a fine example written by her 5 year old son: 'RUDF ?' He used his available knowledge of the names and sounds of the letters to create a question. Sulzby (1985) found that, prior to formal tuition, 5 year old Kindergarten children were aware of the difference between their own invented versions and conventional spellings, and of several other aspects of adult writing.

Ehri and Ehri and Wilce(1978,1979, 1980, 1985, 1987) worked with young beginning readers/ spellers. Ehri's model (1978, see Figure 2) showed the various identities of a printed word. Three of these were derived from the spoken word - the syntactic, the phonological and the semantic. The child's task, as the process of learning to read print began, was to amalgamate all the possible identities into that fast direct recognition of the printed word. Ehri and Wilce's studies (1985,1987) showed various aspects of this long process of amalgamation. They found, for example, a phonetic cue stage of processing which fell between the visual strategy of the pre-reader and the deciphering capability of the more competent veteran beginning reader. Phonetic cue reading involved an association between some letters of a word and their sounds. Because not all letters were processed, this type of reading led to inconsistent performance. Ehri suggested that this might be the point at which poor readers failed to progress. Ehri and Wilce also maintained that novice readers who could read only a few words were more successful using a phonetic cue strategy rather than just a visual one. This finding was different from predictions from the models of Marsh et al (1981) or Frith (1985) who stressed the predominance of visual processing at this early reading stage.

Ehri maintained that the orthographic image of the word was the link between reading and spelling, mediated by memory processes. Ehri and Wilce (1987) explored how spelling tuition might aid reading performance. The tuition consisted of taking a selection of vowels and consonants, represented by letter tiles, then of teaching children to listen to the sounds of words and nonwords using these letters. The children had to be able to segment the sounds they heard, repeat them and select the correct letter tiles to represent them. They were not taught to sound out and blend, though when blends occurred, they were taught how to pronounce them. When errors occurred in any of these sub - processes, correction was given. This meant that these subjects both heard the correct versions and also saw the correct spelling set out in tiles. The control group used the same set of letters and letter tiles, and also received tuition in linking individual sounds with particular letters, but this was done in isolation. They did not see correct spellings of whole words and nonwords.

The results showed that those who had received spelling tuition could read new words more accurately than those who had not received this tuition. The authors attributed this to the help they had received in phoneme segmentation as well as the spelling tuition. They had been taught to process all the letters in each word. They were pulling the phonological, articulatory and orthographic identities together. Because many nonwords were used, semantic and morphological identities were largely ignored in this experimental study.

Ehri noted Weber's (1970) study in which over 90% of first grade readers' word substitutions were grammatically acceptable in the context of the preceding sentence. Moreover, about 95% of the substitutions came from the child's existing print reading repertoire. This being so, the conclusion had to be that moving forward in the sphere of decoding new words would be a very slow process, having little impetus.

Ehri and Wilce (1987) stressed the need for tuition in moving a child from the ability to use phonetic cue reading to full deciphering. Others, such as Francis (1990), did not view tuition as essential. The child could gradually build up and develop his or her own repertoire of strategies through interaction with appropriate text.

The main purpose in considering Ehri's work was to appreciate the process of amalgamation which in spelling concerned uniting the orthographic and morphological identities of a word with its syntactic, semantic and phonological identities.It was also to see the processes of reading and spelling interacting with and benefiting from each other by two - way use of letter - sound associations stored in memory. Other work with young children aged 4 - 7 years looked more closely into the role of implicit and explicit phoneme awareness in relationship to their direct or indirect influence on spelling and on reading. Whether because of tuition, or because children become more aware of varying sounds and discover by themselves that letters can represent them, there is general agreement about the importance of young children's developing ability to hear and reproduce discrete phonemes at the time when they are beginning to learn to read and write.

In a longditudinal study, of 40 children in their first 3 years of school N.Ellis (1991) showed that implicit phonological awareness from the age of 4 1/2 years was predictive of spelling at all stages, but explicit phonological awareness eventually had a direct influence, not only on spelling, but also by 6 1/2 years, on reading regular words also. He stressed the phonological, speech associated aspect of spelling. Bruce (1964), however, had found only a tenuous link between phonological awareness and spelling at an older age , 7 - 9 years, though it is not clear from his report how spelling was tested and whether the test included both regular and irregular words. He stated that even at the age of 8 and 9 years plus, the subjects had difficulty in separating out discrete sounds such as /s/t/ in 're<u>st</u>'.This being so, the case for a visual component to spelling was strengthened.

4.3. SPELLING AND PS CHILDREN.

These early stages of writing are generally not intrinsically rewarding to PS children and seem often to be left untouched, perhaps actually avoided, unless actively taught. So it could arise that a 5 year old PS child had not the basic pencil control skills, nor the word awareness, to write his or her own name, when a FS peer could do so. The PS child would typically prefer to communicate mainly by talking for as long as was allowed.

Spelling shares some processes with reading. Both are based on the same repertoire of spoken words. Both share the same letter- sound code. Reading may require some sounding and blending followed by smoothing (Francis, 1990), whilst spelling, if it is based on sounding, also requires analysis or transformation of the heard sound. Spelling requires that the author writes each letter correctly, in the right sequence. Reading is not so exacting - the reader has only to recognise sufficient letters to enable the lexical entry to be found. Spelling requires the generation of a message from its conception to the written form. Reading requires the reception of a message from the printed form on the page. In the case of reading, the essence is to move from the printed form to the full lexical entry. For spelling, the crucial step is from the abstract message to its accurate visual representation.

In considering these two processes, it would seem likely that PS children would find the reading process more difficult than the spelling process. In reading, the message is enshrined in the visual form on the page. In spelling, the message is within the child and has simply to be reproduced in a visual form which the recipient can identify.

Despite anecdotal reports of general early disinterest in pencil and paper, there is some confirmation that PS children do find early spelling easier than early reading (Lansdown, 1973). At the ages of 6 and 8 in his study, the raw spelling scores of the

PS were higher than those of the FS , though not significantly so. This may be possibly because of differences in tuition which focused more on letters than on words.

In the case of PS children, the notion was tested in Chapter 3, that they were nonlexical readers. They were taught to be such, and the question was whether they could use the lexical route at all or whether it was inevitably damaged by virtue of impaired eyesight. Evidence for the use of the nonlexical route came in the form of the presence of a regularity effect, a pseudohomophone effect and an effect from disrupting the functional spelling units of regular words. However, there was also evidence for some use of the lexical route - there was a legal nonword effect, the regularity effect was not always present, and irregular words were most affected when print was turned 90^{o}.

If it is argued here that spelling is just assembled, then PS children should have little difficulty. If, however, spelling involves drawing on the long term lexical store, from learned addressed visual representations then use of the lexical route might be required and this would be likely to cause the PS more difficulty. If spellings are a mix of assembled and addressed versions, then PS spellings should show evidence of the use of both lexical and non-lexical strategies.

Francis (1990) found such evidence of a variety of ways of spelling in the written scripts of 6 - 7 year old writers and of use of both strategies side by side. Morton (1991) also argued for this parallel use of strategies by suggesting that misspellings which look like assembled ones ('baegg', or 'munny'), with letter- sound spelling rules inappropriately applied, might well have been assembled by analogy instead. In other words, spelling is not necessarily built only on the spoken word, as those like N. Ellis might stress (1991) who emphasised the link with early phonemic awareness .

4.4.STAGES, STEPS OR AVAILABLE STRATEGIES.

Marsh et al (1981) wrote of four stages in reading development. At each stage the child was observed to use a predominant strategy, each time more sophisticated than at the previous stage. Frith (1985) set out phases in her model of reading and spelling development, with 6 steps from the novice to the fluent reader/speller. She stated that the phases follow in sequence. However, the strategy which dominated at each phase did not just disappear, but was built on and incorporated into the final accomplishment. She stated that this model was largely speculative.

There is no general agreement about the notion of a sequence of steps or phases. Clay (1975) found no evidence for these amongst the writing of children aged 4:10 - 7:0 years. Rather she found that children discovered principles which governed their writing. Francis (1990) found from the written scripts of a large number of 6 - 7 year old that they were using many strategies, rules in the correct place, rules in the incorrect place, visual and phonological information. These findings are aptly reflected in the model put forward by Seymour & Evans(1991).

4.5.SEYMOUR & EVANS' PARALLEL DEVELOPMENT OF THE SPELLING PROCESS.

Seymour & Evans (1991), also working with young beginner readers, saw the logographic and alphabetic strategies developing in parallel, whilst phonological awareness became more refined.

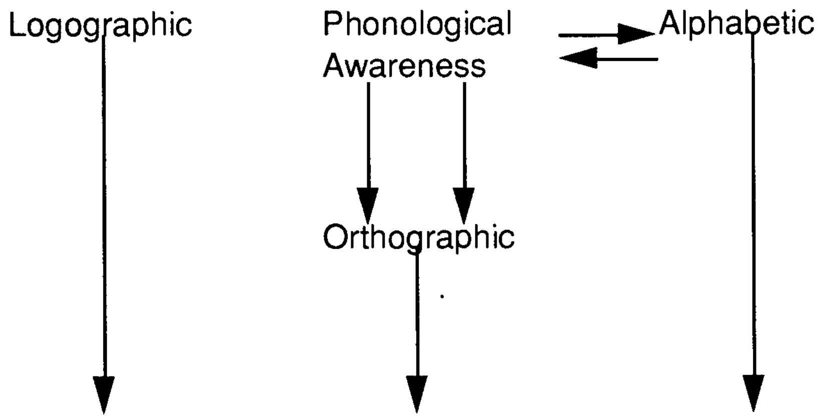

Figure 3

A model of the parallel development of the spelling process. Seymour & Evans (1991).

Seymour quoted a young child's ability to read names as evidence of the logographic strategy - fast direct recognition without the overt influence of phonology. Using matched non-names, such as ' Richine' or 'Janola', he found the same young readers sounded these out and were slower at naming them than when naming true names like ' Richard' or 'Janice'. By the end of their seventh term in school, these children were equally swift at naming the non-names as the names. In other words, at the outset, they had two usable strategies, one slower than the other. One and a half years later, with these particular stimuli, the two strategies were inseparable. In that time, phonological awareness had improved and was possibly beginning to merge into an orthographic strategy.

Frith (1985) included the term symbolic for the earliest writing step (see Figure 4). This was likely to be the early picture stage of written communication, followed by the writing of a name by means of the logographic strategy. Spelling was the pace-maker at the alphabetic phase in this model, indicating that it was possible for children to make an attempt to spell words, when they could not yet read those words (see also Ehri and Wilce 1985).

Some maintain that spelling is never logographic, it is always alphabetic. However, it is observable that some children can write a name before being aware of the properties of the alphabet. Although this could arise through the invented spelling of a name, it is also the case that the visual form of particular letters come to stand for a name like a sign.

4.6. FRITH'S 6 STEP MODEL OF SKILLS IN READING AND WRITING ACQUISITION.

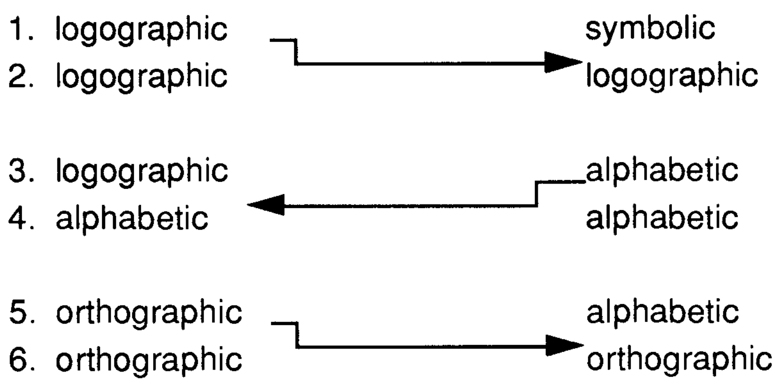

Figure 4

The 6 step model of skills in reading and writing acquisition. Frith (1985).

The value of a step or phase model might be to pinpoint locations of difficulty or uneven performance, perhaps of greater relevance in an analysis of dyslexia rather than for study of normal child development in these skill areas. The same was true of the model of Ellis and Young (1988) whose main advantage was that it displayed graphically possible links between the written and the spoken word, speech and writing. This detailed model enabled dysfunctional processes to be located.

4.7. EVIDENCE THAT THE LEXICAL ROUTE IS BEING USED.

If the visual lexical route is being used and developed, then information from its use, should be available to be drawn on, as children write the words which they have learned to read. Regular words could be reassembled by use of phoneme-grapheme translations. Irregular words, however, have components which can only be remembered, not reassembled. Context sensitive information such as silent letters are a valuable source of information. They might be rule based, such as the final 'e' which lengthens the preceding vowel, or digraphs such as '-ck'. or the silent letters may be from foreign roots, such as the 'a' in beautiful or the 'k' in knee. Other anomalous letters are remnants of old forms: 'any' is an example of a vowel shift arising from a following 'i' or 'y'. Although the sound has changed, the written form has not reflected this vowel shift.The spelling of 'women' and 'answer' reflect old English forms.

It is an interesting notion that young readers may particularly note and remember these silent or anomalous letters, just because they are out of step with the rules the children are formulating. Reid (1966) found that 5 year olds expressed protest that such letters were present, when they apparently served no purpose. Of course, the silent or anomalous letters have only survived in the written language because they do serve a purpose: they disambiguate such forms as 'damn' and 'damnation', they preserve the morphology as well as the history of the language.

4.8.SPELLING TUITION.

In the tuition outlined in Chapter 2 of this thesis, learning to read and spell went side by side. The teacher spelled out many words in the early stages of reading and exhorted pupils to do the same in order to begin by identifying the letters in the word, even if the whole word could not be read. This inevitably led to action, to word attack and to a complete visual analysis of the whole word. At all stages, spelling a word and sounding it out were strategies used singly or in parallel by the teacher to prompt the child to a successful recognition of the word. This suggested assembly of the orthographic image - not direct addressing. Again, there was evidence of the PS children being pushed towards a non-lexical strategy.

One of the features of this process which is of importance, is that it is slow. The PS child has to inspect print closely and slowly, for the sake of accuracy. This may mean that, paradoxically, his or her visual recording is the better.

The shift from the phonetic cue stage of the first letter, to full sounding out is evidently difficult for some young readers. The teacher models how to do it, and there is a stage when the child can sound out only part of the word but then needs assistance to complete the sounding out. Finally the child can complete this task independently.

This is how a visual orthographic image is built up, and it is this which should be reflected in the spellings of the PS child. The purpose of examining the spellings of PS children in this thesis is to look for signs that the lexical route is being used, as well as the nonlexical one. This will be achieved by looking for evidence that PS children reproduce silent or anomalous letters in their spellings, which could not be reassembled from a phoneme- grapheme conversion.

4.9. STUDY 3.

4.9.1. INTRODUCTION.

The statement being put forward with regard to the processing of words by the PS children in this sample is that, because of an underlying shape matching difficulty, they are taught to use nonlexical processing, as they begin to learn to read and write. This is the strategy which converts the graphemes of a word into phonemes and so favours the processing of regular, predictably spelled words.

If the lexical route is the only one of the two which can effectively process regular and irregular or inconsistent, exception words, whilst the nonlexical route can only process the regular ones, then any impairment to, or bypassing of, the lexical route is likely to affect the spelling of irregular words. Any specific tuition in the use of the alphabetic strategy is likely to favour the processing of regular words, which follow the orthographic conventions of the English language.

The main purpose of Study 3 is to provide a qualitative analysis of a small number of spellings of matched PS and FS children, together with reading attainment data collected over a period of 14 months, from the beginning of Study 1, to well beyond its ending.

There are 3 main expectations in respect of PS spellings:

1. If spelling is based principally on an alphabetic strategy, with little essential reliance on purely lexical processing, then PS children should not experience undue delay nor difficulty in the early stages of mastering spelling. As soon as they know the names and sounds of letters, they should be able to begin to assemble written words.This is unlike their starting position in respect of the earliest steps of reading, which requires greater use of eyesight.

2. In view of the 'phonic' tuition received, the spellings of PS children should reflect good use of the alphabetic principle.

3. If the lexical route is being used by the PS , this will be seen in their writing of silent or anomalous letters in words.

4.9.2.METHOD.

SUBJECTS.

As for Study 2. The PS and FS subjects were matched on age, gender, ability and reading age. The 11 PS children were all pupils at one school for visually impaired children (Details of visual status are provided in Appendix 5). The 22 FS children attended a nearby mainstream primary school. Matching was achieved by testing reading ability individually for all available children, over 100 in all, at the relevant ages. Then, those who could be matched with the PS children, on age, gender and reading ability, were rated on general ability by their teachers. Some were tested by the author on the British Ability Scales (1983 Edition). This enabled the final matching and selection on the 4 variables to be completed. Each PS child was matched with 2 FS children.(Details are provided in Appendix 10.)

At the time of the spellings which are the subject matter of Study 3, the average age of the PS group was 8 years 6 months (s.d. 1 year 1 month), and the average age of the FS sample was 8 years 4 months (s.d. 1 year).

There were 11 PS subjects in the group, but in the Graphic Similarity analysis, one subject did not produce any 'incorrect' versions to analyse, so for that part of the Study, the number reduced to 10 subjects.

The method of reading tuition adopted in the school for visually impaired children emphasised predominantly letters and letter patterns in relation to their pronunciation. In the mainstream primary school, from which the FS sample was drawn, the method of reading tuition was described as a 'mixed' one, emphasising no one strategy predominantly, but using all the conventional ones.

(For issues concerning the matching of PS and FS children, see. 1.4.)

MATERIALS.

Two tests were used with standardised norms derived from the sighted population.

1. The Salford Sentence Reading Scale, Forms A,B,C. (Bookbinder,1978)
2. The Daniels and Diack Graded Spelling Test (1964).

The spelling test consists of 40 words, 20 regular and 20 'irregular' or inconsistent ones. Although in the test administration the children do not normally complete items much beyond their spelling competence, nonetheless this test provides a balanced range of words to test knowledge of those known by sight and those which can be derived from spelling rules and grapheme-phoneme correspondences. (Full details of the spellings of the PS and FS subjects are provided in Appendix 12.)

APPARATUS.

The Visualtek CCTV was used by the PS for reading the test sentences.

DESIGN.

Attainment testing of reading was carried out 3 times for the PS subjects, near the beginning of Study 1, then 9 months and 14 months later.
Attainment testing for spelling was carried out twice, near the beginning of Study 1 and 14 months later.(Details are provided in Appendix 13.)
The spellings for the qualitative analysis were written towards the end of Study 1.
For the statistical analysis of the correct spelling of regular and irregular words, the dependent variable was spelling accuracy There was 1 between subject factor (Group,PS/FS) and there was 1 within subject factor (Regularity of the Word Stimuli).

Data Analysis.

1.In order to explore the possibility of progress in reading and spelling as PS children first learned to read and spell, Pearson Product Moment Correlation Coefficients were calculated between chronological age and reading or spelling attainment, tested at separate points in time. Because it seemed likely, that, if there were rapid progress, it would be amongst the younger subjects, when the teaching method was capitalising on their growing phoneme awareness, the sample of matched PS and FS children was divided into two groups. This corresponded approximately to the ages 5y 9m - 7 y 1m for the younger group, and 7 y 9m - 8y 10m. for the older group, at the beginning of the period studied.
In these calculations, for reading attainment, 'no score' on the reading test was assigned a reading level of 48 months, as the subjects in question were able to identify and name letters of the alphabet. A reading level 'below 6 years' was assigned a score of 60 months, as this level denoted the ability to read one or two individual words

For the calculations for spelling attainment, 'no score' on the spelling test was assigned a level of 54 months, as each of the 3 subjects in question could write his or her own name.

2.In order to compare the correct writing of regular and irregular words, an Analysis of Variance was carried out to compare the mean scores of PS and FS subjects.

3.An analysis was made of the nature of the spellings and misspellings written by PS and FS subjects.Two groups of inconsistent words were selected from the spelling test used - one exemplifying, in particular, the use of silent letters, the other, letter patterns which could not be derived from the sounds of the word.

4.In order to be able to compare quantitatively the spelling accuracy of PS and FS children, up to a maximum of 10 misspellings per subject was allowed for the calculation of a mean Graphic Similarity Index (GSI) Use of a GSI enabled spellings to be compared which were not conventionally correct. The Weber GSI (Weber, 1970), first devised and used for first grade American children, 6 - 7 years old, was selected, rather than the Soderbergh Index, first devised for a 2 - 3 year old Swedish child.

The Weber Graphic Similarity Index, used to determine how similar an erroneous spelling is to its correctly spelled target, takes into account the following features:

- total letters in common between word substitute and target regardless of position or order.
-pairs of letters in common, in correct order or in reverse order.
- first and/ or last letters in common.
- length.

The Soderbergh Index gives credit for a correct letter in the correct order. There is also a correction for length.

The Weber Index gives credit for a wider variety of features present in the word substitute than the Soderbergh Index. A preliminary investigation using both Indexes on the same words revealed that neither particularly favours regular or exception words. The Weber Index, because of the wider variety of features it gives credit for, provides a more differentiated Index than the Soderbergh one. The figures yielded on Weber are generally lower than those yielded by Soderbergh.

The choice here was determined by the fact that the Weber Index was devised for an English speaking group close in age to the one in this Study. Taking account of a wide variety of features in a word substitute which are associated with the target word, it gives credit to all the features a child has noted and reused to create the imperfect spelling attempt.

PROCEDURE.

Each subject was tested individually.Where reading was tested, the PS subjects used the Visualtek CCTV to enlarge and illuminate the print, as needed.

4.9.3.RESULTS.

Table 18. Pearson product moment correlation coefficients between chronological age and reading age for the 5 younger and the 6 older PS subjects, tested on reading on three separate occasions over a period of 14 months.

	Younger Subjects (n=5) Reading.			Older Subjects (n=6) Reading.	
	r	p		r	p
Test A.	.5	>.05	Test A.	- 0.5	>.05
Test B.	.6	>.05	Test B.	.3	>.05
Test C.	.81	<.05	Test C.	.4	>.05

This Table reveals increasing closeness in correlation on the part of the younger subjects between reading attainment and chronological age This is not the case with the older subjects. At the outset, the correlation coefficient for the younger readers was not significant, but 14 months later, there was a significant positive correlation between age and reading attainment.(r = 0.81, d.f.3, p < .05, one tailed test)

Table 19. Pearson product moment correlation coefficients between chronological age and spelling attainment of the 5 younger and the 6 older PS subjects, tested on spelling on two separate occasions over a period of 14 months.

	Younger Subjects. (n=5) Spelling		Older Subjects. (n=6) Spelling	
	r	p	r	p
Test 1.	.3	>.05	.18	>.05
Test 2.	.92	<.05	-.04	>.05

This Table shows that there was a positive correlation on the part of the younger PS children between spelling attainment and chronological age when spelling was tested on the second occasion (r = .92, d.f. 3, p < .05).This was not the case at the outset of the Study , when the correlation coefficient revealed only a weak relationship between age and spelling attainment. This was not so for the older PS subjects. For them, the relationship between age and spelling attainment lessened over time.This was attributable to two particularly low scores in the older group.

Although here the attainment of PS subjects in reading and spelling was examined to establish progress over time, the main focus of the thesis was on the strategies being used, and to that end a further analysis of the spellings of individual words was undertaken.

Table 20. A comparison of the means and standard deviations of **correct spellings** of regular and irregular words produced by PS and FS subjects, measured on the Daniels and Diack Graded Spelling Test.

Regular and Irregular Words.

	Regular Words		Irregular Words	
	PS	FS	PS	FS
mean	13.3	13.4	9.5	11.4
s.d.	5.9	6.3	3.7	4.8

ANOVA SUMMARY (Table 20)

Source	df	F	p.
A (Group)	1	.28	
B (Regularity)	1	25.01	**
A x B (Group x Regularity)	1	2.7	
Error terms			
A x subjects within groups	1	57.06	
Subjects within groups	1	4.48	

* p< .05 ** p< 01

An ANOVA of Table 20 with 1 between subject factor (Group) and 1 within subject factor (Regularity) revealed that PS and FS writers performed equally well, but that overall, there was a significant regularity effect between the word stimuli, the regular words being written better than the irregular ones. ($F_{1,31} = 25.01$, $p < .01$) The interaction between group and regularity did not reach significance.

After this analysis of the **correct** spellings, a further analysis was made of the total misspellings. Those misspellings were counted which showed that the writer had used a phoneme-grapheme conversion, even though it was inappropriately applied in that instance. These were 'phonic misspellings' such as 'dun' instead of 'done'.

Table 21. The means and standard deviations for phonic misspellings made by PS and FS subjects.

	Phonic Misspellings.	
	PS	FS
	n = 11	n = 22
Mean.	2.72	1.9
s.d.	2.33	2.04

The difference in the number of phonic misspellings yielded by PS and FS subjects did not reach significance ($t = 1.1$, d.f. 31, $p > .05$, one tailed test), although the results were in the predicted direction.

Next, 20 selected words from the spelling test (17 exception and 3 regular words) were divided into two groups - one set contained silent letters, such as the 'w' in 'who', and exemplified the presence of lexical processing: the other set were exceptional for other reasons, having foreign or Old English roots, for example.These words, such as 'women' or 'me', do not contain silent letters, but they are pronounced in such a way as to be difficult to spell correctly if phoneme - grapheme conversions are being used. So these words reveal well whether lexical or nonlexical strategies, or both, are being used by the writer (see Appendix 12 for the complete lists).

Table 22. A comparison of the correct writing of irregular/exception words by PS and FS subjects.

	10 selected exception words.	
	PS	FS
	n=11	n=22
Mean no. of words written correctly. (max 10)	3.5	4.5
s.d.	2.0	2.55

There is not a significant difference between the PS and the FS in the correct writing of these exception words (t = .56, d.f.31, 2 tailed test).

Table 23. The means and standard deviations for 10 selected words containing silent letters written correctly by PS and FS children.

	10 Selected Words Containing Silent Letters.	
	PS	FS
	n=11	n=22
Mean no. of words written correctly. (max 10)	4.4	5.77
s.d.	2.4	2.6

The difference between the PS and the FS in the correct writing of these words was not significant. (t = .32, d.f.31, 2 tailed test).

Finally, the relative accuracy of the misspellings written by PS and FS children was calculated.

Table 24. A comparison of the means and standard deviations of the Graphic Similarity Indices derived from the **misspellings** of PS and of FS children.

	Graphic Similarity Index.	
	PS	FS
	n = 10	n = 22
mean G.S.I.	539	584
s.d.	69	104

The difference between the mean GSI for the PS and FS subjects was significant (n = 32, t = 8.76 ,d.f.,30, for independent samples, $p < .01$, two tailed).

4.9.4.DISCUSSION.

There were three principal findings in this Study which will each be discussed in turn in fuller detail below.

First, reading and spelling attainments did increase with age. It would have been surprising if this had not been so. The higher correlation coefficients for the younger children, when attainments were tested against age at the end of the Study, does indicate progress for this group but not for the older children.However, in this thesis, it is not age which is the focus, but the strategies used by the children, so this issue will not be taken further.

Second, both PS and FS subjects wrote significantly more regular words correctly than irregular ones.Clearly, the support provided by phoneme-grapheme rules allows for this advantage.

Third, PS and FS subjects were equally able to include silent letters in their correct spellings, and equally able to write exception words, reflecting lexical processing. However, inspection of misspellings showed that the PS incorrect versions were significantly less accurate and further from the target words, than were those of the FS.

The purpose of inspecting the spellings of PS and FS subjects was to see if there was evidence of major use of the nonlexical processing route by the PS. This use would be demonstrated by the presence of a marked regularity effect on the part of the PS.The PS would be very poor at spelling irregular words correctly and, in particular, they would not reproduce the silent letters contained in those words. Their spellings of incorrectly written words would reflect a phonic strategy. In looking at progress over time, the PS would show that they were slow to start to read and write, with particular difficulty at Frith's (1985) logographic stage of literacy acquisition, when phoneme awareness and alphabetic knowledge may still be poorly developed. Their misspellings of words would be less graphically similar to the target than those produced by the FS subjects, reflecting an underlying shape matching difficulty.

Before considering the results above in more detail, it is worth noting that the PS and FS samples were matched amongst other variables, on reading age.The difficulties inherent in this task were outlined in 1.4. Despite care in the matching, the mean reading age of the PS sample was lower than the mean reading age of the FS sample (see Appendix 10) and in Chapter 3, there were significant differences between the PS and FS in the first three experimental tasks, in the case of lexical decisions to words, but not to nonwords. In these reading related tasks, the difference in reading age between the two groups, seemed to make a difference to performance. It was noted earlier in this Chapter, (4.3), that there was some evidence of spelling being easier for PS children to master, and indeed in the results available here, there was only one occasion when there was a significant difference in the performance of PS and FS writers, in the case of the mean GSI.

Turning to the analysis of individual spellings, there was a significant regularity effect, but it was shared by the PS and FS alike. This evidence does not support the idea that the PS,in particular, were predominantly nonlexical readers/spellers, despite the phonic tuition the PS children received. The results did highlight the difficulties presented to the PS by irregular words.(see Table 20).

Both lexical and non-lexical strategies alike were being used by PS children, but the evidence suggested perhaps a greater use of a nonlexical strategy by the PS, unmodified by visual information. The spellings and misspellings revealed that both processing strategies and routes were being used by both groups of subjects (see Tables 22, 23).

This means that the incorrect spellings of the PS resembled the correct versions less than did those of the FS This could signal some failure in the lexical route, with the original shape matching difficulty playing a part in relaying incomplete or faulty information about salient features. It could, of course, also reflect incomplete phonic strategies and a failure of the nonlexical route. So this finding of a lower mean GSI on the part of the PS merely highlights the fact that the misspellings of the PS differ significantly in accuracy from those of the FS. They are further from the target word in terms of key features, such as the beginnings and endings of the word, cluster of letters and number of letters in common with the target. One implication of that is that the PS may be worse at carrying out a spelling check once the word has been written down, quite apart from any spelling check which may occur as they retrieve the information from the lexicon.The findings lead back to the ideas generated by Ehri, namely that phonic tuition does not only stress the sound- letter correspondences, but paradoxically it seems to intensify the visual specification of the word as well.

CHAPTER 5

A SUMMARY OF FINDINGS CONCERNING THE WORD PROCESSING OF PARTIALLY SIGHTED CHILDREN.

As the processing of printed words must rely to a certain extent on visual analysis, it goes without saying that a reader with impaired sight will experience some effect of this impairment at different times in terms of both accuracy and of speed.

One hypothesis under scrutiny in the foregoing chapters has been that the visual lexical processing channel was bypassed as far as possible by PS readers.

Normally, the young FS child would start by developing the lexical route, learning to read by sight and would then gradually learn the relationships between letters and their sounds in order to be able to decode more easily words which were consistent with English orthography.

The argument put forward in relationship to PS beginner readers was that right from the outset of their reading tuition, they learned the letters and their sound correspondences without the initial sight word learning phase.

Perhaps because putting this phonic knowledge into use is so difficult, PS readers in this series of Studies appeared to make a late start with reading and spelling.

One possible reason why Lansdown's (1973) PS readers could read well at the age of 8 years might have been that the PS were predominantly nonlexical readers, relying only to a limited extent on lexical processing.

This possibility was studied in three separate ways:

First, there was a longer term study, spanning over half a year, of the reading strategies used by PS children, aged 5 1/2 - 8 1/2 years, in particular of the misidentifications they made and the salient cues they used. This provided evidence of both lexical and nonlexical processing.Because of the choice made for them of a phonic teaching method, the hypothesis was strengthened that the visual lexical processing route was being bypassed as far as possible.

Next, there was a series of experimental tasks with matched FS and PS subjects aged 6- 9 years using a lexical decision task.The nature of the task ensured that it was the early stages of word processing which were the focus of study.

Finally, there was a study of spelling by matched PS and FS subjects, in the age range 5 - 10 years.

The results of the experimental tasks did provide evidence that the nonlexical processing route was being used but by both PS and FS children. Moreover, there was also evidence that the lexical route was being used.

The main conclusions reached were that crucially no clear cut differences were found between PS and FS children in the performance of the tasks presented. The PS children were not found to be predominantly nonlexical readers. However, there was a different balance in the use of available processing strategies between PS and FS children.On three occasions the PS showed a larger regularity effect than the FS. Once the PS also yielded a larger pseudohomophone effect than the FS. In Chapter 4, the PS produced more phonic misspellings than the FS. These results did not reach the level of significant difference but were sufficient to warrant attention.

Overall, the findings suggest that reading tuition which emphasises letters and letter patterns in relation to pronunciation can allow for lexical processing, but perhaps with slow beginnings. Partial sight in itself is not associated with insurmountable processing problems.

This part of the study of partially sighted children started with the work of Lansdown (1973) and with the possibility that an underlying shape matching difficulty might affect word processing. Despite the finding that a compensatory strategy could be used for word processing, it remained possible that the bias towards constructed, nonlexical reading might be related to visual retention problems, which in turn might affect lexical memory. The exploration of visual retention by use of picture stimuli was selected as an appropriate approach for this young group of PS children, and the following chapters turn to a description of how PS children process pictures.

CHAPTER 6

PICTURE PROCESSING.

6.INTRODUCTION.

Lansdown (1973) identified developmental delay in the visuoperceptual sphere on the part of PS children, and the question arises as to whether impaired eyesight is accompanied by impaired visual memory, too. This could be explored independently of word processing by studying picture processing. This chapter briefly reviews the main concepts and research relating to such processing.

Lansdown (1973) included a test of visual retention in his first study, but did not report results and left it out of his second study. He commented that the test was lengthy and that the PS subjects had not liked doing it. If Ehri's theories, outlined in Chapter 4, are to be accepted, it is not only perception which is important in the acquisition of literacy skills, but it is, crucially, visual memory, too. Seymour (1986) distinguished between visual memory for objects and pictures of objects, and visual memory for letters which develops with reading and writing. Paivio (1986) made this distinction, too, pointing out that pictures have a logical relationship with their referents, whilst words do not.

6.1 THE BASIS OF PICTURE PROCESSING.

Picture processing is essentially visual and spatial. The trace is laid down in the first 100 msecs, when identification occurs. Eye saccades occur about every 300 msecs and that length of time was required to protect a trace from being obliterated by a following image (Potter, 1979). A name for what had been identified was available in about 500 msecs (Posner & Warren, 1972). So, in the first half second of viewing, a picture could be identified, protected and named. As the viewing time was lengthened, so memory for what had been seen, increased (Shaffer & Shiffrin, 1972) and inter stimulus intervals of varying lengths could also, under certain conditions, lead to improved visual memory (Weaver, 1974). Thus, despite Shaffer and Shiffrin's findings (1972), rehearsal of picture material did seem to occur, but it was not quite clear whether the process was verbal or visual. The process of storing visual material consisted of identifying and cataloguing, perhaps tagging, a distinctive feature in some way. Models of memory moved away from stores to emphasis on processes, and in the case of memory for pictures, to the exploration of processes which increased the richness and distinctiveness of pictures.

6.2. PILOT STUDY 3.

PRELIMINARY PICTURE PROCESSING TASKS WITH PS CHILDREN.

Several preliminary tasks using picture stimuli were carried out with the group of PS children who are the subjects of the Studies reported in this thesis. These tasks were - naming colour photographs of familiar people, places and objects and naming a set of line drawings taken from the Test for Reception of Grammar (Bishop, 1983).

Each of these pilot studies revealed an important aspect of picture processing as experienced by PS subjects, and each will be described in brief below.

6.2.1.IDENTIFICATION OF PHOTOGRAPHS AND LINE DRAWINGS.

It is commonly observed that PS children have difficulty in identifying pictures in story books. It seemed possible to alter this, if, instead of using complex line drawings, photos were used instead, and if the PS children themselves were actively involved in taking the photographs, of objects and places well known to them and within their own school (details in Appendix 14).

Two sets of photographs were taken:-

a) Photographs taken of each other acting out little scenes displaying various given emotions, such as happy, sad, puzzled.

b) Photographs of each child's face as he or she was sitting in class working and also of such items as a school desk, the closed circuit TV monitor they used every day for reading, the school entrance, the doorway to their classroom and so on.

Each child was shown the set of photographs individually, allowed to inspect each one for as long as required, and then asked to name it. Many of the PS children found difficulty with this task . The known familiarity of the people, places and objects did not make them immediately recognizable. A mean number of 9.8 of the 11 pictures of objects were recognised, particular difficulty being experienced by four of the children. The photograph of the desk and chair was called 'a gate' or 'a fence', and the closed circuit TV monitor was thought to be 'the front of a lorry'. The angular features of the picture seemed to stand out but not sufficiently for identification, in some instances. A mean number of 10.5 of the 11 pictures of each child was correctly recognised, but often correct recognition was only achieved after several attempts.Friends were often identified by their clothing -'I think it's a boy with glasses and a tie - is it --?'. 'It looks a bit like ... She's got that sort of glasses, with metal frames.' Generally, people were identified better than objects and only two of the PS children found it impossible to recognise all the photographs of themselves and their friends correctly. Facial expressions were rarely captured, though there was a hierarchy of difficulty. 'Sad' and 'pleased/ proud' were relatively easy, whereas 'cross' and 'puzzled' were not. Only two children were unable to identify correctly emotions displayed by themselves, giving a mean correct identification level of 89%, but when it came to identifying emotions portrayed by their friends, all the children had difficulty and the mean correct identification level was only 47%.

c) The next step was to use a set of line drawings, which seemed much less complex, giving the mere outline of the object in question. It seemed possible that these would be easier to identify. A set of 5 cards, each bearing 8 line drawings from the Test for Reception of Grammar (TROG) was used. This test is for children aged 4 - 8 years 11 months.The Test consists of pictures representing different grammatical structures.The Vocabulary cards are used at the outset to ensure that the subjects all know the nouns, adjectives and verbs being used in the test. Only 5 of the 6 Vocabulary cards were used here.

None of the PS subjects, aged 6 - 9 years, could name all 40 line drawings correctly, although a group of FS children of the same age should be able to name all but one or two correctly. The mean percentage correctly named by the PS children was 75%, with a range from 45% - 95%. Typical confusions lay in discriminating members of a category. PS subjects could see that a line drawing represented a person or an animal, but within the category, they could not distinguish accurately whether the animal was a sheep, cat. dog, cow, or elephant, nor whether the person was a man, woman, boy or girl.

Another source of error arose from the shape of the line drawing:

the picture of a book was named as :

- a sandwich
- a box
- a flat box
- a case

the picture of a flower was named as :

- a fan
- leaflets
- a tree

The naming of line drawings depicting actions or verbs was even more aberrant, and again revealed the abstract symbolic nature of these types of drawings for the PS.

PICTURE	NAMED AS
pushing	getting dressed
	person climbing inside a box
	lifting a wall
	not known x 2

jumping	crying boy kneeling and up in the air kneeling sitting down crouching and hands in the air. dancing exercise

This widespread difficulty in naming pictures was always evident when PS subjects were working with pictures, in their own school, when reading books, or in viewing these line drawings. Occluded parts were particularly difficult to identify.

6.2.2.CONCLUSIONS FROM THE PRELIMINARY STUDIES.

TASK ANALYSIS.

As part of analysing the task to be presented to PS subjects, the following considerations had to be made:

1. If line drawings were to be used, then an advantage might be conferred, if these could be named by some subjects and not others.

2. The quality of the picture had to be considered - how familiar was the item, how complex the drawing?

3. The response would have to accommodate the naming difficulty experienced by the PS. Drawing as a response is difficult if the picture is complex or unusual: naming on its own might reveal gaps in vocabulary, rather than in memory.

6.2.3.COMPENSATORY STRATEGIES.

Whereas phonics tuition provided the compensatory strategy to enable young PS children to store lexical representations in the lexicon, similar compensation is not evident for encoding picture stimuli. Moreover, the underlying shape matching difficulty still remains.

It seemed possible, however, that attention to four aspects of the picture processing task would provide those compensatory mechanisms:

a) practice in naming

b) adequate viewing/study time

c) attention to the content of the line drawing in terms of its familiarity and clarity

d) flexibility of response in the Recall task.

Before addressing these issues in practice, picture processing can be examined within the framework of Paivio's dual coding model.

6.3.A MODEL FOR PICTURE PROCESSING.

Paivio (1986) based his dual code theory of mental representations on the fact that verbal and nonverbal subsystems were separate structurally and functionally, though they could and did interact and activate or trigger each other. One implication of this functional independence was that picture naming did not inevitably occur when pictures were viewed (see Figure 5 below).

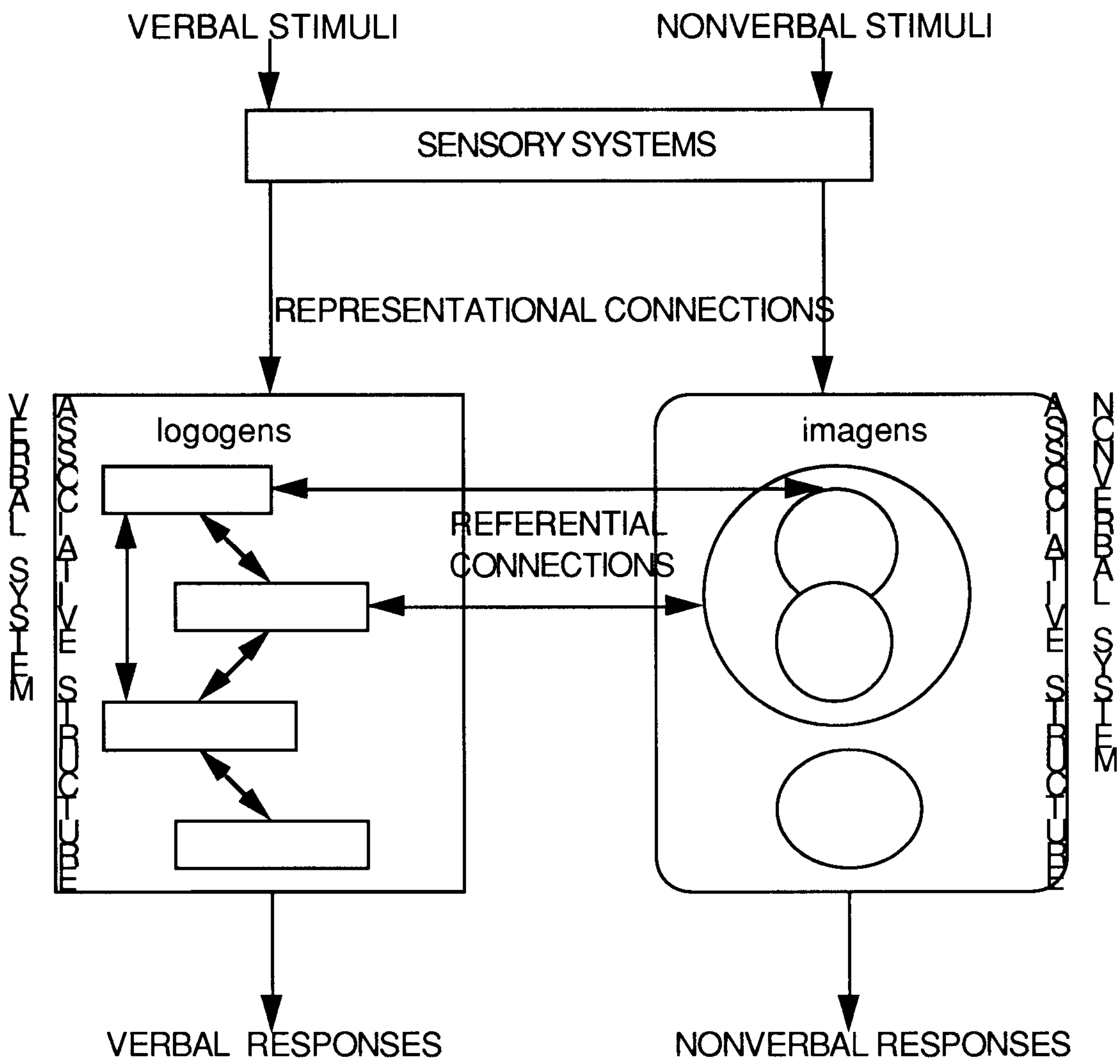

Figure 5.

Schematic depiction of the structure of verbal and nonverbal symbolic systems, showing the representational units and their referential (between system) and associative (within system) interconnections as well as connections to input and output systems. The referentially unconnected units correspond to abstract word logogens and 'nameless' imagens, respectively (Paivio, 1986).

Visual logogens were available in this system corresponding to print, or 'visual words'. An important feature of Paivio's model of memory was that internal mental representations had their origin in experience: processing was modality specific not amodal, and memory and perception reflected a continuity.

Processing, according to Paivio, took place at three levels :
The first was representational, the level at which judgements of familiarity or recognition were made.The referential level was when dual coding occurred - for example, when objects or pictures were named and when imaging occurred in response to words. The associative level was where representations within either system activated other representations within the same system as in word association tasks.

The dual coding model, Paivio maintained, had features in common with the Levels of Processing model of Craik and Lockhart (1972),except that in the dual coding model, the processing and coding could be described very specifically.

One implication of this model was that at the early representational level of memory, coding may just be single, either sequential or synchronous. And for certain recognition or matching tasks this may be very effective. For other tasks, however, it may be advantageous or necessary to use two codes and the model allowed for this addition of the two codes.

It was open to question, however, when such a decision was taken to use one or two codes. It was often the case that the response required by a task clearly determined whether naming, for example, was going to be needed or not. This requirement was usually known in advance. However, there were times when overt naming was not demanded but was nonetheless beneficial for good performance of the task.The issue then was whether, in adults, naming of pictures took place 'automatically' unless it was actively prevented by presenting the stimuli very fast, or by presenting hard to name stimuli.

A different model of visual object recognition, taking into account information derived from neuropsychological studies, was put forward by Humphreys and Riddoch (1987). The notion here was that vision was highly modular, with specialist areas for movement and depth perception. These were separate from static form perception. These authors were able to identify several aspects of static form perception in their model.

A Model of Visual Object Recognition. Humphreys and Riddoch (1987)
1.the registration of local form elements (such as edges):
2. the coding of the local relations between the form elements (in line with Gestalt principles):
3. the coding of a global interpretation of an object or scene from local part descriptions:
4. the assignment of orientation to the object descriptions: and
5. the matching of the final object description against a memory of all known objects.

Figure 6.

This model included two processes described above, and a third one, if the seen object was not only identified, but also named:

- the structural-spatial registration process
- the semantic process
- the phonological process

Humphreys and Riddoch were able to demonstrate that cortical damage could impair discrete areas of functioning, whilst leaving others intact. The functional relations between these areas of functioning , nonetheless, still remained obscure.

Visual memory is known to be powerful and robust. One important issue in this thesis is whether any restriction is placed on visual memory as a result of impaired eyesight, and for this, a comparison is made between FS and PS children. Such a restriction might arise developmentally from the fact that experience of objects normally is derived from a combination of information from the senses including vision. If vision is absent to any degree, that must of itself reduce the sensory information upon which object recognition is built. On top of that, there may be difficulties in processing visual information, and then in interpreting that information cortically. It could be anticipated, for example, that the PS might have difficulty at Paivio's representational level.

Paivio's model was modality specific and so had pragmatic validity in relationship to making links with physiological knowledge and with work such as that of Humphreys and Riddoch (1987). These authors had analysed the visual object recognition process in detail through the study of one subject showing some impairments in the recognition process as a result of a stroke and consequent cortical lesions.

A further implication of Paivio's model was that picture material could reach the associative level independently and still in its modality specific coding. Others (Potter, 1979) had postulated a final abstract, conceptual memory level. However, to state that memory was modality specific still begged an important question, namely, exactly what it was that was recorded and later activated. The idea of a cortical, isomorphic representation of a perceived object could not be regarded as a realistic account in view of the fact that different aspects of visual object recognition were known to be located in different areas of the cortex. Even the idea of specialist cells such as 'edge detectors' did not provide an answer, for such a model did not explain the phenomena of visual illusions. Humphreys and Riddoch,(1987) adopted the notion of a modular visual system, with various modular systems operating in parallel to identify such features as depth, movement, viewer orientation, colour and contour. This resembled aspects of Marr's (1982) 'first pass', primal sketch, followed by a 'second pass' addition of detail. This might also correspond to the global low spatial frequency features transmitted by the transient visual system, and the high spatial frequency detail of the sustained visual system.(Stein, 1991)

The two most frequently studied aspects of visual memory are recall and recognition. Visual working memory - the sketch or scratch pad - has received less attention in the case of children , than its auditory counterpart, the articulatory loop (though see Hitch et al, 1988).

6.4.RECOGNITION.

The ability to recognise objects, people and pictures as familiar or unfamiliar, as having been seen before or not, has evolutionary significance. Matching, noting similarities and differences, and grouping on the basis of these, plays an important part in the young child's ordering of the world. The process of visual object recognition is multifacetted (see Humphreys and Riddoch, 1987) and involves an alignment of the fresh material with stored knowledge.

Visual recognition memory is known to be very powerful, even over long periods of time. The 'picture superiority effect ' refers to the advantage of pictures over words in terms of memory for them.

Explanations for this powerful capacity were provided, for example, by Craik (1979) in stressing the 'distinctiveness' of the stimulus. Craik and Lockhart (1972) emphasised the various possible ways or levels of processing visual material, from sensory and pattern or feature analysis to a semantic level Nelson et al (1977) proposed that processing could be sensory and semantic in parallel, not just serially.

These two models, together with Paivio's, provided alternative frameworks for those which had been developed in the 1960s to understand memory for words, moving away from emphasis on memory and stores, to the processes required to transmit various types of stimuli.

6.5.RECALL.

Recall is a more complex process than recognition, for it involves search for and the retrieval of a desired item from long term store of knowledge. This item has to be accessed or generated, and it then has to be discriminated from similar but incorrect items.This retrieval requires that , perhaps on the basis of similarity, the item has been stored well enough to retrieve, moreover that it has been identified at storage time in such a way as to enable later location to occur, perhaps by noting something distinctive or unique about it.

One feature which might influence good storage is the thorough identification and categorisation of the item, not just once, but possibly several times, before it is relinquished into storage. Baddeley (1990) suggested hierarchical storage in domains and quoted examples of lesion studies where only the caption for the category could be accessed, not each individual member within it.

6.5.1.RECALL RESEARCH.

Much recall research has focused on the ways in which eye witness accounts can be altered in recall by subsequent information, on the nature of rehearsal and the organisation of information, but also on the frequently experienced difficulty with retrieval. Levels of recall are typically lower than those of recognition, but that might be an artefact of the method of recording recall (Ranken, 1963).

Presentation time of the stimulus, giving time to name, and interstimulus intervals with time to rehearse, were both beneficial to recall, though Shaffer & Shiffrin (1972) had stated that there was no direct analogue of verbal rehearsal in processing complex visual information. When information content was high, they maintained, visual rehearsal might not be an effective device. Many visual recall experiments were confounded by the intrusion of verbal information.Some authors, however, had devised recall tasks which were purely visual (Ranken, 1963) and found that visual recall without unwanted verbal intervention proved superior, when the task did not require a verbal but a visual solution, for example, the solving of a mental jig-saw puzzle.

If recall was to be verbally recorded, then naming the picture material at study time was likely to help recall. If recall recording was not verbal, then naming the picture may not help.Craik (1979) stressed the influence of the 'compatibility' between presentation and mode of recall.

Conrad (1971,1972) worked with young children of 4 to 11 years of age and distinguished between vocalising and overt or covert naming. Vocalising aided attention but did not necessarily mean that verbal mediation was occurring. In a serial recall task in which pictures with homophonous or nonhomophonous names were matched, he was able to tell if covert speech was being used or not. Up to five years of age, it made no difference to recall whether the pictures had homophonous names or not, suggesting that covert naming was not being used.Beyond the age of 5 years, however, there was an increasing advantage to recall, if the names of the pictures did not sound alike, suggesting that the children were naming the pictures themselves. The point Conrad (1972) made was that the very young child might vocalise but was not using functional verbal mediation, so at this young age, naming had no effect on short term memory.

This last observation was confirmed by Brown (1977) and Hayes and Schulze (1977). Both investigated preschoolers' visual encoding and found that in an immediate picture recall task, preschoolers used visual encoding of pictures without using the option of verbal encoding. Recall was tested by a picture matching technique.

Hitch et al (1988) examined the visual working memory of 5 and 10 year olds. Five year olds were confused in picture recall by the visual similarity of the pictures, but the 10 year olds were not. There was evidence that the 10 year olds had been using subvocal rehearsal, because recall was influenced by the word length of the names of one group of pictures. The 5 year old control group who had named the pictures at presentation demonstrated an overall improvement in recall over against those who had not named the pictures. The recall task, here, was to say the names of the pictures in the correct order.

Because of the age gap, between the 5 and 10 year olds, it was still not clear precisely at which age, children began to use verbal encoding of pictures. Flavell (1970) found with 6 year olds that it was the 'producers' i.e.' those who named or produced a model who recalled more than those who did not, but the nonproducers could quickly be turned into producers.

6.6. INTERFERENCE AND CROSS - MODAL TRANSFER.

Processing codes can either help or hinder each other. Evidence from working memory experiments on the visuospatial sketchpad showed that motor responses such as writing or pointing, could interfere with the visual coding of the stimulus - pointing to the 'yes' or 'no' response interfered with memorising a letter presented visually (Brooks, 1968), whereas saying the response did not interfere with visual memory.

If, as Nelson maintained, meaning representations for simple pictures and their referents were functionally identical, then cross-modal transfer should not be an issue, but if memory was modality specific, as Paivio claimed, then it was. Information in one modality could make referential connections with related material in another modality, and also associations within its own modality, but the source of the information could always be specified. Pezdek (1977) found that relevant cross-modal information was absorbed into an original memory, and moreover, it proved difficult to tell when the modality of the intervening material had changed, especially in the case of verbal material, sentences. On this basis she challenged Paivio's view that a memory remained modality specific.

6.7.ELABORATION.

From these cross - modal investigations, it was a short step to look at the impact of improving memory for a picture by means of relevant verbal elaboration. Wiseman, MacLeod and Lootsteen (1985) demonstrated that memory for pictures followed by descriptive sentences was better than memory for pictures without description, even if a blank period was left for possible rehearsal. More surprisingly, these authors found that both related and unrelated sentences following the picture aided recognition, but related sentences helped more, regardless of the amount of related information available. The authors concluded that a post - picture sentence improved attention to and perhaps rehearsal of the representation of the picture following its display. The findings supported the idea of elaboration of the pictorial representation initiated by the sentence. i.e. what happened was not just the formation of a semantic representation of the existing sensory image, but rather an expansion, perhaps an elaboration of it.

6.8.ORIENTING TASKS.

One important question concerned what was attended to, when a picture was viewed and what information was recorded.

Craik and Lockhart (1972) postulated that processing at deeper levels led to a richer, more elaborated trace, the implication being that processing at the sensory level was 'shallow'. Intraub & Nicklos (1985) challenged some of these ideas and argued that semantic processing would occur anyhow, so that focusing on the physical attributes of a picture might add information, not otherwise gained.One important aspect of Nelson's model (1977) was that of non-focal codes. Picture stimuli, for example, would be processed visually, using synchronous, visuospatial coding. However, during this, it was possible that verbal codes might be activated also, and that these non - focal codes could be encouraged or enhanced by the viewing instructions. Paivio (1986) stressed that two codes could be added and that this was what gave rise to superior memory for pictures, rather than words. Pictures were more likely to be dually coded. Stimuli which are attended to are generally considered to be more likely to be retained in memory than those which are not, thus instructions and orienting questions were important.

6.9. SUMMARY.

Without an efficient visual memory, each object and person encountered would have to be treated as new. An efficient recognition system ensures this is not so, and can even keep separate, to a certain extent, information gained through different senses, whilst also being able to combine information from different senses. Whatever is seen, assimilated, organised and stored, can also be retrieved if there is an efficient recall system. Both processes are fundamental to the acquisition of information about the world through the visual sense.

The question in this section of the thesis is how far the PS are limited in their visual memory performance by virtue of impaired eyesight.

CHAPTER 7

THE RECOGNITION OF PICTURE STIMULI BY PARTIALLY SIGHTED CHILDREN.

7. INTRODUCTION.

The high level of visual recognition amongst the FS is well documented (Nickerson, 1965, Standing et al, 1970), and, even after a year's retention, may be as high as 63% The amount of stored detail required for recognition has, however, been queried (Nickerson and Adams,1979)

There is an assumption, when viewing picture stimuli, that two codes must be better than one. Yet, consideration of Paivio's model showed that naming pictures was not inevitable. A dual code may be better for particular tasks, but verbal encoding may also be unnecessary in some cases, and indeed, where time was limited, may be undertaken at the expense of visual inspection and processing. In the case of homogeneous stimuli, the verbal labels for the pictures would need to capture the distinctive feature of the picture in order to be able to distinguish that particular one from other members of the category.Nelson et al (1973, 1976) found that high graphic similarity or high verbal label similarity on their own caused confusion in picture identification.

Be that as it may, in the case of adults, it may be almost automatic for the viewer to name what is seen. It is difficult to tell, because of the speed at which a verbal label comes to be formed. Posner and Warren (1972) found that a verbal code was beginning to be evident by 500 msecs after visual presentation. Potter and Levy (1969) varied the exposure rate for pictures from 125 msecs through to 2,000 msecs, and the longer the exposure rate, the higher the level of correct recognition, but the authors also reported that, at an exposure rate of 250 msecs, many of the subjects said they had been trying to name the pictures as a way of remembering them, but had not had time to do so.

One way of preventing naming is to present picture stimuli so fast that naming is impossible. Another way is to use hard to name pictures.

7.1. RECOGNITION AND VERBAL MEDIATION.

Goldstein and Chance (1970) selected 3 homogeneous categories of hard to name picture material - faces, inkblots and crystals. Immediate recognition within these homogeneous groups was lower than normally reported recognition levels : - faces, 71%, inkblots 46% and snow crystals 33%.

After a delay of 48 hours, there was very little drop in recognition level for faces, but there was a 17% drop in the recognition of inkblots and crystals. All 3 sets of stimuli were complex and hard to name, but the dimensions for face coding were familiar, and those for the inkblots and crystals were not.

The conclusion of their first experiment was that levels of accuracy for homogeneous picture stimuli may be lower than for heterogeneous picture stimuli because, in the first case, finer discriminations had to be made between similar members of the same category. In the case of heterogeneous material, subjects may simply be recognising on the basis of category.

In the second and third of this series of experiments, Goldstein and Chance found that the pictures which were best recognised were not necessarily those which elicited the most verbal associations, or verbal mnemonics. This indicated the relative unimportance of verbal mediation in the recognition of homogeneous pictorial stimuli. The verbal label might not discriminate finely enough for the task.

7.1.2.VISUALISERS AND VERBALISERS.

Two further sets of experiments are of interest, in which both recognition and recall were tested.

In the first, Kurtz and Hovland (1953) confirmed their hypothesis that verbalising, when studying objects to be remembered, aided verbal recall, more so than did just looking at the objects at study time.They stated that the critical factor was the accuracy of the verbalization.

However, in addition, their results showed, that when recognition was tested visually and the subjects at post - test had to put a circle around photographs of the objects, looking at study time, without the requirement of verbalising, was also highly effective. The visualisers, who at study time had been actively engaged in looking at the objects, recognised more than the verbalisers, when recognition was tested visually. But the difference here did not reach significance.

In the second, Bahrick and Boucher (1968) compared verbal recall and recognition under two conditions, one in which subjects were instructed to name sixteen drawings of objects as they were presented, the other in which the subjects were given no such instructions, and so were free to use the visual code alone, or visual and verbal codes.There were either one or nine practice trials.Memory was tested both immediately and after a delay, two weeks later. Testing was first of the free verbal recall of the names of the objects and then, immediately, of visual recognition of each picture from amongst ten distractors. Control groups were used who had exactly the same stimuli presentation and training, but who were not required to recall the stimuli verbally. This meant that their visual recognition in the immediate condition was one minute earlier than that of the experimental groups.

Highest scores on the visual recognition test came from the control group, and from the experimental group which was not instructed to name at study time, but was left to view the stimuli and name at will, and which had nine training trials, rather than just one.This showed the greatly enhanced immediate recognition of line drawings after extended practice when subjects were not required to name them at presentation. This exemplifies the power of visual recognition memory. It cannot be claimed here that the silent viewers did not name the drawings. All that can be claimed is that naming the drawings aloud did not obviously aid recognition memory either with one or nine training trials However, naming the pictures at presentation did yield greatly enhanced immediate recall levels.Comparison of the recall scores between the eight conditions suggested that after a delay in recall what was being tapped was visual memory i.e. after score improvements had been deducted for either naming or extended practice, there was a core recall level left which was thought to be derived from the original visual input.

It was clear from the results of this experiment that recognition and recall were not just related memory processes, but were susceptible to different influences. Recognition benefit ed from practice, whilst recall benefit ed from naming. Whether a subject could recall the word 'cup' was unrelated to whether s/he could recognize the picture of a particular 'cup'.The authors concluded: 'The most significant finding was that the probability of recall of object names is essentially uncorrelated with the accuracy of visual recognition of these same objects by the same subjects.'. They pointed out that naming pictures as they were viewed meant that the subjects were carrying out two tasks, and that verbalising might have been at the expense of looking.

A further experiment (T.O.Nelson et al, 1974) examined the relative difference in recognition of photos, unembellished line drawings of the main theme of the photos, main theme line drawings embellished with extra details from the photos, and verbal descriptions of the main theme of the photos. The three pictorial conditions did not differ greatly from each other in recognition success, but all three were significantly better than the verbal description of the pictures, especially after a delay.Again, it seemed that especially after a delay, it was the visual process which provided a more potent memory store. There was a picture superiority effect, but also, importantly, the amount of detail in the picture was not the significant factor in recognition - the more detailed photos were no better recognised than the unembellished line drawings.

Both Conrad (1971, 1972) and Hitch et al (1988) looked at the developmental issues involved in naming. As both these authors tested recall rather than recognition, no more will be said here than to point to a useful distinction made by Conrad between vocalising, naming and attention. One way of guaranteeing that a young subject has attended to the stimuli is to hear them named. This naming may, however, be vocalising or echoing, rather than true verbal mediation. It was not clear what subjects are doing at study time in a memory task, if they were silent.

7.2.PARTIALLY SIGHTED CHILDREN AND RECOGNITION PROCESSES.

Various ways have been described in which authors have tried to separate out the visual and verbal processes with regard to remembering pictures, either by speeding up exposure rates, by using unnameable stimuli, or by instructing subjects to name them rather than stay silent.

One group of children who are of interest in this context are those who have so little sight that they have difficulty in deciphering visual material - partially sighted children, who are accustomed to using pictures drawn for sighted children, but who, nonetheless, can see so badly that the same stimuli will be for them degraded and difficult to name. It might just be possible for them to recognise the picture material as well as the fully sighted, if encoding was visual. If, however, it was a question of the superior recognition of visual material arising because of visual and verbal coding, they were likely to fall behind the fully sighted, in respect of the availability of the verbal code.

This unavailability of the verbal code arises from two possible sources, the one is not knowing the correct word for the blurred picture seen, the other concerns the time needed for the child with partial sight to generate the visual and the verbal code. The underlying point being made here is that PS children, with their visual loss, may not have either the time or competence to name or fully categorise a visually presented picture.

Before carrying out a series of experiments to investigate visual recognition by PS children, a pilot study was carried out to see whether they were able to perform the task at all, and to determine in advance any complexities arising from the nature of the stimuli. There have been no other investigations of this kind with PS children.

7.3. PILOT STUDY 4. VISUAL RECOGNITION.

This study used the British Ability Scales (BAS) Visual Recognition Test. This is a short term memory task for the age range 2 1/2 - 7 years 11 months. The items in the scale consist of one or more pictures which are exposed for 5 seconds each. There are 17 items in all, with two initial practice ones. The pictures may be representational drawings of objects, usually 1, 2, or 3 toys , or later in the scale, at item 10, they are non - representational designs. After the exposure of the drawings for 5 seconds, the page of the booklet is turned over and the child is presented with an array of drawings within which the original object or objects are embedded. The task for the child is to identify which of the pictures were the ones originally shown. The item is scored 1 for completely correct identification, and 0 otherwise.

The mean age of the PS subjects was 7 years 6 months (s.d.13 months) at the time of this Pilot Study.

With the PS group, there were two conditions used for this task: one followed the BAS timing and instructions exactly. The second, which came several weeks later, followed the instructions entirely but not the timing. The children were told to take as much time as they liked to view the pictures. All members of the group completed both sets of task, despite the fact that some were over age for the standard administration. (Full details of the results are provided in Appendix 15).

In all but 2 cases, increased study time led to better recognition levels, but even at the 5 second exposure rate, all the PS subjects were able to score on this visual recognition test

One hypothesis was that at item 10 of the test booklet, where the display changes from pictures of toys to designs, the children's scores would drop noticeably because they would not be able to name the designs, for double coding and rehearsal. This was not entirely the case. Recognition scores dropped as the numbers of toys and distractors, pictured on the page, increased. Some children had been labelling the pictures to help them identify the toys, but this could lead to errors. For example, to use the label 'boat', when there were two or three boats in the selection array, did not help.

It seemed that it was not the difference between the toys and the abstract designs which makes the difference, but rather it was the amount on the page which was the key factor, coupled with the time available for inspection..

7.4. EXPERIMENT 6

AN INVESTIGATION OF THE VISUAL RECOGNITION MEMORY OF PARTIALLY SIGHTED CHILDREN.

In the following sections a fairly large study of recognition memory will be described. The results have been divided into:

1) overall performance.

2) analysis of sorting strategies revealed by misplaced pictures.

3) the familiarity and complexity of the pictures.

7.4.1. INTRODUCTION.

The overall aim in this experiment was to examine the visual recognition memory of PS subjects for picture stimuli, and to compare their performance with that of matched FS subjects.

Only the first condition (LOOK) was a true measure of visual recognition, since here the children saw pictures and later recognised them from distractors. A second condition (NAME) was planned, in which all children named the pictures with the adult. This was to ensure that all subjects had the opportunity to learn the names of any unknown picture stimuli. All would therefore have the option of dual coding. This was not a pure test of memory, since the pictures had already been viewed and sorted once. In the third condition (GENERATE), children were required to generate a name for the pictures as they studied them.This they had to do on their own, without help, having learned the names in the previous condition. It seemed probable that having to generate a name for each picture would heighten attention and would enable dual coding. This condition also did not yield a pure measure of memory, since the pictures had already been inspected and sorted twice before.

In the 2 sets of picture stimuli for immediate and delayed recognition, the target picture stimuli were referred to as 'physical match' stimuli or 'old'. In addition, there were two different types of distractor stimuli; one group came from the same large standardised set as the target stimuli, 'new', and the second group came from other sources but were matched by name with the target stimuli. These were called 'name match' or 'same name' pictures.

The first and most important hypothesis being tested was that PS children would have lower scores than FS children on this visual recognition test as reflected in the LOOK study condition.

The second hypothesis was that the Physical Match picture stimuli, which were studied, would be better recognised than the Name Match or the New pictures which were not studied.

The third hypothesis was that with these heterogeneous sets of pictures the usual drop in recognition level would occur after a delay in testing.

It was also of interest to see whether or not PS subjects would have particular problems with the Name Match stimuli. Moreover, it was hoped that the different encoding conditions would provide a pattern of response that might distinguish between the PS and FS, and illuminate where their differences might lie.

7.4.2.METHOD.

SUBJECTS.

The 11 PS subjects (6 girls and 5 boys) all attended a school for visually impaired pupils.They were, as a group, of average ability, measured on the British Ability Scales (1983 Edition) IQ 103 (s.d.13). Their average age was 8 years 6 months (s.d. 1 year 1 month, range 7 years - 10 years). Their mean score on the B.A.S. Recall of Digits test was 18 (s.d. 4).

The matched FS control group consisted of 22 children (12 girls and 10 boys), all of whom attended a nearby mainstream primary school. They were of average ability as rated by their teachers, or as measured on the British Ability Scales IQ 107 (s.d. 10) The average age of the group was 8 years 6 months (s.d. 1 year 1 month, range 6 years 8 months - 10 years 3 months). Their mean score on the BAS Recall of Digits test was 18 (s.d. 4) (Full details are provided in Appendix 16).

The two groups were matched on age, gender, ability and, importantly for a memory task, on auditory recall. The matching on auditory recall was accomplished by testing over 100 FS children in the relevant age groups, and from those, matching first on age, gender and ability and then finally on auditory recall. Each PS child was matched with 2 FS children

MATERIALS.

There were 2 sets of 80 pictures per set, one assembled for the immediate recognition task, and the other for the delayed recognition task.In each case, the pictures were individually mounted on white card of post card size. (Both sets are reproduced in Appendix 17). In each case , the pictures were selected as follows.

Two sets, of 32 pictures each, were drawn from the Snodgrass and Vanderwart (1980) set of standardised pictures, with ratings from 1 - 5 on the two dimensions of visual complexity and familiarity. A rating of 1 represented a low score, a score of 5 a high score.The original rating of familiarity had been a judgement made by adult subjects 'according to how usual or unusual the object is in your realm of experience.' The judgement of complexity was made on the basis of 'the amount of detail or intricacy of line in the picture.' There was a significant negative correlation between the familiarity and complexity variables (- .466). Visually complex pictures tended to be rated as unfamiliar. The authors concluded that the intercorrelations among the measures were quite low, suggesting that they represented largely independent attributes of the pictures.

For the first set, pictures were selected with the following ratings:

8 rated high on familiarity mean 4.58 (s.d. .21) (mean complexity rating 2.65 sd .7)

8 rated low on familiarity mean 2.28 (s.d. .56) (mean complexity rating 2.87 sd .6)

8 rated high on complexity mean 4.21 (s.d..15) (mean familiarity rating 2.69 sd 1.0)

8 rated low on complexity mean 1.6 (s.d. .28) (mean familiarity rating 3.87 sd .66)

In addition:

16 rated high on familiarity mean 4.49 (s.d. .3) (mean complexity rating 2.6 sd .75)

For the second set, pictures were selected with the following ratings:

8 rated high on familiarity mean 4.4 (s.d. .24) (mean complexity rating 2.74 sd .69)

8 rated low on familiarity mean 2.2 (s.d. .35) (mean complexity rating 2.2 sd .36)

8 rated high on complexity mean 4.3 (s.d. .24) (mean familiarity rating 2.5 sd .5)

8 rated low on complexity mean 1.5 (s.d. .35) (mean familiarity rating 3.5 sd .6)

In addition:

16 rated high on familiarity mean 4.5 (s.d. .16) (mean complexity rating 2.5 sd .3)

To complete each set, the 32 pictures above were each paired with a picture of the same name (a Name Match picture) taken from children's books and dictionaries.

The two sets of 16 pictures were selected for their high rating on the Familiarity dimension and were assembled for the 'New' distractor sets.

APPARATUS.

The pictures were viewed without any special equipment. They were presented to each subject one at a time. The viewing time of 5 seconds per picture was measured by hand held stop watch. Handling the pictures meant that each PS child could gain the most favourable viewing angle for him- or herself.

DESIGN.

Three separate analyses were carried out, one for each of the three study conditions, LOOK, NAME, GENERATE.

For each one, the dependent measure was the number of correctly sorted pictures in the recognition phase.

There was 1 between subject factor, **group** (PS/FS) and there were 2 within subject factors, **picture stimuli** (Physical Match, Name Match, New.), and **time interval**,(immediate or delayed).

The raw scores for the New picture set were doubled in each analysis to achieve comparable scores with the other two sets.

(See Appendix 18 for further comment on this statistical design and analysis)

PROCEDURE.

All testing took place in a small private room in the school.

In the LOOK condition, the subjects were instructed individually to look at each pictures for 5 seconds. They were told to do this without saying the name aloud, if they spontaneously began to vocalise whilst inspecting the pictures.

After they had studied the 32 target pictures, subjects were then instructed that they were to be given another set of pictures, including the studied ones, to sort into 3 sets, those they had studied, their name matches, and new pictures. These instructions were given very carefully, with examples, to each subject, who was then asked to explain back to the experimenter what was required. This was to ensure that the instructions had been understood. 4 minutes per subject were allowed for this.
On the table were placed three labels - OLD, SAME NAME, NEW - to guide the child's sorting.

The immediate recognition task was carried out directly after these instructions. Delayed presentation was on average 1 1/2 hours after the pictures had been studied, the instructions about sorting being given just before subjects carried out the sorting task.Two separate sets of pictures were used for the two time intervals and the immediate recognition task was always carried out before the delayed recognition task.

In the LOOK condition, after the subjects had sorted the pictures into the 3 sets, they were each asked to name each picture and these names were recorded by the experimenter.

In the NAME condition the instructions were given again as above, but this time each subject was told that s/he was to say the name of each picture with the adult as s/he viewed it at study time. This naming of each picture was also required of the child as each picture was sorted.If a name was not known, the adult provided it.

In the GENERATE condition, the instructions were given again as above, but this time each subject was told to say the name of each picture on his or her own as each picture was studied, and again, as each picture was sorted.No help was given by the adult. Several days, at least, elapsed between the administration of the 3 study conditions.

So, the children would see the 2 sets of pictures 3 times. Clearly practice, both with the procedure and with the target pictures, which were the same in all conditions, would influence the outcome of the studies, but nonetheless it was felt useful to include the second and third conditions (see 7.4.1.).

7.4.3. RESULTS.

Table 25. The means and standard deviations for the correct recognition by PS and FS children of pictures in the LOOK study condition, when recognition is immediate and delayed (max 32 per cell).

	PHYSICAL MATCH		NAME MATCH		NEW	
(correct scores)	PS	FS	PS	FS	PS	FS
LOOK mean.	24.5	22.0	15	16	31	27
IMM. S.D.	4.0	6.0	8	5	1.8	6.8
LOOK mean	19.5	18.1	18.8	16.2	25.6	27.6
DEL s.d.	5.4	5.6	5.7	5.0	5.5	4.2

Table 26. The means and standard deviations for the correct recognition by PS and FS children of pictures in the NAME study condition, when recognition is immediate and delayed (max 32 per cell).

	PHYSICAL MATCH		NAME MATCH		NEW	
(correct scores)	PS	FS	PS	FS	PS	FS
NAME mean	21	22	23.5	22.3	31.6	27.9
IMM s.d.	6.0	6.0	6.3	6.0	0.8	6.
NAME mean	20	22.5	21.3	21.2	30.7	27.4
DEL. s.d.	5.7	5.6	4.5	5.7	2.3	6.6

Table 27. The means and standard deviation for the correct recognition by PS and FS children of pictures in the GENERATE condition, when recognition is immediate and delayed (max 32 per cell).

	PHYSICAL MATCH		NAME MATCH		NEW	
(correct scores)	PS	FS	PS	FS	PS	FS
GENERATE						
IMM mean	25.2	24.4	23.5	23.1	30	28.7
s.d.	8	6.4	5.1	4.9	2.3	5.3
GENERATE						
DEL. mean	22.5	23.5	21.2	22.8	27.6	27.8
s.d.	5.4	6.8	4.6	5.7	4.6	6.1

An ANOVA for each condition in turn (details in Appendix 18) with 1 between subject factor (Group) and 2 within subject factors (Picture Stimuli and Time Interval) revealed that in none of the 3 conditions was there a significant difference in recognition level between PS and FS subjects.

With regard to the difference in recognition level between immediate and delayed recognition, there was a significant difference in the LOOK condition ($F_{1,31} = 5.3$,

$p < .05$), but in neither of the other two conditions was the difference significant, although immediate responses yielded higher performance than delayed conditions. The differences between Physical Match, Name Match and New pictures were significant for each study condition.(LOOK $F_{2,62} = 60.14$, $p < .01$, NAME $F_{2,62} = 26.77$, $p < .01$, GENERATE $F_{2,62} = 16.68$, $p < .01$). As expected in the LOOK condition, the Name Match pictures were the worst identified, but this was by both PS and FS subjects. The PS in particular were expected to experience most difficulty in recognising the Name Match pictures, because of their underlying shape matching difficulty and the associated problem of naming accurately what they saw.This was not so.

A Newman-Keuls multiple comparison of means for each study condition (full details in Appendix 18) revealed that in the LOOK study condition, immediate recognition only, there were significant differences between each picture type. This was the only condition where a significant difference was found between recognition of the Physical Match and Name Match pictures.In all other study conditions, there was a significant difference between the Physical Match and the New pictures.

In the NAME and GENERATE conditions, none of the ANOVA interactions was significant, but in the LOOK condition, the interaction of Time Interval and Picture Sets reached significance ($F_{2,62} = 4.78$, $p < .05$) together with Group by Time Interval by Picture Set ($F_{2,62} = 8.2$, $p < .01$). This means that in the LOOK condition the main drop between immediate and delayed recognition lay with the Physical Match pictures, and for the PS subjects performance was also worse for the New ones.So, the FS children were less affected than the PS by the delay in the recognition test.

7.4.4. DISCUSSION.

The principal purpose of this series of experiments was to investigate visual recognition memory for any differences between PS and FS subjects. Exposure time for the picture stimuli was lengthy (5 seconds), to give time to the PS to inspect each picture. This would allow the FS ample time for dual coding.Recognition requires establishing a match with stored knowledge, and presumably when this occurs, as with the Physical Match pictures, there is a high level of activation in the visual object recognition system in the presence of the recognised stimulus. If there is no match, as with the New pictures, and the level of activation is low, then the distractor should be discarded without any problem. In the case of the Name Match pictures, these would have yielded low visual activation in the LOOK condition, as they had not been seen before, but in the NAME and GENERATE conditions, high verbal/ auditory activation. The presence of Name Match pictures, and performance with them, could allow some indication of auditory or verbal mediation in the visual memory task. What was the effect of this on sorting?

The first result to note was that there were no significant differences in correct recognition level between the PS and FS subjects.The conclusion to be reached from this was that the 5 seconds exposure time for each picture, coupled with the PS subjects' habit of inspecting material very closely and carefully was sufficient for high performance on this task. An additional factor may be that for recognition to occur, only a number of salient features have to be recognised, not the whole set. The PS may have had time to identify sufficient detail for this task.

The anticipated drop in recognition after a delay only occurred in the LOOK study condition. The failure to find a significant drop in the other two conditions was probably because the two sets of pictures were being used for a second or third time, in addition to any effect arising from the study condition itself, naming and generating a name for each picture.Bahrick and Boucher (1968) had also found a drop after a delay in recognition. But this drop was reduced when their subjects named the pictures and had extended practice on the task. It was the practice which seemed to increase recognition, and verbalising aided less. Practice increased visual inspection. Perhaps verbalising took time and attention away from visual inspection.

If one looks at each type of picture stimulus in turn, the initial expectation was that the Physical Match pictures would be recognised best. These were pictures which had been studied and so would be freshly stored knowledge, presumably producing high activation when sorted. This high level of match was not, in fact, what was found. It was the New distractor pictures which were recognised best as being New. These New pictures would fail to generate strong activation at sorting time, as they had not been studied nor labelled.There was no possibility of confusion with the Name Match pictures, and the High Familiarity rating (Snodgrass and Vanderwart, 1980) would mean that the subjects were more likely to know what the pictures represented. For these reasons, it must have been evident to them that these had not been studied. Thus their strategy appears to be sensitive to 'lack of activation'.

One reason for the lower-than-expected Physical Match recognition level might have been that the presence of the Name Match set caused confusion at a verbal level. A verbal label may have been used which served only to distinguish between categories of object rather than within categories and so was powerless, for example, to discriminate one 'key' from another Thus any 'table' or any 'stove' remembered only by the name and/or by salient prototype cues as having been studied, not by a distinctive visual feature, would be placed on the Physical or Name Match piles, interchangeably. This confusion was most evident in the sorting of the Name Match pictures, but might also have been present in the case of the Physical Match ones. A final possibility was that as both the Physical Match and the New pictures were line drawings in the same style, the Physical Match pictures were being misplaced into the New pile, on this basis. A check of the misplaced Physical Match pictures revealed that this was not so. (see Appendix 18 for details.). When they were misplaced, it was predominantly into the Name Match pile.

In this experiment, there were two aspects to the task, involving recognition memory: one required that the picture stimuli were sorted into those seen before (Physical Match) and those not seen before (New). This task could be completed on the basis of a visual or a visual and verbal strategy.

The second aspect required visual and verbal coding. The Name Match pictures could be confused with the Physical Match pictures if it was principally the verbal label (bed, cup, table etc) which was being used to sort by. But, if only the visual aspect was being coded, these pictures would be regarded as New. To reach a correct solution by placing the Name Match pictures correctly, both codes were required.

It had been anticipated that the Name Match pictures would be the hardest to identify correctly, but particularly for the PS. However, it turned out that they were the hardest for both PS and FS and for the LOOK, immediate recognition, set only. In all other conditions, the recognition of Name Match pictures did not differ significantly from recognition of Physical Match pictures. If only the PS had found the Name Match pictures difficult, it would have been assumed this was because of their difficulty with accessing a verbal label within the picture stimuli viewing time, as it was, it seemed possible that the dual task took more time for both PS and FS. Clear instructions about how to carry out the task had, of course, been given at the outset. Additionally, the artistic style of the Name Match pictures differed from that of the Physical Match and New ones. It would have been possible, in fact, for subjects to have looked only at the heavier art work and sorted the pictures on the basis of that. As it was, in the LOOK condition, about 50% of the Name Match pictures were sorted correctly, signifying that some subjects at least were using verbal coding, as well as visual coding.

It was assumed at the outset that the PS would find difficulty in naming some of the pictures, whether because they did not know the name, or because exposure time was too short to retrieve the name after the picture had been inspected and identified. A condition was, therefore, introduced, in which child and adult named each picture together. This was designed to be a way for a child to learn the names of any unfamiliar pictures, and also as modelling of how to look at and simultaneously name a picture. It was thought that the PS would benefit most from the NAME condition. After the administration of the LOOK condition, the fact that there was no difference in the recognition of line drawings between PS and FS subjects meant that the reason for planning two further study conditions no longer held good. It seemed that PS subjects did not especially need to learn to name pictures in order to be able to recognise them at a high level. Indeed there was a suggestion that the use of a verbal label had not always helped here in discriminating two pictures which had a common verbal label. Evidence was found that both PS and FS were distracted by the Name Match category, although clearly verbal processing as well as visual coding is usually involved in visual recognition memory. Despite this reasoning, there remained the possibility that PS and FS subjects were relying on slightly different processes in carrying out the recognition task and that the two additional conditions, NAME and GENERATE, would reveal these, though inspection of the correct responses so far had not done so. More about what sorting criteria they were using, might be deduced from an inspection of misplaced pictures.

7.5. EXPERIMENT 6. ANALYSIS 2.

AN INVESTIGATION OF THE **MISPLACING** OF PICTURES.

7.5.1. INTRODUCTION.

Experiments by Kurtz and Hovland (1953) and Bahrick and Boucher (1968) suggested that looking at picture stimuli at study time was as powerful as verbalising, if recognition was tested visually, rather than verbally. Various means have been tried to prevent naming, which in adults is thought to be almost automatic when pictures are viewed. Some used very short exposure rates, others, like Goldstein and Chance (1970) used hard to name picture stimuli. The results confirmed high levels of recognition, if the stimuli were familiar and readily distinguishable. For the familiar, hard to name items there was little drop in recognition after a delay, though there was for the unfamiliar ones.

A main purpose of this Experiment was to compare PS and FS subjects carrying out a visual recognition task. It could have been the case that PS subjects tried to name the pictures seen, in order to back up their assumed weak visual powers. Alternatively, they might not have been able to do so, either because of lack of time, or lack of naming competence. Naming may have been automatic for the FS.

In this Experiment, the first condition was the LOOK condition. This was planned so as not to remind subjects to verbalise. If they did so, it was done silently and spontaneously. However, one group of picture stimuli, the Name Match pictures, could best be sorted, if they were named, so the sorting of these pictures would reveal what processes were secretly in use, verbal and visual coding, or just visual processing. If coding was purely visual, then in the LOOK condition, when the Name Match pictures were misplaced, they would be misplaced amongst the New pictures, because they had not been seen before. If verbal coding was occurring, then the Name Match pictures would be more likely to be misplaced amongst the Physical Match ones. In other words, if the verbal label took precedence, rather than the visual appearance of the picture, and if the verbal label did not discriminate between the two items - the Physical Match 'dog' and the Name Match 'dog', then the Name Match item would be misplaced into the Physical Match pile. In the 2 later conditions (NAME and GENERATE) verbalising was known to occur and so some shift in misplacements of Name Match pictures was expected.

In the case of the Physical Match pictures, they were studied in the LOOK condition, and if coding were purely visual, they should have been readily matched with recently stored knowledge. If some subjects were concentrating on the style of the drawing, then the Physical Match pictures could have been misplaced on this basis into the New set, as both the Physical Match and the New pictures were drawn from the Snodgrass and Vanderwart set. This same factor might have led to some New pictures being misplaced into the Physical Match set. The analysis of the misplaced pictures was designed to see if a pattern of misplacement could be detected.

DESIGN.

The significance of the distribution of misplaced pictures into one of the two alternatives was measured by reference to the binomial distribution. The dependent measure was the frequency of the misplaced Physical Match pictures into one of the two possible wrong piles (Name Match or New),of the misplaced Name Match pictures into one of two possible wrong piles (Physical Match or New) and of the misplaced New pictures into one of the two possible wrong piles (Physical or Name Match).

7.5.2. RESULTS.

Using the binomial distribution, with 1 df and a two tailed test, it was possible to determine whether the distribution of misplaced pictures occurred on a chance basis, or whether there was a significant misplacement of pictures into one of the alternative sets, rather than the other.

Inspection of the data in Tables 28, 29, 30 (see Appendix 18) revealed that in the case of the Physical Match pictures, in all but one instance, both PS and FS children misplaced the Physical Match pictures significantly more often into the Name Match pile. The one exception was in the case of the PS children, who, when recognition was immediate, misplaced the Physical Match pictures equally into the Name Match and the New sets.

LOOK immediate recognition	PS $z = 1.5$ $p > .05$	FS $z = 5.8$ $p < .01$
LOOK delayed recognition	PS $z = 5.8$ $p < .01$	FS $z = 3.1$ $p < .01$
NAME immediate recognition	PS $z = 4.45$ $p < .01$	FS $z = 8.5$ $p < .01$
NAME delayed recognition	PS $z = 6.6$ $p < .01$	FS $z = 9.2$ $p < .01$
GENERATE immediate recognition	PS $z = 6.1$ $p < .01$	FS $z = 7.6$ $p < .01$
GENERATE delayed recognition	PS $z = 5.9$ $p < .01$	FS $z = 9.4$ $p < .01$

In the case of the New pictures, the number of misplaced pictures was very small and often there were no misplacements into a particular set, so no statistical analysis was carried out for those. Inspection of the means showed that misplacements were evenly distributed between the two alternatives.

The misplacement of the Name Match pictures showed a change over conditions. In the LOOK condition, both PS ($z = 7.4$, $p < .01$, and $z = 2.2$, $p < .05$) and FS ($z = 8.9$ and

$z = 6.8$, $p < .01$) misplaced significantly more Name Match pictures into the New pile. When naming was introduced a change occurred, the PS now misplaced significantly more Name Match pictures into the Physical Match pile ($z = 3.1$, $z = 3.1$, respectively, $p < .01$). The FS, when recognition was immediate, continued to misplace more Name Match pictures into the New pile ($z = 3.8$, $p < .01$), but after a delay, they misplaced more into the Physical Match pile ($z = 2.2$, $p < .05$) Finally, in the GENERATE condition, the misplacements of the PS were evenly balanced between the 2 alternatives. The FS again misplaced significantly more Name Match pictures into the New pile when recognition was immediate ($z = 2.3$, $p < .05$).

7.5.3. DISCUSSION.

In the first statistical analysis of the data for Experiment 7, the correct recognition responses were examined. Here, it was the incorrect ones which were inspected for evidence of any bias in the misplacements of the pictures which would reveal strategies in use. In particular, the aim was to see whether the children were sorting, in the LOOK condition, principally on the basis of visual information, or whether the children were also spontaneously using verbal information.

It could be argued that when pictures were misplaced they were simply placed into the next nearest pile. This may have been so in the case of the Physical Match pictures which were, except in one case, overwhelmingly misplaced into the Name Match pile However, that argument cannot be sustained about the Name Match pictures, for their sorting position was midway between the Physical Match on one side and the New on the other. The main outcome of this analysis was that the NAME condition did make the most impact on the strategies of the PS children.

When the Name Match pictures were presented in the LOOK condition, they might have aroused a weak activation of the visual trace, as their Physical Match counterparts had been seen before. If no naming was occurring, there would have been no auditory activation in respect of the name they shared with their Physical Match counterpart. Misplacements into the New pile would signify that the visual activation was very weak and allowed them to treat the picture as not having been seen before. Misplacements into the Physical Match pile would signify strong auditory activation.

What happened in the LOOK condition was that both PS and FS misplaced significant numbers of Name Match pictures into the New pile, as though they were treating them as novel. There was little sign that these misplaced pictures were being named. The conclusion in this condition was that sorting of the misplaced pictures was principally on a visual basis. Those who had sorted the Name Match pictures correctly were probably able to use both visual and verbal coding combined, but those who made errors could not.

In the NAME condition, a change occurred for the PS children when recognition was immediate and delayed, but for the FS children only when recognition was delayed. The Name Match pictures had to be named when they were given to sort. This would have aroused strong auditory/phonological activation as the name was shared with the studied Physical Match pictures. There would have been weak visual activation arising from the memory of these similar, studied pictures, and also from having seen the Name Match pictures previously. In this condition, a significant number of misplacements were made into the Physical Match pile. Reliance was being placed on the verbal/ auditory signal, except for the FS when recognition was immediate. It was possible that the weak visual activation was weak enough to convince the FS that they had not studied these pictures, whereas the PS may have been less confident of this.

In the GENERATE condition, both PS and FS were able to interpret the weak visual and strong auditory/ phonological activation from the Name Match pictures evenly. Only the FS, when recognition was immediate, misplaced significantly more into the New pile, relying principally on the weak visual activation which signalled that these pictures were only similar to those which had been studied, not the originals themselves.

The pilot studies had shown that PS children had difficulty in naming, not only photographs , but line drawings (6.2.1). They might see the shape correctly, such as a square, but identify the square as a box or case, rather than a book. They might see the features of a person or an animal, but not detect whether the person was a man or a boy or a girl, and not tell if the animal was a cat or a dog or a cow or sheep. These visual difficulties all heralded problems in a visual recognition task. Yet they were not actually apparent. Identification of the totally New pictures was at a high level. The PS were well able to distinguish those line drawings they had studied and those they had not. The studied Physical Match pictures were relatively well identified when they came to be recognised from amongst the two types of distractor. A point worth noting in this context may well be that in the case of visual recognition, the whole picture does not need to be identified, but only sufficient distinctive information to achieve a match.

It might have been the case that none of the Name Match pictures were identified correctly, for they could all have been put into the New pile as not having been seen before. What prevented this from happening? It could have been the training given at the outset. It could have been, inadvertently, the fact that the Name Match pictures were a slightly different style from the other stimuli, or it could have been that from the outset some of the children were coding verbally and visually, and that given further instructions and further practice, together with help with naming, this ability, in the NAME condition was equal to that of recognising the studied Physical Match pictures.

The pilot study of Visual Recognition (7.3) had shown that PS viewers were impaired in their recognition performance by the amount on the page to be inspected in a limited time. One of the aims of this Experiment was to see whether the complexity or familiarity of picture stimuli affected recognition, when the amount to be viewed, in terms of numbers of pictures, remained constant. Thus, in view of the pattern of response found on the part of the PS children in the pilot studies and, to a limited extent, in the present recognition Experiment, the following analysis should illuminate further some of the factors inherent in the task.

7.6. EXPERIMENT 6. ANALYSIS 3.
THE IMPACT OF PICTURE COMPLEXITY AND FAMILIARITY ON RECOGNITION.

7.6.1. INTRODUCTION.

The commonly held view had been that visual recognition levels generally were very high. Goldstein and Chance (1970) introduced the idea that picture stimuli which varied in familiarity or in complexity might yield different levels of recognition accuracy. In their experiments, the faces, for example, were complex and familiar, but difficult to distinguish one from the other, so that the initial recognition level was lower than had been found for heterogeneous stimuli. After a delay in recognition, however, for these stimuli, there was little forgetting. In the case of the inkblots and snow crystals, which were unfamiliar, extremely difficult to distinguish from each other and also complex, initial recognition was low, and there was also a further drop when recognition was delayed.

In the present analysis, the picture stimuli were drawn from a set which had been rated by adults, for their familiarity and complexity. The aim, once again, was to determine whether the PS were at a disadvantage in the recognition of any particular type of picture stimuli, when compared with the FS.

The first hypothesis was that there would be a significant difference between the PS and FS subjects in respect of the recognition of the variously rated pictures. Arising from observations in Pilot Study 4 (7.3) that difficulty in recognising stimuli was associated with the amount on the page to be viewed within a limited time, it seemed likely that pictures here which required extra time to view would be the least well recognised. This might be the case with the High Complexity pictures and also with the Low Familiarity ones.

The PS were expected to be able to recognise the High Complexity and the Low Familiarity pictures least well. This would be because of lack of inspection time for the complex pictures, and for the novelty of the low familiarity ones. It was not anticipated that the familiarity and complexity ratings would have any significant impact on the recognition levels of the FS.

7.6.2.METHOD.

Only the Physical Match pictures in the LOOK condition are considered in this analysis. (see 7.4.2.)

DESIGN AND STATISTICAL ANALYSIS.

Snodgrass and Vanderwart (1980) considered that the dimensions of familiarity and complexity could be regarded as independent attributes of picture stimuli.Thus a comparison between responses to pictures rated high on the familiarity dimension and to those rated high on the complexity dimension is feasible. So, too, is a comparison between those pictures rated low on the two dimensions. Nonetheless, the significant negative correlation between the two dimensions (-.466) was appreciably high. For this reason, a t-test for correlated samples was used for the statistical analysis. Correct responses to pictures rated high complexity were compared to those rated high familiarity , and correct responses to pictures rated low complexity were compared to those rated low familiarity. The comparisons between the two samples of subjects, PS and FS, were carried out using a t test for independent samples.

7.6.3.RESULTS.

Table 31. The means and standard deviations for the correct **recognition** by PS and FS children of variously rated Physical Match pictures in the LOOK condition in Experiment 6,when recognition is immediate or delayed (max 8 per cell).

PICTURE RECOGNITION.

LOOK condition.	Immediate recognition.		Delayed recognition.	
	High Familiarity	High Complexity	High Familiarity	High Complexity
PS mean	6.0	6.1	4.6	4.6
s.d.	1.7	1.2	1.7	1.8
FS mean	5.1	5.7	4.8	4.6
s.d.	2.1	2.2	1.8	1.4
LOOK condition.				
	Immediate recognition.		Delayed recognition.	
	Low familiarity	Low complexity	Low familiarity	Low complexity
PS means.	5.9	6.4	4.7	5.5
s.d.	1.6	.9	1.4	1.8
FS means	5.3	5.4	3.9	4.5
s.d.	2.0	1.9	1.4	2.1

A comparison of the performance of the PS and FS in their responses to high familiarity and high complexity pictures revealed no significant difference between the two groups ($t = .74$, df 31, $p > .05$, independent samples, one tailed test) The same was not so for the comparison of the two groups' performance with the low familiarity and the low complexity pictures.($t = 2.35$, df 31, $p < .05$ independent samples, one tailed test).The scores of the PS were significantly higher than those of the FS.

In the case of the comparison between correct recognition of high familiarity and high complexity pictures, the difference on the part of the PS children was not significant either for immediate or delayed recognition ($t = .16$ and $t = 0$, df 10, $p > .05$, for correlated samples, one tailed test, ns). The same was so for the FS children. ($t = 1.1$, df 21, $p > .05$, $t = .39$, $p > .05$ for correlated samples, one tailed test, ns).

With regard to the comparison of responses to pictures rated low complexity and to those rated low familiarity, responses of the PS revealed no significant differences ($t = .99$, and $t = 1.2$, df 10, $p > .05$, correlated samples, one tailed test, ns). In the case of the FS, the difference in response to low familiarity and low complexity pictures showed no significant difference when recognition was immediate ($t = .12$, df 21, $p > .05$, correlated samples, one tailed test, ns). When recognition was delayed, however, there was a significant difference between responses to the two sets of picture stimuli ($t = 1.79$, df 21, $p < .05$, correlated samples, one tailed test). it was the unfamiliar pictures which were significantly worse recognised by FS subjects after a delay.

7.6.4.DISCUSSION.

The good performance of the PS with these studied pictures was notable and revealed the effectiveness of their visual inspection. It was to be expected that the unfamiliar pictures (goat, camel, turtle, giraffe, sheep, rolling pin, sailboat and frog) would be hard to identify correctly, but surprising that this was only so for the FS children. If the FS subjects were accustomed to naming pictures as they viewed them in order to dual code, these would be the pictures which were hardest to name. After a delay, they had to recognise these as pictures they had studied, and to keep them separate from the same style, unstudied New pictures, and from the potentially verbally confusing Name Match pictures. If the FS were rather careless about visual inspection and moreover did not know the name of an unfamiliar picture, errors would arise.It was possible that the PS recognised these pictures adequately as a pattern or design, because of the close visual inspection they had received. In the case of the low complexity pictures, however, it was possible that they were also fairly familiar and so easier to name. The fact that the PS did not experience the same difficulty with these unfamiliar pictures suggests that their close inspection of each one compensated for any lack of knowledge of the picture's name.

Intuitively, it would be expected that high familiarity pictures would be recognised significantly better than high complexity ones and that this might be most evident for the FS because of their greater familiarity with picture material. The fact that this was not so demands explanation. One reason might be that the high familiarity pictures also had a medium rating on the complexity dimension, and vice versa. Additionally, Snodgrass and Vanderwart suggested that high complexity pictures might be recognised more easily precisely because they were novel. In a recognition task, they did not have to be named, and their visual complexity could have added to their distinctiveness and uniqueness.

In the case of the correct recognition of low frequency and low complexity pictures, the difference in recognition level on the part of PS subjects did not reach significance.However, after a delay, the low familiarity pictures were recognised significantly less well than the Low Complexity pictures by the FS group. Why should this be so for the FS but not for the PS? The next section looks more carefully at the naming responses of PS and FS subjects to the same picture stimuli, to see whether the difficulty with recognition was matched by a difficulty in naming the same pictures.

7.7. EXPERIMENT 6. ANALYSIS 4.

THE IMPACT OF PICTURE COMPLEXITY AND FAMILIARITY ON NAMING.

7.7.1.INTRODUCTION.

One expectation following Pilot Study 3 described in Chapter 6 was that the PS would not know all the names of the pictures at the outset, whereas the FS would do so.

This was tested out in the LOOK condition, in that after the sorting had finished each subject went through the pictures and named them.

The first hypothesis was that there would be a significant difference between the naming levels of the PS and the FS, and that the levels achieved by the PS would be lower than those for the FS.

The second hypothesis was that the pictures which would be the hardest to name on pragmatic grounds would be those rated Low Familiarity, and for the PS, because of their visual difficulty, those rated High Complexity.

7.7.2. METHOD

as for Experiment 6 , though the focus here is entirely on the naming of the pictures. (see 7.4.2.)

DESIGN AND STATISTICAL ANALYSIS.

The dependent variable was the frequency with which each picture was correctly named.

Although Snodgrass and Vanderwart (1980) regarded the dimensions of complexity and familiarity as independent attributes of picture stimuli, nonetheless, there was a appreciable negative correlation between them (- .466). For this reason the comparisons between the naming of pictures rated high familiarity and high complexity, or pictures rated low familiarity or low complexity were carried out using a t-test for correlated samples. For the comparison between scores of PS and of FS groups a t test for independent samples was used.

PROCEDURE.

Each picture was named by each subject after the recognition testing had been undertaken in the LOOK condition.The scores used here refer to the names given to the pictures by subjects before any help had been given them. A strict criterion for the correct name was maintained.

7.7.3. RESULTS.

Table 32. The means and standard deviations for the correct **naming** by PS and FS subjects of the variously rated Physical Match pictures in the immediate and delayed recognition sets for Experiment 6 (max 8 per cell).

PICTURE NAMING

	Immediate recognition set.		Delayed recognition set.	
	High Familiarity	High Complexity	High Familiarity	High Complexity
PS mean	7.3	5.7	7.0	5.4
s.d.	0.9	1.2	0.7	1.8
FS mean	7.9	6.8	7.6	6.9
s.d	0.2	1.0	0.5	0.8

A comparison of the responses of PS and FS subjects revealed that there was a significant difference between their naming levels (t =-5 , df 31,p< .005, independent samples, one tailed test), those of the PS being lower.

In the comparison between High Familiarity and High Complexity pictures, immediate recognition picture set, there was a significant difference on the part of the PS (t = 6.25, df 10, p< .01, 1 tailed test) and on the part of the FS (t = 5.8, df 21, p< .01, 1 tailed test). The very complex pictures were less well named.For the delayed set of pictures, the same was the case. (PS, t = 3.6, df 10, one tailed test. FS, t = 3.65, df 21, p< .01, one tailed test)

Table 33. The means and standard deviations for the correct **naming** by PS and FS children of the variously rated Physical Match pictures in the immediate and delayed recognition sets for Experiment 6 (max 8 per cell).

PICTURE NAMING				
	Immediate recognition		Delayed recognition	
	Low Familiarity	Low Complexity	Low Familiarity	Low Complexity
PS mean	6.4	7.5	5.9	6.8
s.d.	1.6	0.7	1.1	1.6
FS means	7.6	7.7	7.7	7.7
s.d.	0.5	0.44	0.6	0.4

A comparison of the responses of the PS and FS groups with regard to the naming of low familiarity and low complexity pictures revealed a significant difference between the two groups (t = -5.1,df 31, p< .005, independent samples, one tailed test). The PS were poorer in general than the FS at naming the pictures.

When the responses of the PS to the Low Familiarity pictures were compared with the Low Complexity ones, it was clear that they had more difficulty in naming the unfamiliar pictures in the first immediate recognition set (t = 2.56, df 10, p< .05, correlated sample, one tailed test).This was not so for the second set of pictures (t = 1.3, df 10, p> .05, correlated sample, 1 tailed test) This difficulty was not shared by the FS (t = .62 and t = .26, df 21, p> .05, correlated samples, one tailed tests) They named unfamiliar and visually simple pictures equally well.

7.7.4.DISCUSSION.

It should be recalled that the 2 sets of pictures were equivalent with regard to naming. PS subjects had significant difficulty in naming pictures rated Low Familiarity in one set (whistle, flag, seal, penguin, bear, chicken, wheel, mouse). This may have been because they had fewer, or less well differentiated internal representations. Both PS and FS subjects had significant difficulty in naming the visually very complex pictures (fly, clown, violin, butterfly, crown, doll, bee, windmill: stove, train, elephant, cockerel, alligator, basket, eagle, snake).In the exposure time available, there may have been too much detail to identify.The PS children would not have been able to reach the point in the identification process of accessing a category and a name.The reason for the FS to find the visually very complex pictures difficult to name may have been similar but additionally, Snodgrass and Vanderwart argued that these visually complex pictures also tended to be unfamiliar. The origin of the complexity could have been because of the artist's style, but they specifically guarded against that and instead ensured that the source of the complexity lay within the real life object. Unfamiliar objects did not develop a refined and simplified pictorial representation.The dimensions on which they were inspected were unfamiliar. The pictures were, in this respect, similar to the hard-to-name picture stimuli used by Goldstein and Chance (1970).

7.8.GENERAL SUMMARY AND CONCLUSIONS.

From this series of 4 analyses, several results emerged clearly.

Broadly speaking, the recognition memory for pictures by PS children was the same as that of their FS counterparts. This is a fascinating result which was not predicted but has, as its likely cause, a good visual memory which might be independent of associations with object names. Some of the PS and the FS children were naming pictures covertly, as they viewed them, because half the Name Match pictures were sorted correctly. But when it came to naming the pictures accurately, the PS were at a clearer disadvantage.

There was evidence from the misplaced pictures that some of the FS and the PS were relying on visual coding alone for the Name Match pictures in the LOOK condition and this let them down when it came to sorting. The introduction of naming at study time, did show signs of influencing the coding processes of the PS in particular. The reason for the FS continuing to rely for sorting decisions on a visual coding strategy alone for longer than the PS is obscure. It must have been that those who mis-sorted these Name Match pictures, forgot the original instructions, and were overimpressed by the visual difference between the Name Match pictures and the studied ones. The FS were also less influenced than the PS by the signals they picked up from naming the pictures.

In the analyses of the Physical Match pictures (7.6. and 7.7.) along the dimensions of Complexity and Familiarity, there was evidence that the recognition level of the PS was sometimes higher than that of the FS (low familiarity and low complexity pictures), but that in the case of naming the pictures, it was always lower.

The results provided evidence that visual impairment is not necessarily associated with impaired recognition memory for pictures. It seems that the same strategies are used by the PS group in terms of perception and memory, but the balance between reliance on visual or verbal strategies may vary a little from those of the FS. The association of object descriptions and object names is likely to be far richer with the FS than the PS, and this is one explanation of the findings. Under the circumstances provided in these experiments, the PS and FS subjects were not stretched to their limits. Recognition levels were high and the PS scored well. It seems possible that under less favourable conditions, faster exposure times or harder to name stimuli, this parity of performance would not have been sustained. But that remains for future experimentation to determine.

This analysis of the impact on naming of differently rated pictures, and to a lesser extent the impact of the different ratings on recognition, is a useful indicator of a series of dimensions to be taken into account when using picture stimuli with PS children. The familiarity of the pictures matters, and so,too, does their complexity. However, it is not only the PS subjects who were influenced by the picture ratings. The FS children were too. For them, there was difficulty in naming the complex pictures, and also in recognising the unfamiliar ones after a delay.

The conclusion which can be reached from this Experiment is that the PS are able to use their visual inspection skills and that this high level of attention to visual material compensates to some extent for their low vision. However, when time is short, it is likely that this time taken on close visual inspection will be a the expense of something else - for example, identifying the whole picture verbally and naming it. If the exposure time for viewing were to be reduced, or if the pictures were more difficult to identify, the PS might be placed at a disadvantage.

CHAPTER 8

THE RECALL OF PICTURE STIMULI BY PARTIALLY SIGHTED CHILDREN.

8. INTRODUCTION.

It could easily be imagined that PS children would be able to recall very little visual material, particularly if they were allowed only restricted viewing time and were given no advance information about what category of item was to be viewed. Perhaps the most difficult visual material to recall would be an abstract design, for this would require detailed inspection, with no possibility of help from use of a verbal label. Lansdown (1973) had already demonstrated that PS children had a shape matching difficulty, but this was more likely to affect recognition performance. He also established that PS children did not enjoy doing a Visual Retention task.

The good visual recognition performance of the PS had been a surprise. Recall levels are generally found to be lower than recognition levels, but, in the light of Chapter 7, here in Chapter 8 picture stimuli were specially selected so as to be difficult for both PS and FS to remember.

In the case of recall, the visual stimulus has first to be inspected, identified, stored and then retrieved, by access and activation, then discrimination. Nothing exact is known of the ability of PS children to carry out these functions, although their drawings should provide guidance. Drawings, however, are often of self selected items which may have been inspected or learned about over considerable periods of time. The task, in this Experiment, was to be harder, namely to recall two - dimensional pictures of a wide range of objects.

Pilot Study 3 described in 6.2. revealed some of the difficulties of naming pictures which would be experienced by PS children. The experiments mentioned above

(6.5.1.) indicated that in this age group, the youngest children were unlikely to name pictures spontaneously, though the older ones would do so. It was also established by Hitch et al (1988) that naming pictures aided recall amongst 5 year olds onwards, when the recall task was verbal.

To test how far this picture recall was a feasible task to set PS subjects, a Pilot Study was carried out.

8.1.PILOT STUDY 5. VISUAL RECALL.

This pilot study used the BAS Recall of Designs Test. There are 19 designs in this test, following the three initial practice ones for which feedback is given. Exposure time for each design is 5 seconds, after which it is concealed and the child draws it from memory.

Two conditions were used here:

- first, 5 seconds viewing time
- second, at least a week later, unlimited viewing time.

The BAS Handbook states:

'Performance on this scale requires not only visual perceptual encoding and retention, but also an adequate level of motor skill. However, the drawings are such, that they should not cause major difficulty in themselves for children with normal motor development. It is, of course, possible to code the designs verbally to a certain extent, and performance may therefore be aided by efficient verbal coding. Poor performance may be attributed to poor short term visual recall but may also be influenced by poor motor skill or by poor verbal encoding strategies.'

It was clear from this Pilot Study that given an exposure time of 5 seconds, PS children were able to score over the full range of the scale. Of the 19 items, 5 children completed 16 or more, 1 only completed 5 designs, the remaining children completed intermediate numbers.

With unlimited viewing of the design, there was a general increase in score except in two cases, but recall was still not perfect. In other words, if extra study time is available, the child has to know what to do with the time. Frequently, here as elsewhere, some children had to be slowed down and encouraged to use the available time to its full extent.

Given the results of the Pilot Study set out in full in Appendix 19, it seemed reasonable to proceed with Experiment 7. Three separate, short, experimental investigations of visual recall were carried out.

8.2. EXPERIMENT 7a.

AN INVESTIGATION OF THE RECALL OF VISUALLY INSPECTED PICTURES BY PARTIALLY SIGHTED CHILDREN.

8.2.1. INTRODUCTION.

The good visual recognition performance on the part of PS children reported in Chapter 7 had been a surprise. Previous studies of the FS, reported in the literature, have established that recall levels are lower than recognition levels by as much as a half to a third, or even more. Attention has been drawn to the fact that in the case of recognition memory, the viewer only has to recognise part of the picture in order to achieve a match, whereas, in the case of recall, more has to be retrieved to locate and communicate the precise member of a category.

Bahrick and Boucher (1968) established that overtly naming picture stimuli improved recall a little compared with silent viewing, if recall was immediate and there was only one training trial.The purpose of this set of experiments was to investigate visual memory with subjects who had difficulty in seeing the picture stimuli and difficulty in naming them, by use of hard-to-name picture stimuli selected on the basis of high complexity and low familiarity. Because of their known difficulty in accessing the correct name for a picture, the method of recall allowed to both PS and FS was to use the picture's name or give a verbal description. The specific purpose of the first in the series of three experiments was to establish a base level for recall when children were required just to look at the stimuli at input.

The first hypothesis was that the PS would be poorer at the task of recalling pictures than were the FS. This was because of their poor visual capacity to make out the lines which formed the picture, and then to identify each picture by name, within the exposure time.

The second hypothesis was that there would be a drop in recall scores after a delay.

8.2.2.METHOD.

SUBJECTS.

As for Experiment 6 reported in Chapter 7.

(Full details of the two samples are provided in Appendix 16)

MATERIALS.

10 sets of pictures were prepared, 2 for Experiment 7a and 4 each for Experiments 7b & 7c. Each set contained 8 pictures. 8 pictures were selected for the immediate recall set and 8 for the delayed recall set from the large Snodgrass and Vanderwart (1980) standardised set. Care was taken to ensure that the pictures for each set came from a range of categories (animals, insects, tools, food etc.) and that here the number of pictures from any one category was strictly limited to a maximum of 2. The pictures were selected and the sets balanced for their ratings on 2 dimensions - familiarity and complexity. Ratings were from 0 - 5. A rating of 0 was low, a rating of 5 was high.

In order to make the pictures difficult to name and to recall, they were selected as being rated low in familiarity and high in complexity.

The ratings of the sets for Experiment 7a were as below:

Immediate recall

mean complexity rating	3.2	s.d. .7
mean familiarity rating	2.6	s.d. .6

Delayed recall.

mean complexity rating	3.6	s.d. .8
mean familiarity rating	2.2	s. d. .7

(Full details of the Picture Stimuli are provided in Appendix 20)

APPARATUS.

The pictures for recall were presented by hand and the timing was by hand held stop watch. Handling the pictures meant that each PS subject could gain the most favourable viewing angle for him - or herself.

DESIGN.

The dependent variable was the number of picture stimuli correctly recalled by name or description.

There was 1 between subject factor, **group** (PS and FS), and 1 within subject variable, **time interval,** (immediate or delayed recognition).

A chi-square analysis was used to distinguish the frequency of recall by name or by description. A t test for independent samples was used to compare PS and FS children's ability to find the correct name or use a description for a recalled picture.

PROCEDURE.

Each subject was told that this was to be a test of memory and each one was instructed individually to look at each picture very carefully for 5 seconds per picture. A practice trial with a small set of different pictures was given to ensure that the nature of the task was understood.The pictures were presented in random order for each subject. He or she was then asked to recall the pictures seen in any order, either immediately or after a filled delay of 10 - 15 minutes. The subjects did not know in advance whether recall was to be immediate or delayed. This was because it seemed likely that if they thought recall was to be immediate, they would expend less effort on remembering.Time of recall was counterbalanced across children, so that half received the immediate recall condition first and half the delayed condition first.They were specifically told that if they did not know or could not remember the name for a picture, they could reproduce their recollection by means of a description. After the recall task, each subject was asked to name the pictures one by one, and their naming responses were recorded by the Experimenter. This enabled the Experimenter to align the children's idiosyncratic names for recalled pictures with the pictures themselves.

8.2.3. RESULTS.

Table 34. The means and standard deviations for the correct recall of pictures in Experiment 7a by PS and FS children, both when recall is immediate and delayed (max 8 per cell).

	IMMEDIATE RECALL	DELAYED RECALL.
PS means	4.2	3.1
s.d.	1.1	1.1
FS means	4.0	3.0
s.d.	1.4	1.4

An ANOVA of Table 34 (see Appendix 21) with 1 between subject factor, (Group) and 1 within subject factor, (Time Interval) revealed that overall, PS and FS performed this task equally well.($F_{1,31} = .16$, $p > .05$) There were significant differences in the recall of the pictures under the various time intervals ($F_{1,31} = 12.36$, $p < .01$), those recalled after a delay being fewer in number.

Table 35. The means and standard deviations for the correct name or an adequate verbal description of each picture,given by PS and FS children, immediate and delayed recall combined (max 8 per cell).

	PS		FS	
	Name	Description.	Name.	Description.
mean	3.6	3.6	5.2	1.7
s.d.	1.8	2.1	2.2	1.1

It is evident that PS subjects name or describe pictures equally often. A chi-square analysis of the FS distribution of frequencies in either category revealed a significantly above chance level of correctly named pictures ($x^2 = 38.8$,df 1, $p < .01$). A comparison between PS and FS children of the correctly labelled pictures showed a significant difference between the two groups ($t = -2.04$, df 31, $p < .05$, independent samples, one tailed test).The FS were able to name pictures more often than could the PS.

8.2.4.DISCUSSION.

This brief recall experiment was intended to provide a baseline view of the recall capacity of PS and FS children, when they were simply required to view the stimuli at study time.Recall was so arranged as to give the PS a chance of demonstrating their ability to recall, rather than their ability to retrieve the correct verbal label. Under those circumstances with two permitted modes of recall - the correct picture name or a description - both groups recalled picture stimuli equally well but there was the expected drop in amount recalled after a delay.

If the dependent variable had been recall of the correct name for the picture, the FS children would have been significantly better than the PS. To obtain a glimpse of what the PS were able to recall, it is necessary to return to their responses and descriptions. What might PS viewers be looking for? Few extrinsic clues were available to them, for the pictures were simply of objects on their own, not in action nor in context. Key categorisation features, though, might be -

the presence or absence of a head

the presence or absence of 2 legs

the presence or absence of 4 legs

the presence or absence of a tail

the presence or absence of corners

Identification of these might lead to the categories of person, animal, bird or furniture. In the search for these key features, the PS child might just identify shapes:

- 'a door shape', 'a triangle' Part recognition of features could be helpful - or might lead them astray - for example,' a head like a horse'. Perhaps it was an animal,? But it had only two legs and they were long and thin - search in an adjacent category yielded the name 'ostrich'.

These are some of the examples provided by the PS children, where they have identified the shape and then tried to match that with an object on the basis of shape alone, a very inadequate basis for matching.

'door shape' 'sort of case', 'like a line - triangle thing'.(sledge),

'ladder/ bench', 'train track', 'kind of sleeping bed', 'like a board', 'sunbed thing', (fence),

'ball, orange, apple', (peach),

'butterfly' (bow),

'tree' (mountain),

'bottle' (chisel),

'plate under bottle' (candle),

'like a milk bottle- point at the top, and a dish' (candle and holder) 'thing like a mushroom - half round at the front' (helmet)

'big round thing like a drum' (cannon)

'tree with 2 stalks' (lobster).

'kind of two things at the top', (lobster).

Others had identified only parts of the picture:

'cannon ball' (cannon),

'wheels', (cannon),

One description was a combination of these two types of feature identification:

'head like a horse - along at the top - half a circle at the back and then two legs' (ostrich).

In many cases, the correct category name was identified, though the member named may not have been the correct one -

'sort of horse' (fox),

'duck' (ostrich),

'duck - looked like a bird' (ostrich),

'sort of goose' (ostrich)

'thing you use in woodwork" (chisel).

These processes, then, might be considered as a breakdown of aspects of picture processing by PS children, with the sequences of recognition probably occurring in parallel:

1. Perception of shapes.
2. Identification of parts.
3. Finding the category to fit certain identified requirements, for example - presence of head, wings, beak, 2 or 4 legs, tail etc. i.e. matching the shape and/or part to a known internal representation.
4. The correct naming of the member of that category.

Exactly the same processes could be recognised from the responses by the FS children :

1. Reliance on shape - 'gate' (fence)

'ball' (peach)

2. Identification of parts -'black tail and black things round the eyes' (raccoon).

3.Search within a category - 'looks a bit like a cat' (raccoon)

'use to cut something with' (chisel)

'screwdriver' (chisel)

'things where balls fly out, gun thing' (cannon)

Reliance on shape alone when seeking a category, usually provided insufficient detail for correct identification. For example, in the case of the peach, the shape was indeed circular, and those who had named it a 'ball' had failed to take account of the slight indentation in the circular shape. Those who named it an 'apple' had gone a stage further. They had noticed the indentation and had even found the right category, but had finally named the wrong member of the category.Many parts of the identification process were, in fact, correct. Only the last aspect, the name, was not, and this must be because the detail in memory was missing, a result also found by Pring (1985,1992) with blind children.

Reliance on identification of a part of the whole was also liable to lead to error in seeking the correct category. For example, when 'wheels' were identified, these would not lead easily to finding the cannon, of which they were a part.

Normally, these processes of picture recognition are traversed very quickly, in less than half a second, and become automatic. However, here, because the task was purposely made difficult, they were revealed by both groups of children, more so by the PS group. It seemed likely, that had even less time been allowed for the inspection of the pictures at study time, the PS in particular, would have revealed more evidence of the earlier stages of picture identification.

It is clear from this description, that had the subjects been required to recognise rather than recall, they could probably have done so on the basis of use of any of the perceived shapes, features or categories mentioned above. For accurate recall, more detail has to be identified. More information had to be in stored knowledge in order to find a distinguishing feature to discriminate one animal from another - a skunk from a raccoon, for example.

Pring (1989) compared the stored internal representations of common objects by blind and sighted children and noted the difficulty of blind children in identifying and storing distinctive features.It was these distinctive features, not just the global outline, which enabled one object to be differentiated from another. Given just tangible pictures without any other information, blind children might find the correct superordinate category by virtue of structural features. However, to be able to go beyond that, through the various subcategories to distinguish the correct subspecies required minute sensory analysis of detail, of a kind rarely made available in tactile pictures. Pring drew attention to the gap which might exist between what could be deduced or inferred from tangible information, and what could be acquired semantically from other sources. Links from one source of knowledge to another had to be made for optimal performance and blind children might not necessarily make those demanding associations.

Because of the findings in this experiment concerning the recall of shape and the reliance on shape for trying to find a match with an internal representation, the next experiment explored further the effect of drawing attention to physical attributes of the pictures, when each was initially studied .

8.3. EXPERIMENT 7b.

THE IMPACT OF ORIENTING QUESTIONS ON THE RECALL OF PICTURES BY PARTIALLY SIGHTED CHILDREN.

8.3.1.INTRODUCTION.

The notion of semantic processing was central to the Levels of Processing model (Craik & Lockhart, 1972) Semantic processing was portrayed as deeper and fuller, and so would lead to a better level of recall, but this notion of depth still remained an ill-defined concept. These authors moved away from a multistore model to one in which there was sensory analysis, then processing of features and finally semantic processing. The idea, here, was that the sensory level was relatively shallow, memory for this information was not necessarily retained if deeper processing was carried out. For Paivio (1986), it would be the dual coding which would be likely to lead to better recall, as wider activation of the image was made possible. Codes could be added to each other, if referential connections were made.

The Levels of Processing model rule of thumb was the semantic superiority effect. This may have been because in the case of words, it was the meanings which were important not their sensory attributes.

Hyde and Jenkins (1973), for example, had found that a semantic orienting task requiring a judgement between pleasant or unpleasant words led to better recall than did orienting tasks which focused attention on either syntax or orthography. Warrington and Ackroyd (1975) pointed out that up to that date research into the effects of an orienting task on memory had all used verbal stimuli. They stated the position as follows: 'It is well established that performance on a recall task is a function of the nature of the orienting tasks. Recall following semantic orienting tasks is as good as recall without such a task and is superior to recall following nonsemantic orienting tasks.' However, Intraub and Nicklos (1985) found that this result might only be true for words not pictures.They used both scenes and photos of single objects.They asked adult subjects to orient towards semantic and non-semantic (physical details) aspects of pictures at very fast exposure rates, allowing for only one fixation. They found the physical effect could occur for pictures but not for words. This was so even when the Semantic Orienting Questions directed attention to categories. It was still the Physical Orienting Questions which gained the best recall results.

They argued that the meaning of pictures can be very speedily accessed, almost automatically, and this being the case, they reasoned that Semantic Orienting Questions would provide redundant information, whilst Physical Orienting Questions would provide something additional and possibly distinctive.

In the Experiment which follows children were given two kinds of orienting questions and oral recall memory was tested later. The physical questions were ones that did not require the children to consider the picture's meaning. They required attention to structural characteristics and would therefore be applicable to meaningless random patterns as well as to meaningful pictures. Conversely, semantic questions could not be answered unless the child considered the picture's meaning. An attempt was made to make both types of questions equally general or global in nature.

8.3.2. METHOD.

SUBJECTS - as for Experiment 6.

MATERIALS.

Selection of pictures was as for Experiment 7a. For this Experiment, there were 4 sets of pictures: 8 for the semantic orienting task, immediate recall, and 8 for delayed recall: 8 pictures for the physical orienting task, immediate recall, and 8 for delayed recall. Presentation was randomised within each set. Care was taken in this selection that no one category of picture was over-represented in any set. Thus each set contained only 2 four-footed animals and no other concept was represented in any set by more than 2 members. The pictures were all selected from the Snodgrass & Vanderwart set with ratings that were low on familiarity and high in complexity (a rating of 0 was low, 5 was high), as below:

	Picture Sets 1 and 2 Semantic Orienting Questions.		Picture Sets 3 and 4 Physical Orienting Questions.	
	immediate	delayed	immediate	delayed.
Mean complexity rating.	3.6	3.6	3.7	3.4
s.d.	.8	.6	.7	.7
Mean familiarity rating	2.3	2.5	2.2	2.4
s.d.	.3	.4	.4	.4

(Picture stimuli are provided in Appendix 20)

The four sets of pictures were, therefore, comparable with regard to ratings on familiarity and complexity, and with regard to category membership. In each set, each picture was of a single item.

APPARATUS; as for Experiment 7a.

DESIGN.

The dependent variable was the number of pictures correctly recalled by name or description.

There was 1 between subject factor, **group**,(PS and FS) and there were 2 within subject factors, **orienting question** (physical or semantic), and **time interval** (immediate or delayed recall).

A chi-square analysis was used to distinguish the frequency of recalled names or descriptions for a picture. A t test for independent samples was used to examine the difference between PS and FS children in producing a correct name or a description and in cued recall.

PROCEDURE.

Each subject was instructed individually that he or she would be given a small set of pictures, one by one, to remember, and that each picture would be preceded by a question. The question required an answer - either 'yes' or 'no'. and the answer should only be given when the experimenter took the picture away after 5 seconds viewing time. One practice trial with a small separate set of pictures was given, to ensure that the subjects understood the task. Within each set of pictures an equal number of 'yes' or 'no' responses was required.

The order of recall was counterbalanced across children, so half the children did the immediate recall condition first , and half did the delayed recall condition first. This was to prevent any order or practice effect. Subjects did not know in advance whether recall was to be immediate or delayed, and this was because it seemed likely that if they thought recall was to be immediate, they would not expend maximum effort on remembering. Immediate recall began after the eighth picture had been shown, whilst delayed recall was 10 - 15 minutes after the display of the eighth picture. Subjects returned to their work during this interval. Each subject was specifically told at recall time, that if the exact word was not known, or could not be recalled, then the picture could be described. After this immediate or delayed recall, cued recall was employed: the original questions were repeated and the subjects asked to name the picture which had accompanied each question.

At study time, which lasted 5 seconds for each picture, viewing of the picture was preceded by a question. This was one which either directed the viewer's attention to physical or to semantic attributes of the picture.The two types of questions were used in blocks.The orienting questions were taken from Intraub and Nicklos (1985). They acknowledged that the two types of question might differ, in that the Physical ones might be more specific. The questions were chosen so as to be broad and global, but this might not mean specific. However, they did investigate the effects of making some of the semantic questions more category specific, but the end result remained the same.They showed that he two types of questions, as used below, did have differential effects, and yielded a 'Physical Superiority Effect'.

Semantic questions directed attention to the picture's meaning: is this animate, inanimate, edible, inedible, man-made, natural, indoor, outdoor ?

Physical questions directed attention to physical characteristics: is this balanced, unbalanced, horizontal, vertical, cluttered, sparse, rounded, angular?

To be understood by child subjects, some of the words were altered to make them easier e.g. 'eatable' for edible, or they were demonstrated e.g. a motion of the hand as the words 'horizontal' or 'vertical' were said.

The questions could not be ignored for the subject was required to answer the question at the end of the viewing time, by answering ‘yes' or ‘no'.The response was recorded so as to ensure that the subject processed the orienting question.

After recall of each picture set, subjects were asked to name each picture and the names were recorded by the Experimenter. This was to enable an alignment by the Experimenter of the child's recall response with any idiosyncratic picture name.

8.3.3.RESULTS.

Table 36. The means and standard deviations achieved by PS and FS children in Experiment 7b for the correct recall of pictures following Semantic or Physical Orienting Questions in both immediate and delayed recall (max 8 per cell).

	Immediate Recall		Delayed Recall	
	Physical Q.	Semantic Q.	Physical Q.	Semantic Q
PS mean	2.3	2.8	0.6	1.1
s.d.	1.4	1.3	0.8	1.0
FS mean	3.0	4.0	1.8	1.3
s.d.	1.3	1.8	1.2	1.4

An ANOVA of Table 36 (see Appendix 21) with 1 between subject factor, (Group) and 2 within subject factors, (Orienting Question and Time Interval), revealed that there was a significant difference by group: PS subjects recalled fewer pictures. ($F_{1,31} = 6.28$, $p < .05$) Recall was significantly better for immediate than delayed recall ($F_{1,31} = 69.88$, $p < .01$) The main effect difference between recall after semantic orienting questions or physically orienting questions did not reach significance ($F_{1,31} = 3.3$, $p > .05$). However, one interaction effect did reach significance, that between Orienting Question and Time Interval ($F_{1,31} = 4.9$, $p < .05$). When recall was immediate, there was a significant difference between recall following physical questions and recall following semantic questions ($t = -2.25$, $p < .05$, independent samples, one tailed test). The semantic questions yielded the higher recall scores. After a delay, there was no such significant difference.Recall was counted as correct if the picture was either named accurately or described unambiguously. The description took two forms - one was a near miss, e.g. 'horse' for 'donkey'. The other was a description, such as 'music thing' for 'accordion'.

Table 37. The means and standard deviations achieved by PS and FS children in Experiment 7b for the correct recall of pictures following Semantic or Physical Orienting Questions, where correct recall, immediate and delayed combined,is either by use of the correct name or by description (max 8 per cell).

	Immediate and Delayed Recall.			
	Physical Questions		Semantic Questions	
	Name	Description.	Name	Description.
PS.mean	1.45	1.45	2.0	1.7
s.d.	1.6	1.3	1.3	1.4
FS. mean	3.5	1.3	4.8	0.6
s.d.	1.8	1.1	2.4	0.7

A chi - square analysis of the differences between the frequencies in Table 37 revealed that the difference on the part of the FS between the number of pictures given a correct name was significantly higher than those described (Physical Questions x^2 = 22.8, p< . 01, Semantic Questions x^2 = 71.7, p< .01). The differences on the part of the PS did not reach significance.(x^2 = .13 and .1 respectively, p> .05)

An analysis of the responses following a question requiring a 'yes' or a 'no' response showed no bias arising from that source in this experiment.

In this Experiment, following Intraub and Nicklos (1985), cued recall was employed to try to enhance recall levels in cases where forgetting had occurred.

Table 38. The means and standard deviations for the number of additional pictures recalled (max 8 per cell).following cued recall ,by PS and FS children in Experiment 7b, where picture stimuli were preceded by Semantic or Physical Orienting Questions.

	Immediate Cued Recall		**Delayed Cued Recall**	
	Physical Orienting Q	Semantic Orienting Q	Physical Orienting Q	Semantic Orienting Q
P.S.means	1.6	1.6	2.2	2.2
s.d.	1.7	1.6	1.6	1.9
F.S. means	1.9	1.6	2.2	2.6
s.d.	1.5	1.1	1.3	1.5

PS n=11, FS n=11.

There was no significant difference on the part of PS subjects between cued recall of pictures following Physical or Semantic Questions (t = 0, and t = 0, df 10, p> .05, correlated sample, 1 tailed test). This was also the case for FS subjects (t = 0.57, and t = 0.92, df 21, p> .05, correlated samples one tailed test). Both PS and FS subjects improve their recall scores by about 2 additional pictures under each condition, following cued recall.

8.3.4. DISCUSSION.

In this experiment, the main findings were:

1. The PS children recalled significantly fewer pictures than the FS children.

2. Recall fell after a delay.

3. When recall was immediate, there was a significant difference in recall following Semantic Orienting Questions and inspection of mean scores showed that this was particularly so for the FS children.

4. The FS children were significantly better able to name the pictures they recalled correctly.

All these findings can be explained by the fact that the structural analysis of pictures (horizontal /vertical, balanced/unbalanced etc) is not well developed in children and thus fails to allow for a physical superiority effect.Moreover, as reported in connection with the recognition tasks, recall is more demanding of stored information than is recognition. It is not just a question of recalling a part of what was originally seen and relying on this as being sufficient to identify and communicate the original. Much more has to be recalled for it be unambiguous.

In the time available for inspection, the FS children had been able to inspect the picture quickly and find the superordinate category, identify distinctive features, and covertly name the picture as closely as possible. The PS children, in the same time, might only have had time to identify overall shape and, on this basis, may have named the identified part of the picture as a recognised object, possibly with a particular function.

Inspection of the 'description' responses for all conditions, showed that descriptions of recalled shapes were found when recall was immediate, but rarely after a delay, unless recall was cued. It is possible that for the FS children access to a semantic category and name was almost automatic, and if they could not access a category, the picture was forgotten, especially after a delay. Looking at the frequencies with which

PS and FS were able to name or had to describe the pictures, it was clear that the FS were much more often able to name the pictures. This meant that they could access the correct category at a high level of accuracy. The PS were equally reliant on description as on the correct name and this being so, they were having to try to attend to an Orienting question on the basis perhaps of having identified the shape only, or one of the parts.Thus, when recall was immediate, the Semantic Questions would help with these difficult pictures in suggesting a category.

The PS subjects, for example, used the following descriptions:

First based on shape -

'rounded' - 'tin' (barrel)

'ball' (pumpkin)

'sort of like a 3 at the bottom' (peanut)

The identification of features:

'a bit round, curved things, flat top and bottom' (barrel)

'slanting thing like a flag pole with a flag on the end' (axe)

Finally, there was the search for a category:

'kind of squirrel - furry - a big furry tail' (skunk)

'sort of potato' (peanut)

'horse' (deer)

'thing you use in woodwork' (wrench)

'thing you have knitting wool on' (thread).

The FS children recalled similar types of detail :

First shape:

'long thing with little dots' (flute)

'square shape' (accordion)

Then features:

'round thing with a little sort of tail' (skunk)

Finally the category search:

'music thing' (accordion)

'like a drum stick' (flute)

'looks like a pen or pencil' (cigar)

'insect' (beetle)

'knitting needle' (flute)

The initial implication mentioned in the Introduction was that the viewer would take in the semantic content of a picture, with or without a Semantic Orienting Question. Comparison of the Immediate Recall scores for the FS both here and in the previous experiment, suggest that this was so for them. However, the Semantic Orienting Questions may have directed the PS children too quickly to a category search, before they had time to identify shape or parts. The Physical Orienting Questions were not particularly helpful to either group. It is worth considering here that the Orienting Questions may indeed have proved to be an interference.Instead of just looking at each picture and being able to concentrate on visual analysis, covertly naming or not, what was required was that the child had to listen to the Orienting Question, inspect the picture, generate hypotheses as to the identity of the pictured object , decide if the answer to the Question was 'yes' or 'no' and say so. This dual process of integrating sensory and semantic information is exactly what Pring (1989) predicted would be troublesome for blind children.

This Experiment showed that it was the Semantic Orienting Questions which elicited the higher levels of recall. Thus both PS and FS children were tapping into stored knowledge to produce their responses. Because of that, it seemed possible that accompanying verbal information might also influence picture recall. So, it was interesting to find that providing cues to recall did elicit further recalled pictures. The original information was not entirely lost. Moreover, both types of Questions yielded additional recalled material. Associations had clearly been made between the Questions and the pictured content.

8.4.EXPERIMENT 7c.
THE EFFECT OF ELABORATIVE SENTENCES ON PICTURE RECALL.

8.4.1.INTRODUCTION.

If the PS, in particular, had been shown to be operating principally on a structural level, recalling only outlines or shapes, it would have seemed less probable that verbal information following viewing of the picture would have a favourable impact on recall. As it was, it was decided to investigate this issue further.

Pezdek (1977) showed that relevant information in a different modality could be absorbed into the original trace and suggested that this was achieved by a review of the original visual information. Work on eyewitness accounts showed the same - information or questions after the original event could alter what was recall (Loftus et al, 1978). Was the original obliterated and lost or overlain with other information? Different forms of questioning did lead to different information being retrieved - so it seemed it was not lost. It also seemed that the timing of other information or the fact of telling subjects they were being misled, could lead to new information being incorporated into existing information or not. The trace, therefore, seemed malleable to a certain extent. Others considered that some forgetting was a result of inability to retrieve, and that retroactive inhibition resulted in a loss of retrieval cues. Provision of those cues aided retrieval.

Visual rehearsal could be the elaboration of the trace by use of verbal means - this is similar to work on eyewitness information, for it relates to verbal information added after the visual event, which cannot be verified from the picture. The timing of such verbal information is critical as well as its relevance. One idea is that if the verbal information follows closely on the visual information, the trace will be malleable enough to be influenced - but this influence would presumably only occur if the verbal elaboration were relevant and if connections could be made with the visual trace. The experiment using elaborative sentences following the picture stimuli was designed with this in mind. The relevance or irrelevance of the elaborative sentence would only matter if referential connections were or were not made between visual and verbal information, as in Paivio's model.

The suggestibility of eyewitnesses had already been shown by Loftus et al (1978). Here the intention is rather different. Wiseman, McLeod and Lootsteen (1985) showed that described pictures were remembered better than undescribed ones. Related elaborative sentences aided memory more than did unrelated sentences. Previous experiments tended to leave the rehearsal interval blank. Here it was filled with a descriptive sentence designed to add something to the visual image. The sentence was spoken after the picture had been removed from view and the aim was to see how verbal information contained in the sentence, which was deliberately not verifiable in the picture, extended the content.

In the next Experiment, the effect of relevant and irrelevant elaboration with PS and FS children was investigated. If the PS were operating on the level of structural representations, not yet having categorised the visual information, one question which arose was would verbal elaboration help? If they knew the verbal information was relevant, it might do so, because the verbal information could shape and make sense of what they thought they had seen and provide an additional verbal tag or coding. If the verbal elaboration was irrelevant, it might not help with categorization but could still be helpful as a retrieval cue (see Intraub & Nicklos 1985).

8.4.2. METHOD.

SUBJECTS: as for Experiment 6.

MATERIALS: pictures were selected as described for Experiment 7a.

4 sets of 8 pictures each were selected for the 4 conditions:

1. immediate recall with a relevant following elaborative sentence.

2.delayed recall with a relevant following elaborative sentence.

3.immediate recall with an irrelevant following elaborative sentence.

4.delayed recall with an irrelevant following elaborative sentence.

Each picture had a relevant or irrelevant sentence devised for it. Examples of a relevant elaborative sentence are the following:

Picture of a tiger: 'one of the cat family, it is fierce and also swift and elegant.'

Picture of a bell: 'weddings are lovely occasions - friends and relatives all rejoice.'

Picture of a saw: 'nowadays, a lot of men make their own cupboards and tables of wood.'

Picture of a trumpet: 'army bands and orchestras have this loud and noisy instrument.'

Examples of irrelevant elaborative sentences are the following:

Picture of a harp: 'footballers are very tough and always have to keep very fit.'

Picture of a caterpillar: 'at Easter the weather usually begins to get better and warmer.'

Picture of a peg;'every day except Sunday, letters are delivered to houses in England.'

Picture of a watering-can: 'Jamaica is a very beautiful and large island in the Caribbean Sea.'

Each picture selected came from the Snodgrass and Vanderwart (1980) standardised set and was rated low on familiarity and high on complexity , as set out below.

	Immediate Recall.		Delayed Recall.	
	Relevant	Irrelevant	Relevant	Irrelevant.
Mean Complexity				
Rating	3.2	3.3	3.7	3.3
s.d.	.9	.5	.5	.6
Mean Familiarity				
Rating	2.3	2.4	2.6	2.5
s.d.	.4	.5	.5	.5

DESIGN:

The dependent variable was the number of pictures correctly recalled.

There was 1 between subject variable, **group**, (PS and FS), and there were 2 within subject variables, **sentence type**,(relevant/ irrelevant) and **time interval**, (immediate/delayed).

A chi-squared analysis was used to distinguish the relative frequency of naming correctly or describing pictures. A t test for independent samples was used to compare the performance of PS and FS children on naming or describing pictures.

APPARATUS as for Experiment 7a.

PROCEDURE;

Each subject was instructed individually that he or she would be given a small set of pictures one by one, to be remembered and that each picture should be viewed for 5 seconds.At the end of that time the picture would be covered and a sentence would be spoken. Each subject had a brief practice trial to ensure the procedure was understood. After each picture had been viewed for 5 seconds, it was covered with a piece of coloured paper to control subsequent images, and a sentence was spoken by the Experimenter. Each sentence was the same length and occupied the same time interval - 3 1/2 seconds.

Subjects were not told in advance that recall would be either immediate or delayed.This was because it seemed likely that they would expend less effort in remembering, if they thought recall was to be immediate.

Immediate recall occurred directly after the final elaborative sentence had been spoken, whilst delayed recall occurred after a delay of 10 - 15 minutes. During that time subjects went back to their work. At recall time, each subject was told that recall could be in a variety of ways. If the exact word was not known, then what was recalled could be conveyed by description. The order of recall was counterbalanced across children, so that half did the immediate recall condition first, and half did the delayed recall condition first. This was to prevent any impact of order or practice on the results.

After recall, each subject was asked to name each picture in the 4 sets. These responses were recorded by the Experimenter to enable pictures and each child's idiosyncratic names for the pictures to be aligned.

8.4.3. RESULTS.

Table 39. The means and standard deviations for the correct recall of pictures by PS and FS children in Experiment 7c, whether immediately or after a delay, when a relevant or irrelevant elaborative sentence follows each picture presentation (max 8 per cell).

	Immediate Recall.		Delayed Recall	
	Relevant	Irrelevant	Relevant	Irrelevant
PS means	3.7	2.7	1.9	1.7
s.d.	1.6	1.4	1.2	1.1
FS means	5.0	4.0	2.45	2.6
s.d.	1.6	1.7	1.8	1.8

An ANOVA of Table 39 (see Appendix 21) with 1 between subject factor (Group) and 2 within subject factors (Sentence Type and Time interval), revealed that there were significant group differences ($F_{1,31} = 4.9$, $p < .05$), the PS had lower scores overall. There were also significant differences in the level of recall under each time interval ($F_{1,31} = 48.5$, $p < .01$). Scores after a delay were lower than those when recall was immediate.

Pictures followed by a relevant sentence were significantly better recalled than those followed by an irrelevant one ($F_{1,31} = 5.7$, $p < .05$).

Table 40. The means and standard deviations for the correct names and for the descriptions of the pictures recalled (max 8 per cell) by PS and FS children in Experiment 7c, when picture stimuli are followed by a relevant or irrelevant elaborative sentence.

	RELEVANT		IRRELEVANT	
	Name	Description	Name	Description
PS means	3.5	2.1	1.9	2.5
s.d.	1.7	0.9	1.4	1.4
FS means	6.2	0.9	5.45	1.0
s.d.	2.3	0.9	2.9	1.3

A chi-square analysis of this distribution revealed no significant difference in the distribution of the scores of the PS children.They used descriptions and the names of the pictures equally often. ($x^2 = 2.32$ and $x^2 = 1$, respectively, $p > .05$). However, the FS differed in their response. They used the correct verbal names significantly more frequently ($x^2 = 93.8$, df 1 , $p < .01$, $x^2 = 64.8$, d.f. 1, $p < .01$).

8.4.4. DISCUSSION.

The scores of the PS were significantly lower than those of the FS. This difference between the groups was not apparent in the first experiment (7a) but was in the second (7b). There is therefore reason to believe that the following elaborative sentence may have interrupted effective processing of the pictures by the PS . Indeed some of the PS subjects complained about the verbal interruption, and also noticed when the sentence had no bearing on the pictures they were looking at. The auditory input appeared to disrupt the picture processing for the PS but not the FS. It seemed likely that visual analysis had finished in the latter case but not the former.

A second interesting finding of this Experiment was that a relevant elaborative sentence following the picture stimuli did aid immediate recall for both PS and FS children, but not delayed recall.

It was noticeable in this Experiment that there were far fewer references to shape in the recall responses of both groups, but this was particularly so of the PS. Only one example could be found:- 'another straight thing, looks like a paintbrush.' (asparagus). The following was a combination of shape and features:- 'long pretty thing with 6 legs.' (caterpillar). One example of the identification of parts was: 'sort of house with a big bomb beside it' (barn). There were then several examples of a category search, often by identifying the use of the object:

'One of those things what you play' (harp).

'Thing you put on your finger.' (thimble)

'Thing you hold to fix things together.' (nut)

or by refining the global category:

'farm animal' (pig)

'night animal' (owl)

A combination of shape and category:

'Food thing you eat, like a tree' (mushroom).

The FS responses were similar: -

Shape was only occasionally mentioned

'Finger sharpener, long and sharp' (nail file).

'There was one combination of shape and usage:

'Triangle - you screw in the wall '(nut).

There was an example of parts being used to identify a category member:

'2 horns - type of elephant.' (rhino)

And of a category search on the basis of usage:

'You play it' (harp)

'Music thing.'(harp)

'Thing for your finger' (thimble)

'Clips you hang washing with' (pegs).

'Zoo animal' (rhino).

Few of the FS responses were descriptions. In the case of the PS, pictures followed by a relevant sentence yielded a greater number of correctly named recalled pictures than descriptions. This position was reversed after an irrelevant elaborative sentence. It may have been that the relevant sentence acted as an aide-memoire for the correct name.

8.6.GENERAL SUMMARY.

Humphreys and Riddoch (1987) mentioned several possible ways of investigating visual object recognition, and of separating out the component parts of the process. One of these ways was to study in detail how the process was carried out by viewers with poor vision.

It was notable that the PS achieved their highest recall score in the first experiment. This was when there was no requirement to process verbal information, and there was no directing of attention by the experimenter. Here the PS could recall at a comparable level to the FS, but only because the mode of recall allowed descriptions of the picture as well as the name of the picture. The descriptions were sometimes detailed, but often they were fragments. If there had been a stricter definition of what constituted acceptable recall, namely the correct name for the picture, then the PS would have scored significantly less well than the FS. In the second and third experiments, even when the recall criteria allowed for description, the PS recalled significantly less than the FS. It seems clear that the time needed for semantic categorization of pictures by the PS is substantially greater and that care needs to be taken not to interfere with the process through auditory processing occurring either before or after.

The condition, in which picture stimuli were followed by a relevant elaborative sentence, yielded the highest overall recall scores for the FS, and even irrelevant elaborative sentences produced a high recall score, so the proposition of Wiseman et al, that described pictures are recalled better than undescribed ones, was supported.

However, this did require the integration of verbal and visual information. The PS found this hard to accomplish and though some residual advantage from relevant sentences could be used, overall this integrating took away the semantic processing capacity necessary for picture processing.

Recall involved the use of effective strategies - attention, inspection, identification, storage and retrieval. The PS subjects in these 3 Experiments demonstrated that they had these strategies and were as able to recall pictures. Visual impairment did not necessarily mean impaired picture recall, but speed of processing visual material was an issue, together with being able, or not able, to code the picture stimuli verbally for later retrieval.

CHAPTER 9
PARTIALLY SIGHTED CHILDREN AND PICTURE PROCESSING.

Paivio (1986) stressed the modality specific nature of memory - the memory of a picture was essentially visual and spatial. However, Pathak and Pring (1989) commented 'We not only experience the physical world, we also learn about it.' This store of knowledge is an amalgam of sensory perceptions, verbal knowledge and abstractions, derived from many sources. There are two domains of interest: one concerns the processing of the stimuli presented to the children: the other, the organisation of stored knowledge. Only the first was addressed directly in this thesis, the second indirectly.

Left to themselves, PS children would probably ignore pictures. This was evident from the work described in Chapter 2. However, pictures are a potentially rich source of information and the purpose in this thesis has been to begin to explore under controlled conditions what PS children take in when they look at a picture.

A look at the discourse of PS children during picture presentation shows evidence for Humphreys' and Riddoch's model (1987) involving the three stages in static 2D perception:

- the structural - spatial level - the identification of contour and features,
- the semantic level - stored knowledge,
- and the phonological level - naming the picture.

(see Appendix 22)

For a FS viewer, it is almost impossible not to name a picture if the exposure time is more than a second or so, for a name begins to be generated after about 250 msecs. The referential connections between visual and verbal items are then much used and firmly established. This may not be so for PS children. Firstly, they require time to process the information as it is deciphered, and for them it is not clear how quickly a name begins to be generated, perhaps as soon as the overall global contour is formed. If this global 'first pass' shape is very ill-defined, it may be difficult to make accurate referential connections, and it may indeed be difficult to categorise and store the visual information correctly, except in a gross way. For example, a gross distinction between humans, animals and insects may be possible but many errors may be made in distinguishing between members of those categories, a girl and a woman, a boy and a man. Essential distinguishing features may not have been stored, such as the fact that an ostrich does not fly, or that a donkey differs in appearance from a horse in the refinement of its features.

A model of some of the hypothesised events in the picture identification process showing the sequence of events which might follow inspection of a 2D picture of a hard-backed chair.

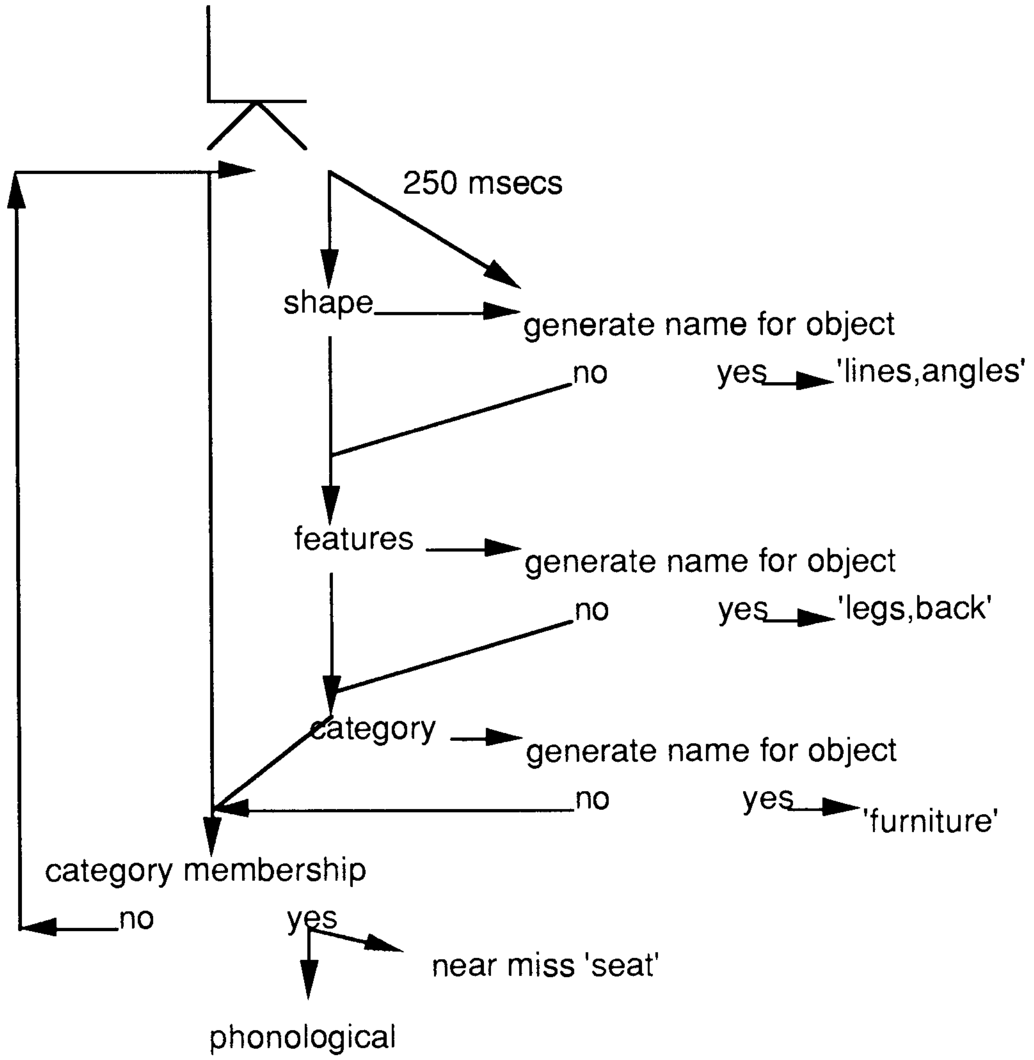

Figure 7

The model reflects how a 2D representation may be matched automatically or instantly to a corresponding internal representation, or how it may be constructed in a slower way in order to achieve identification with an internal representation.

The crucial factors were the identification of critical features and the relationships between them, together with having a sufficiently differentiated store of knowledge, with which to make a match.

Pring (1989) and Pathak and Pring (1989) asked blind children to listen to and compare 3 words ('drum','tin','sock') and draw on their stored semantic knowledge to infer what these might feel like in order to select the word which matched the one tangible picture of a 'drum'. This they could do as well as blindfold sighted children. When errors occurred, it was the item which most resembled the target in shape which was selected. The crucial factor was what the blind children had learned about these named items from any source which would enable them to identify that the raised shape was a 'drum' and not a 'tin'. If they remembered that a 'drum' often had a pattern round the edge, or was a larger, squatter shape, they might have a distinguishing feature to look for. Pathak and Pring also asked blind children to feel 3 tangible representations ('moon', 'banana', 'brush') and then draw on their sensory knowledge of what these might be, to select the correct one to match the given word 'moon'. On this task the blind children were worse than the blindfold sighted and their incorrect responses were the featural distractors, only if the objects were ones they had previously felt directly. If, like 'moon', the objects had not been felt, then the errors were random.What was involved here was the ability to feel three pictures, drawing on their store of internal representations of what they might be, and then distinguish between them in sufficient detail to be able to tell the 'banana' from the 'moon'. The results of this experiment led the authors to conclude that blind children are not accustomed to attending to relevant salient sensory information in pictures, though they clearly do this when reading Braille, nor to cross-referencing sensory and semantic information. The sighted children may well have been covertly verbalising and generating 'guesses' as they felt the pictures, whilst the blind may not have been doing so.

FS children are able to build up their knowledge store by assimilating information from a wide variety of sources - from pictures, conversations, from seeing or experiencing the real object. Everywhere, they are bombarded with rich and varied detail. The PS child has less to draw on - what is available may be harder to come by, less clear, and relationships between similar items less easy to distinguish. Their store of knowledge may be more difficult to interconnect, as between visual and verbal counterparts. Despite this, it was clear that information was being stored and retrieved efficiently. Moreover, cued recall was able to elicit additional information. It was a matter for regret that cued recall had not been employed in the recall task using elaborative sentences. It was clear that when spontaneous recall and cued recall was totalled in the task using orienting questions, the level of recall in that task rose considerably. More was stored than had initially been retrieved.

What was lost or forgotten was the retrieval cue- when that was provided again, more pictures were recalled. The orienting question had become part of the to-be-remembered material - indeed some of the children recalled parts of the question spontaneously, rather than the pictures. However, the provision of orienting questions allowed no possibility for rehearsal. The last of the three studies tried to explore this area. Instead of leaving blank time for rehearsal though, the time was directed.

The provision of a relevant or irrelevant elaborative sentence following the pictures was thought to encourage the subject to turn back and reconsider the picture in the light of the sentence - the visual information would be recycled in the light of what had been said - and perhaps slightly amended or tagged as a result.

Some of the PS children complained about the words following so quickly after the picture, especially when the words were irrelevant. Were they short of processing time, was the picture hard to recapture - or did the mismatch between words and pictures bother them? This is an area which deserves further study, for if pictures and text do not complement each other, one or other will be ignored by PS children. On the other hand, if they do complement each other, there are good gains to be made.

Appreciation of detail and the whole are both necessary for visual object recognition, transmitted by the two visual systems, the sustained and the transient. Damage to one or the other can impair recognition of either overall shape or the detail. In the case of the PS, it is the detail which is often missing. Humphreys and Riddoch (1987) described how a man with cortical lesions focused on parts - on features, without being able to grasp the visual whole. This affected his ability to copy drawings. He copied detail slavishly without knowing how each detail contributed to the whole. Cutting out some of the distracting detail by using silhouettes helped him recognise 'new' from 'old' by use of the overall contour.

The PS children, also, spent all the available time inspecting the pictures closely - probably spending too much time on sensory analysis. Pring reported that blind children did this, too, and if a feature was located and identified mistakenly in isolation, they could be difficult to release from this mistaken recognition or part focus. So, if they explored a raised line drawing of a watch, for example, they might concentrate solely on the overall shape, and think it represented a model of a road with a roundabout. Because of this, they might fail to identify the buckle at the end of the watch strap, or the winder on the side of the watch face. The PS do something similar. The picture of a candle was interpreted by one or two, by the shape, to be a 'milk bottle', but then the pointed shape on the top had to be accounted for. Instead of thinking it might not be a 'milk bottle', they simply commented on the oddly shaped top.

As with the blind (Pring, 1992), the PS suffer from a lack of visual experience and may have reduced semantic sophistication, at least developmentally. Baddeley (1990) gave two examples of individual adults who had a difficulty in tapping stored or semantic knowledge. One could tap the semantic store but could not put a name to what he identified. He had a word-finding difficulty. The other seemed to have a poorly differentiated store of knowledge, for he would be misled into misnaming a picture of a 'tiger' as a 'lion'. He was clearly in the correct part of his memory store, but the contents were not well differentiated.

In the case of PS children, it was not that they had lost a capacity which they once had. They were still in the process of creating, building up and cataloguing, their semantic store. Indeed, in these experiments, it was clear that they had made an effort to construct structural representations of what they saw. However, it seemed probable that their internal representations, built on vision, would be lacking in sharp detail. They might consist of no more than an overall shape. If this was the case, then they were likely to misname the picture of a 'tiger' as a 'lion', but for a different reason from the man with cortical lesions.

One implication of the ideas about the building up of stored knowledge is that in the case of blind children in particular, and also of PS children, there needs to be careful organization and structuring both of sensory perceptions and of information of other kinds which form stored knowledge. Pring and Rusted (1985) were able to demonstrate how the availability of tactile pictures to accompany text could aid blind children to recall verbal details about animals - details such as 'curly horns' or 'spiny backs'. In their study, there was a difference between adventitiously and congenitally blind children as to how much they were aided by the pictures. It was the adventitiously blind children who were helped the most. These were children who had had sight for some of their early life.The congenitally blind were also aided by pictures, but under some circumstances the recall of pictorial facts was at the expense of their recall of non-pictorial fact. The comparison between the PS and the adventitiously or congenitally blind children is an interesting one.

There is no reason why PS children should be any worse than anyone else at building up internal representations - if they are given pictures and detailed descriptions of the content. Stored knowledge of what objects could do, what they were made of, what their uses and functions were, all this formed the semantic base, derived from many sources of information. This is why language development is emphasised for young PS children, but if stored knowledge was largely derived from verbal sources rather than from direct sensory experience, there might be difficulty initially in matching what was stored with sensory perception or vice versa. What is not helpful is a detailed verbal description in a vacuum. If this occurs and a description, for example, of a mountain is provided without any context or sensory experience of a mountain, that stored verbal information is likely to exist encapsulated without referential connections. The PS listener to the description may then generate an idiosyncratic internal representation of the object. The PS have the visual capacity to recognise pictures though it is not easy for them. The Pilot Study of Visual Recognition (7.3) has suggested that a visual recognition task would be within the grasp of PS children, for their internal representations were sound enough to match pictures. However, when a greater amount of content had to be tapped in the recall studies, in order to retrieve the required information, they would be in greater difficulty. It seemed that the PS were at an advantage over the blind in that if they were left to use all their processing resources then pictures could be fairly well appreciated, but for the blind that was more problematic.

The PS children in these studies demonstrated a capacity to operate on all three processing levels- structural, semantic and phonological, though not always consistently. By the same age, the FS children seemed more able to operate on all these three levels almost automatically, as adults can. Because this process of looking at a picture, categorising and naming it, is so fast, it is usually impossible to detect the separate processes involved. It was possible to see them here because difficult pictures had been selected for the task, and because in the case of the PS children, the processes had not become fully automatised and inseparable. It was clear that PS children, like FS ones, were able to reach this automatised stage of picture recognition. They could make the necessary referential connections and tap stored knowledge, though they might need more practice at the task in order to be able to carry out the processes to speed.

A final word could be said about the familiarity and complexity of the picture material. As far as the PS were concerned, these dimensions did not greatly influence recognition, but they did influence recall. If a strict criterion for recall had been adhered to, the correct name for the picture, for example, the PS would have scored much lower than the FS. As it was, it was possible to demonstrate that the PS could recall as many pictures as the FS, though they could not necessarily name the pictures correctly. The amount in the picture to be inspected, or the category search had taken too long in the case of those difficult pictures, and a name for the object had often not been achieved in the time available. Nonetheless, enough had been recalled to convey a memory of the picture.

CHAPTER 10.

IMPLICATIONS.

The Experiments described in this thesis have shown that, when processing words, the PS children are not at a great disadvantage when compared to the FS children, except with regard to speed. They do not get misled into using a phonological strategy all the time to the decrement of other strategies essential for good reading. Instead these Experiments have shown that their reliance on a phonetic educational teaching device has allowed them to lay down well specified visual codes. This means that in all the studies, the performance of the PS children was rather similar to that of the FS children. They showed phonological mediation but to no greater extent than the FS children. The PS children were equally affected by disruptions to the direct (visual) route showing that this was in operation, too. This lexical processing was also revealed in their writing.

It seemed that the PS children benefit.ed to a great extent from their largely phonological learning style and this is in line with some current psychological ideas that phonology is the key to successful reading (Bryant & Bradley, 1985). Indeed, the evidence here from the PS children addresses this issue in quite a profound way and provides really good support for it. But it cannot be the only key, as is also shown by the children's adoption of lexical strategies.

These PS children used effective strategies, with more limited resources than the FS children. They and their teachers must be praised for their success. Early learning problems experienced at the very beginning of literacy tuition clearly were of little serious importance in the long term.

Addressed (direct) and assembled (indirect) codes then were available to the young PS child learning to read. Could the same be said for picture processing? The answer here was less certain. The studies of picture processing provide a useful framework from which more research is necessary. The thesis set out here argued that PS children, like the blind with tangible graphics, (Pring, 1992) can and should be given the chance to deal effectively with pictures. They, perhaps more than the sighted, can use such information in a crucial way to learn about and understand the world. Here, it was shown that visual memory was relatively good. Even when viewing time was not extensive, the capability shown was remarkable. However, picture recall and even recognition, in so far as it was examined here, in contrast to reading, seemed to be cognitive tasks which the PS pursued emphasising different strategies from the FS. For them the process was more laborious and the cascade mechanism of visual processing used by FS children was to some extent broken because of the time delays and lack of visual experience on the part of the PS. For them, it was argued, each stage in picture processing, was far more distinct, and while for the FS an automatic activation procedure may underlie the process, for the PS a more deliberate strategy of linking shape to semantics seemed to be relied on. The child seemed to 'check out' various guesses derived from the 'fuzzy' structural analysis.

The Studies in this thesis describe work carried out with the same small group of PS children on a week by week basis throughout a consistent two year period. By this means, it was possible to gain a detailed and coherent picture of what it meant to them to be partially sighted. They were in a special school specifically designed architecturally and educationally to meet their needs. This was one of the rare schools in the UK at the time specifically for partially sighted children. Only occasionally were blind pupils present. The school was able to specialise to this extent because of the large urban and suburban area it served. The curriculum was one which ran parallel to a mainstream curriculum, but with additional features built in, such as mobility training or keyboard skills, and there was a strong tradition for the older pupils to work towards public examinations. Tried and tested teaching practices were used which were known from experience to lead to educational success. In this sense, the PS children in this sample could be said to have an optimal educational environment. It was one they shared over the period of the studies for this thesis.

The group of PS children formed one class at the beginning of the work. Because of their widely disparate ages, they did, of course, later disperse into different classes. The PS sample was, therefore, not drawn together by random sampling, but the children were, nonetheless, a typical PS group. Inspection of the degree and type of partial sight described in Appendix 5 reveals the usual spread of ophthalmological conditions underlying partial sight with both central and field loss, clear and cloudy media. In most cases, the identification of low vision had been very early in life. There was also a spread of ability within the group, but overall the children were of average IQ. They shared the same teaching for a while, and the same educational environment for many years. In this sense, they can be taken as representative of PS children being educated in a special school for partially sighted children. For this reason, there are grounds for suggesting that the findings of this thesis can be used to comment on both theory and practice in relation to similar groups of PS children.

The initial research question asked which strategies the PS children were using in order to be able to read as effectively as matched FS children by the age of 8 years (Lansdown, 1973). Were the PS children nonlexical readers? The results indicated that a compensatory nonlexical strategy was being taught, but this was not found to be the sole nor predominant strategy employed by the PS children. They were using lexical processing, as well. In the case of word processing, tuition in school included considerable repetition and practice. It remained possible that visual impairment had an adverse impact on visual retention. To explore this second research question, picture processing was used as an appropriate medium. Visual recognition by PS children was found to be as good as that achieved by matched FS children. However, in the case of recalling pictures, where more of the original has to be identified, stored appropriately and then retrieved, the PS children were in greater difficulty. It seemed that their internal representations of objects were probably lacking in distinctive detail. There was evidence of spontaneous dual coding of pictures by some PS children but here difficulties were apparent, associated with their naming capability.

Memorising is a function of links between external and internal factors. If the internal store of knowledge is not sufficiently differentiated, subsequent storage and retrieval, as well as potential linkages, will be affected. This store of knowledge is built up on information from many sources, pictures amongst them. The complexity and the familiarity of the pictures was found to affect the ability of the PS children to name them and this is a factor to consider further. The models of Ellis (1984) and of Ehri (1978) served as a useful framework in which to consider the word processing strategies of PS children, and revealed in this context how very similar the PS children's strategies were to those used by FS children. Paivio (1986) provided a model within which to begin to explore picture processing at the level of representational connections. It was at the level where referential connections were needed that further investigation is required.

PS children can be successful. They can and would be even more successful if the pictures in their books were drawn and titled clearly and if individual features from the text were emphasised (see Pring & Rusted, 1985). If it is true that internal representations may be 'fuzzy' or lacking in distinctive detail, care should be taken to identify what are the salient details which need to be registered. These might be included in recommended book illustrations.

If PS children had practice in understanding pictures, they would gain by deriving more detailed structural codes and in turn more connections between structural, object descriptions and semantic associations. In this way their visual as well as their mental sophistication would be developed. Processing pictures would not then be neglected as an unnecessary part of the reading process, nor be reduced to mechanistic object recognition. It should become a doorway to a rich and exciting store of information beyond immediate experience.

So for PS children, the assembled process in picture recognition is far more explicit than it is for FS children The explicit nature may make it really quite a different processing strategy from that adopted by the FS. The addressed system is still limited and it is for future research to indicate whether or not experience from an early age with well drawn line drawings could increase the effectiveness of picture processing by PS children.

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APPENDIX 1. DEFINITIONS OF PARTIAL SIGHT.

This is a generic term used to cover a broad spectrum of impaired sight. For 'registration' as partially sighted, which is optional but enables provision of certain welfare services, three main categories are recognised:

1.People with an acuity of between 3/60 and 6/60 with full field.

2.Those with acuity up to 6/24 with moderate contraction of field, or certain other defined pathological conditions.

3.Those with acuity 6/18 or better,but where visual field is greatly affected.

The fractions refer to the Snellen Chart for testing distance vision.The chart displays rows of letters of various sizes. 6/6 vision means that the person sees at 6 metres what an average person sees at 6 metres. 6/24 vision means that the person sees at 6 metres what the normally sighted person sees at 24 metres.Occasionally, the viewer can only read the biggest letter at 3 metres, closer than the usual 6 metre distance. Then the acuity measure is 3/60.

A partially sighted person is defined as one who is 'substantially or permanently handicapped by defective vision caused by congenital defect or illness or injury', but not 'so blind as to be unable to perform any work for which eyesight is essential.'Visual acuity of between 6/60 and 6/18 with good or contracted fields can constitute partial sight.

The educational definition of partial sight refers to 'pupils who by reason of defective vision cannot follow the ordinary curriculum without detriment to their sight or to their educational development but can be educated by special methods involving the use of sight. Look and Think Chapman,Tobin,Tooze and Moss (1989)

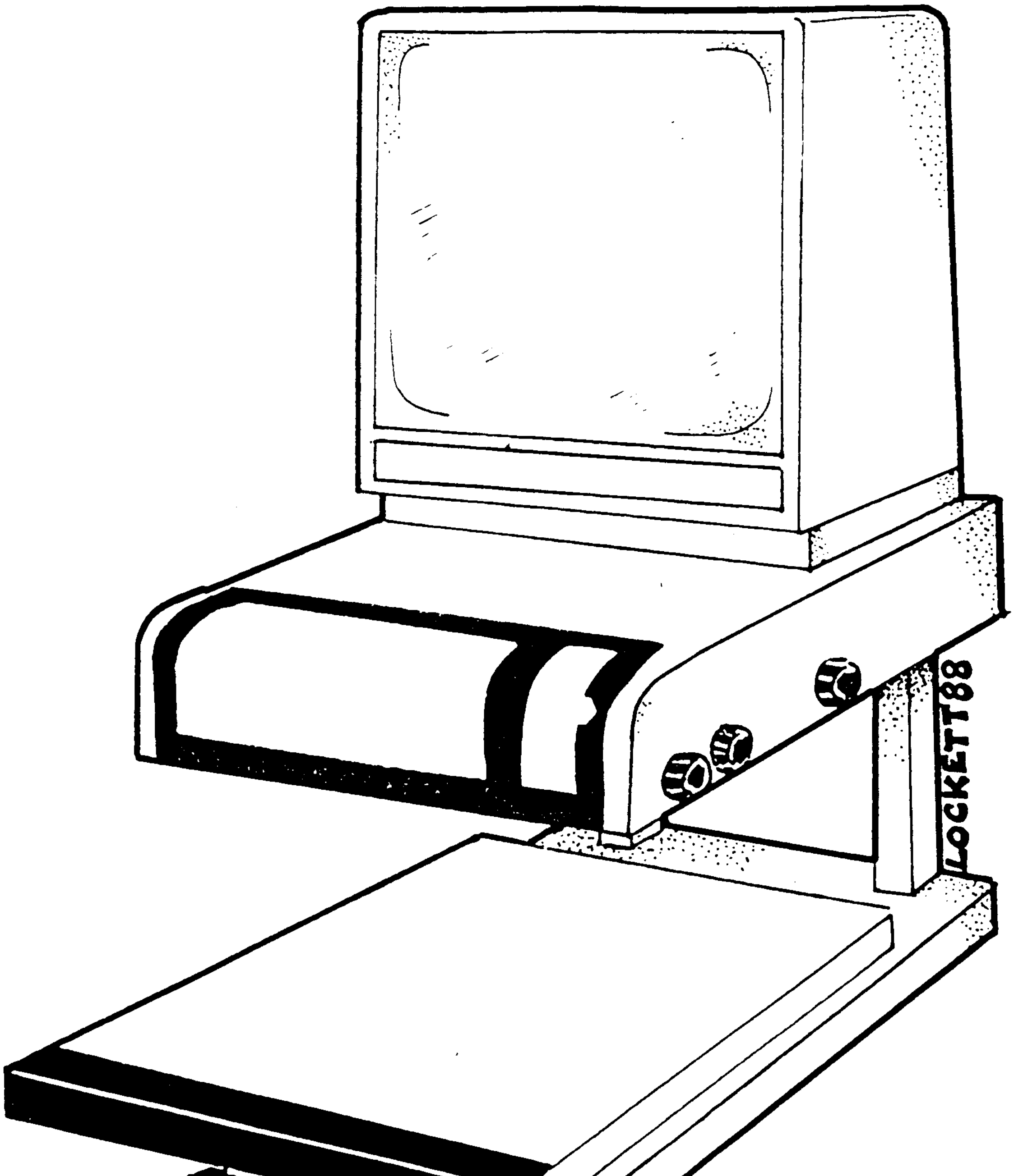
Information derived from:

The Handicapped Pupils and Special Schools Regulations 1945 (amended 1959) London HMSO

Document of the Department of Health, PSS, relating to forms BD8 and SSDA 902 concerning registration as blind or partially sighted. In - house Publication.

APPENDIX 2.

CLOSED CIRCUIT TELEVISION.(CCTV) VISUALTEK.



APPENDIX 3.

SOME COMPONENTS OF PHONIC READING TUITION.

1.During the course of Study 1, 94 separate instructions were given relating to the sounds of letters.

58 of these were direct instructions to sound a word out.

16 of them were instructions to break the word up or put it together again.

17 sets of instructions, out of the 94, concerned specific letters; silent 'w', two 'ee's', final 'e', the sounds of 'o' and 'u', of '-ing', of 'oi', of 'ea'.

General instructions or comments were made too:

'They rhyme, don't they.'

'If you know them, don't sound them out.'

'Now, you can't sound that one out.'

2.108 separate instructions were given to look:

29 of these stressed the need to look at the word.

54 of these stressed the need to look at the letter or letters.

23 of the 108 stressed the need to look at letters in a specific position.

2 required the child to look at the pictures.

3.There were 20 sets of instructions concerned with spelling.

15 of these gave straight instructions to spell the word.

5 of them pointed out such features as capital letters, or the crossing off of 'e' before '-ing'.

4.There were 20 occasions when attention was drawn to whether the word had been read before or not.

10 of these direct attention to the fact that the word was the same as one just read.

8 of them stated that a word had been read previously.

2 pointed out that a word was new.

MISCELLANEOUS INSTRUCTIONS-

(one example only of each.)

'Listen.'

'Remember.'

'Think.'

'Don't hesitate.'

'You musn't guess.'

'You musn't forget.'

'Learn them.'

'Write it down.'

'You have to do it yourself.'

'Read to the end, then you'll understand.'

'Sound it out, if you don't know it.'

'Don't put your own words in.'

'Pay attention.'

'Why are you leaving a word out.?'

Tuition was given concerning punctuation and to a lesser extent, in this context, about grammatical features:

There were 52 occasions when punctuation was taught -

question marks and altered intonation, full stops, inverted commas, comma, exclamation mark, semi-colon, apostrophe, the need to read the story title.

There were 5 occasions when the past tense was mentioned, or the 's' which forms the plural.

It is notable that 5.4% of the total word substitutions contained an apostrophe. It seems possible that PS children did not see it. An exclamation mark was occasionally seen as the letter 'I'.

THE NATURE OF THE TUITION PROVIDED.

The first noticeable impact of this visuoperceptual shape matching delay lay in the choice of the reading tuition method.

Because of the age range of the PS subjects, from 5 1/2- 8 1/2 years at the time of Study 1, and the variation in their reading ability (see Appendix 6 for positions of subjects on the Reading Scheme), it was possible to sample this tuition from the letter learning stage up to a reading level over nine years, when good fluency had been achieved.

From this sample of the reading tuition covering the age range 5 - 8 years, it was clear that tuition was entirely phonic in approach. There was no 'look and say' nor whole word recognition stage of instruction.

An outline of the instruction method is provided later in Appendix 3. It was possible to identify separately, child initiated strategies and teacher initiated strategies.These were carried out either independently or in interaction.

With the younger or less fluent readers, there was a higher level of teacher initiated strategies. As the child became more competent at taking over these strategies, the input from the teacher decreased. More and more, it was the child who initiated the problem solving response and the teacher then provided help, if the child required it.

Even the youngest readers demonstrated independent use of sounding out and self-correction strategies in the face of new or unfamiliar words: one child also used spelling out the word.

There was little evidence of nonresponse in this setting.

TEACHER AND CHILD STRATEGIES.

These four analyses were carried out to elaborate the details of phonic teaching.

INDEPENDENT CHILD STRATEGIES.

SUBJECTS.	WORDS OF TEXT READ	SOUND OUT	SELF CORRECT	SPELL OUT	% IND. CH. STR.
1.High reading level	4342	0.9%	0.27%		1.17%
2.	2487	1.0%	0.5%		1.5%
3	4891	1.3%	1.2%		2.5%
4.	5252	1.9%	0.65%		2.6%
5.	293	3.8%	0.3%		4.1%
6.	2271	1.8%	0.35%		2.1%
7.	1068	3.5%	0.5%		4.0%
8.	1089	3.0%	2.0%	0.5%	5.5%
9. Low reading level.	350	6.6%	0.1%		6.9%
10.	nil				

CHILD INITIATED INTERVENTION SUCCESSFULLY COMPLETED WITH AN INTERVENTION FROM THE TEACHER.

EXEMPLAR.

CHILD SOUNDS OUT	TEACHER AMPLIFIES THIS	TEACHER PROVIDES WORD	CHILD REPEATS
cl- cl-	cl-imb	climb	climb
f-	fin-ish	-	finish
sh- s-	s.h.a.p.e.d.	-	shaped

404 words were recognized after a strategy initiated by the child.This represents 1.7% of the total words read.

TEACHER INITIATED STRATEGY REQUIRING A RESPONSE BY THE CHILD.

EXEMPLAR.

TEACHER SPELLS WORD	TEACHER SOUNDS OUT.	TEACHER PROVIDES WORD.	CHILD REPEATS	CHILD. WORKS IT OUT.
1.D.a.n.n.y.	-	Danny	Danny	
2.	-ack			
	-ackle			
	-rackle			
	crackle		crackle	
3. u.n.	un-			
u.n.c.h.	unch-			
	runch			
	c-			crunch

587 words representing 2.7% of the total words read were recognised with this teacher initiated help.

A further type of teacher initiated strategy requiring a response from the child,was the word cue.There were 331 examples of word cueing, representing 1.5% of the total words read.

The first type of word cue was to take the child back to the last correctly read word in the text, repeat it with a query.The child would then try to read the next word correctly. The second type of word cue was to say 'no' to the incorrect word and the child would then try to read the word differently and correctly.

INDEPENDENT TEACHER STRATEGY REQUIRING NO RESPONSE FROM THE CHILD.

Here the teacher provided the word for the child, often to keep the fluency of the child's reading intact.

198 words were provided by the teacher for the readers and this represents 0.89% of the total number of words read.

APPENDIX 4

SAMPLE OF PARTIALLY SIGHTED CHILDREN.FOR STUDY 1.

Subject.	Gender.	Age.	B.A.S.IQ.	Reading Age. Salford Sentence Reading Scale A
1.	girl	5y 8m	108	6y 9m
2.	boy	5y 11m	106	below 6 years
3.	girl	5y 11m	109	no score
4.	girl	6y 8m	97	6y 1m
5.	boy	7y 5m	117 - 8	8y 3m
6.	boy	7y 7m	78	no score
7.	boy	8y	111	7y 9m
8.	girl	8y	104	8y 2m
9.	girl	8y 1m	80	5y *
10.	boy	8y 7m	117	9y 3m

* British Ability Scales Word Reading Age.

Mean age 7y 1 1/2 m	Mean IQ 105	Mean Reading Age 7y 1m
s.d. 1y 1m	s.d. 11 points	s.d. 1y 6m

*Subject 6 was omitted from these means for purposes of Study 1

Partially sighted children were not included in the standardisation of The British Ability Scales, so caution must be taken in the interpretation of an individual's scores. Each PS child in the Studies for this thesis attempted 6 - 7 different subtests. They tested the following areas: Reasoning (Matrices, Similarities), Spatial Imagery (Block Design, Level and Power), Short Term Memory (Recall of Designs, Recall of Digits, Visual Recognition), Retrieval and Application of Knowledge (Word Definitions). Where a subtest score fell below the 1st Centile, it was omitted from the IQ calculation.

APPENDIX 5.

THE VISUAL STATUS OF THE PARTIALLY SIGHTED CHILDREN.

GENDER	DIAGNOSIS	ACUITY	PRINT SIZE	MEDIA	FIELD
G.	Retinitis Pigmentosa	6/24	N 18	clear	field loss
G	Retinal Aplasia	2/60	N 12		central loss
B.	Colobomata &				
	microphthalmos	6/18 & 6/36	N 12	clear	intact
G	Cataract	6/60 & 1/60	N 8	cloudy	intact
G	Retinoblastoma	6/24	N 48	clear	intact
	R eye only remaining.				
B.	Retinal Aplasia	1/60 & 6/60	N 24		central loss.
B.	High Myopia	6/18	N 18	clear	intact
B.	Retinitis Pigmentosa	6/24	N 12	clear	field loss
G.	Albinism	6/36 & 6/18	N 14	clear	intact.
G.	Cortical loss.	6/36	N 18	clear	intact
B.	Cataract	4/60 & 4/36	N 18	cloudy	intact.

APPENDIX 6.

GINN 360 READING SCHEME.

Subjects in order of Reading Ability.

Subject.	Reading Scheme Level.
1. (High reading level)	Level 8.
2.	Levels 5 - 8.
3.	Level 8
4.	Levels 6 - 8
5.	Gayway Reader 2nd Red Book Level 4.
6.	Fuzz Buzz Story Chest Stage 1.
7.	Levels 3 - 4
8.	Levels 2- 4.
9.	Levels 1- 3
10. (Low reading level)	Ladybird Alphabet Book
11.	Letter learning.

APPENDIX 7

TWO EXAMPLES OF THE TAPE TRANSCRIPTS OF THE CHILD - TEACHER READING INTERACTIONS WHICH FORM THE CORE OF STUDY 1 .

THERE WERE 308 TRANSCRIPTS. THE FIRST OF THE FOLLOWING TRANSCRIPTS IS OF THE INTERACTION BETWEEN THE TEACHER AND AN OLDER MORE FLUENT READER. THE SECOND IS AN INTERACTION BETWEEN A YOUNGER BEGINNER READER.

TEACHER	CHILD.
	There was Miss Tickle with a
	basket.
h.e.a.p.	
h- eaped	
	heaped
-ped	
	high with food
l-ead -ing	
	leading the /k/r/ (crowd)
yes, sound it, yes, go on, say it.	
don't hesitate - /k/r/owd	
yes	crowd, crowd
	Ma. Snelson
	was not far behind, carrying a
	/k/w/ /k/w/ (quilt)
quilt quilt	
yes, mm	quilt and huffing and puffing
	The school master was leading a
break the word	whole line of /s/t/r/ (strong)
-ong, r-ong, s-trong	
	strong boys and girls carrying
	/b/----/d/ (boards)
boards	boards and /n/ (nails)
a.i.l.s. is ails, n-ails is	
	nails and /r/ /r/ (roofing)
yes.	- in roofing
roof -ing roofing	-ing, roofing. /b/ /b/ -in (behind)
b.e.h.i.n.d. You've read this word	

	TEACHER.	CHILD.	
29.	What is b.e.	Be-	29.
30.	h.i.n.d.		30.
31.		Behind them	31.
32.		/k/ come (came)	32.
33.	Is it come ? Is it o. or a.?		33.
34.		a.	34.
35.	So what does it make?		35.
36.	c.a.m.e.		36.
37.		c-ame came every father and	37.
		mother from the village.	38.
39.		Miss Tickle sat (set)	39.
40.	Is it sat?		40.
41.	mm.	/s/ /s/ set the basket down in	41.
42.		front of Benjamin, and Grandma	42.
43.		Snelson /s/ stop stopping (stopped)	43.
44.	Where is stopping?		44.
45.		stop stop	45.
46.	s.t.o.p.p.e.d. There is no -ing		46.
47.		stopped	47.
48.	yes,stopped		48.
49.		puffing long /l/	49.
50.	e.n.o.u.g.h. enough		50.
51.		enough to ra- (wrap)	51.
52.	Now here, the w. - you don't sound		52.
53.	the w. wr- ap	wrap	53.
54.	so w.r.a.p. is wrap		54.
55.		wrap the /k/	55.

TEACHER	CHILD	
56. Yes,what's this word?		56.
57.q.u.i.l.t. quilt		57.
58.	quilt around him /s/h/ (his)(shoulders)	58.
59.What is this ? (demonstration)		59.
60.	shoulders shoulders. The boys and	60.
61.	girls set - set down their	61.
62. boards		62.
63.	boards and nails and /r/ ruffing	63.
	(roofing)	
64. Is it ruff? Look at the word,		64.
65.Spell it please.		65.
66.	roof	66.
67. yes, roof		67.
68.	- ing. Five girls and five boys	68.
69.	came for- ward and handed	69.
70.	Benjamin the	70.
71. shiny		71.
72.	shiny /p/ /s/ /p/ (pennies)	72.
73. What is it? p.e.n.n.i.e.s.		73.
74. pennies		74.
75.	pennies they had found at the	75.
76.	bot-tom of the path and then right	76.
77.	before Benjamin's eyes the	77.
78.	fathers and mothers began to	78.
79.	put up a new house. Benjamin	79.
80.	couldn't find a word to sat (say) He	80.
81.To?		81.
82.	to say he wipped (wiped)	82.

	TEACHER	CHILD	
83.	wiped		83.
84.		wiped two /t/ /t/ tears from	84.
85.		his	85.
86.	You don't say the w. wrinkled		86.
87.		wrinkled face and pa-tted	87.
88.	patted, that's right		88.
89.	the		89.
90.		the black cat.Then he smelled(smiled)	90.
91.	smiled		91.
92.		smiled - smiled and smiled and	92.
93.		smiled	93.

TEACHER	CHILD
	Tom said /l/ look at the (this)
no, no	
	this
that's right	
	goat. He wants
What's that ? No, try and remember	
it. Some	
	Some / / (something)
together: thing	thing.
that's right - something	
	/h/ /h/ /h/ hello
that's right.	
	/l/
sound it out, please.	
together; /l/i/ttle	/l/i/ttle little
good.	
	goat, said Ted
good	
What	
	What
What does that say? Sound it out.	
	/d/o/ (do)
No,we don't say /d/o/. What do you	
want? We say - What /d/u:/	
	do
right, so that says 'do'	
	you want?
up here	

TEACHER	CHILD
	/k/ can (can't)
No,its not can because it got a /t/ at	
the end.	
	can't
that's right	
	you
s-ee	
together: see	see?

'Off, you go !'

APPENDIX 8.

THE WEBER GRAPHIC SIMILARITY INDEX.

In an attempt to describe the degree to which substitution errors approximated correct responses in terms of letters, an index of graphic similarity was devised. The word printed in the text was compared to the response word with regard to the number of letters the words shared, the position of shared letters, the position of shared letters relative to each other, the average length of the words, and the difference in length between the written word and the response word. Similarity in letter shape was not taken into account, so that the confusability of letters like o, e and c, and the differences between upper and lower case were ignored. it should be noted that these features have no obvious phonological correlates.

The graphic similarity of each printed word and each response word was computed according to the following formula.

$$GS = 10\,\frac{(50F + 30V + 10C)}{A} + 5T + 27B + 18E$$

F = the number of pairs of adjacent letters in the same order shared by P and R:

P HOUSE / R HORSE F = 2

P EVERY / R VERY F = 3

V = the number of pairs of adjacent letters in reverse order shared by P and R:

P WAS / R SAW V = 2

C = the number of single letters shared by P and R:

P SPOT / R PUFF C = 1

P FAMILY / R FUNNY C = 2

A = average number of letters in P and R:

P EVERY / R VERY A = 4.5

T = ratio of number of letters in the shorter word to the number in the longer:

P EVERY / R VERY T = 4/5

B = 1 if the first letter in the response is the same as the first letter in the printed word: otherwise B = 0.

P FAMILY / R FUNNY

E = 1 if the last letter in the response is the same as the last letter in the printed word: otherwise E = 0

Weber , R-M, (1970) Reading Research Quarterly. Vol.13. pp 427 - 451.

NOTES;

Many of the word reading errors of the PS subjects involved words containing apostrophes.The Weber Index does not indicate how these should be calculated,so throughout this study the following method was adopted:

-an apostrophe counted as a letter,for example-

-if it were present in both substitution and target.

-in counting the number of letters in a word,it counted as 1.

Examples:

well 10 (100 + 40) + 4 + 27 +18 GSI 801

we'll 4.5

F = 2 i.e. 2 pairs of adjacent letters = 100

C = 4 i.e. 4 single letters in common = 40

A = 4.5.i.e. one word was 4 letters long,the other 5,so the average length was 4.5

won't 10 (30)+ 4 + 27 + 18 GSI 557

want 4.5

C = 3 i.e. three single letters in common.

A = 4.5 i.e. one word is four letters long, the other 5, so the average length is 4.5

In both these examples T, or the ratio of letters in the shorter word to the number in the longer one, was 4.5. 5T = 4

In both pairs, the first letters are the same:B =1 x 27 B = 27

In both pairs, the last letters are the same: E =1 x 18 E = 18.

In the case of two unusual proper nouns, a word substitute was recorded only once, even though a name might be mispronounced on many occasions.

APPENDIX 9.

STUDY 2.

PILOT STUDY 2. PHONOLOGICAL AWARENESS.

Before carrying out this series of experimental tasks with PS subjects , a set of phonological awareness tasks based on those of Stanovich,Cunningham and Cramer (1984) was prepared and used with them.

Use of a phonological, nonlexical strategy depends on the ability to detect and analyse discrete sounds in words.Without this awareness of phonemes, any reader will have difficulty in using nonlexical processing effectively. It seemed important, therefore, to test the subjects' ability to analyse sounds explicitly.

TASKS.

The ten tasks are as follows:

1.Strip initial consonant.	[mice-ice]
2.Supply initial consonant.	[in-pin.]
3.Substitute initial consonant	[hang- bang.]
4.Initial consonant same	[tent- car,plan,tap.]
5.Initial consonant different	[bag,nine,beach,bike.]
6. Initial consonant not same	[mud-mice,dig,mouth.]
7. Final consonant same	[house - boy,road,miss.]
8. Final consonant different	[sit,boy,pit,hot.]
9. Rhyme choice	[star-man,dog,jar.]
10.Rhyme supply	[hill-pill.]

COMMENT.

These tasks were originally designed for and used with a sample of FS children whose mean age was 6 years 2 months, (s.d 4.4 months.) The three rhyming tasks were performed at ceiling.The remaining seven were predictive of first grade reading ability, the more skilled readers performing at near ceiling, the less skilled gaining barely half the items correct.

In the case of the PS subjects of Study 2, the words for these tasks were drawn from their own reading store.

The mean age of the PS subjects (n =11) at the time of testing was 7 years 5 months (s.d. 1 year 1 month) with an age range from 5 years 11 months to 8 years 11 months.

The mean score for each PS subject in the group was 69 out of a maximum of 100, (s.d.25.) 3 subjects scored at or near ceiling level on all 10 tests. No subject was unable to achieve at all.

The scores on the phonological awareness tests correlated positively with test results on a standardised spelling test administered at the same time.($r = .93$ $p < .01$).

The level of phonological awareness amongst the subjects as a group was considered satisfactory to proceed with the lexical decision tasks.

APPENDIX 10. STUDY 2.

SAMPLE OF PS AND FS SUBJECTS FOR THE LEXICAL DECISION TASKS.

PARTIALLY SIGHTED SUBJECTS.

SUBJECTS.	GENDER.	AGE.	READING AGE.	ABILITY.
1.	G.	7y	6y 7m	IQ 107
2.	G.	7y 2m	7y 11m	IQ 108
3.	B.	7y 4m	6y 10m	IQ 106
4.	G.	7y 4m	7y 2m	IQ 109
5.	G.	8y 0m	9y	IQ 97
6.	B.	8y 11m	9y 8m	IQ 117-8
7.	B.	9y 1m	5y	IQ 78
8.	B.	9y 4m	9y 1m	IQ 111
9.	G.	9y 6m	8y 7m	IQ 104
10.	G.	9y 6m	6y 6m	IQ 80
11.	B.	10 y	9y 10 m	IQ 117

PS mean age 8y 6m (s.d. 1y 1m) PS mean reading age 7y 10 m (s.d. 1y 6m, range 4y 10m) mean IQ 103 (s.d. 13)).

FULLY SIGHTED SUBJECTS

12.	G.	6y 11m	6y 6m	well below
13.	G.	7y	7y 2m	average
14.	B.	7y 4m	6y 5m	well below
15.	G.	7y 10 m	7y 11m	slightly below to average
16.	G.	8y 8m	9y	average
17.	B.	8y 7m	9y 10m	well above
18.	B.	8y 11m	6y 10 m	well below
19.	B.	9y 1m	9y	slightly above average
20.	G.	9y 3m	8y 9m	slightly below average

21.	B.	9y 6m	6y 11m	well below average
22.	B.	9y 9m	10 y	well above average
23	G.	6y 8m	7y 5m	IQ 120
24.	B.	7y 3m	7y 11m	IQ 109
25.	B.	7y 3m	8y 5m	IQ 110-111
26.	B.	7y 8m	7y 10m	IQ 112
27.	G.	8y 5m	9y 3m	IQ 112
28.	B.	7y 10m	9y 2m	IQ 120
29.	G.	8y 8m	9y 10m	IQ 82
30.	B.	9y 4m	8y 9m	IQ 113
31.	G.	9y 4m	10y	IQ 103-4
32.	G.	8y 10m	9y 2m	IQ 96
33.	G.	10y	10y 6m	IQ 105

FS mean age 8y 4m (s.d. 1y) mean reading age 8y 6m (s.d. Iy 2m, range 4y 1m) mean IQ 107 (s.d.10)

APPENDIX 11 (a)

Word stimuli for the lexical decision tasks performed by the PS and FS subjects in Study 2.

1.Two sets of 10 words and 10 legal nonwords presented horizontally on Day 1.

2.These same two sets presented vertically on Day 2.

3.Two sets of 10 words and 10 nonwords presented vertically on Day 1.

4. The same two sets presented horizontally on Day 2.

APPENDIX 11a. STUDY 2 . EXPERIMENT 1.

WORDS PRESENTED HORIZONTALLY AND THEN VERTICALLY OR V.V.

REGULAR WORDS		IRREGULAR WORDS.	
makes	teddy	money	young
happy	robber	comes	white
parrot	lunch	author	girls
sister	dinner	nights	bought
indian	seemed	wrong	fights
darted	wigwam	no-one	tyres
going	fairy	played	palace
story	sharks	abroad	school
lived	likes	bread	monday
clock	ground	wants	circle

NONWORDS PRESENTED HORIZONTALLY AND THEN VERTICALLY OR VICE VERSA.

NONWORDS		NONWORDS	
ploder	brait	fostie	sercel
grend	tsore	slompt	boddil
thirry	woldou	surne	kumpis
flass	tybes	targe	bantel
finces	apload	gream	krask
teave	snowl	chendy	hellsh
cairly	trayk	cleese	glure
norge	troath	slean	phict
throd	mooks	chote	phroo
gleats	xyplor	swaze	fynnx

APPENDIX 11 b

Word stimuli for the lexical decision tasks performed by PS and FS subjects in Study 2, Experiments 2 and 3.

Experiment 2.

Day 1. Two sets of words and nonwords, each comprising 10 regular and 10 irregular words, and either 20 illegal nonwords or 20 pseudohomophones.

Day 2. Two sets of words and nonwords as for Day 1, but the set of 20 illegal nonwords changes place with the set of 20 pseudohomophones.

Experiment 3.

Day 1 . Four sets of 10 regular and 10 irregular words.

Two sets of 20 double pseudohomophones.

One set of 20 legal nonwords which differed from the pseudohomophones by only one letter.

One set of 20 illegal nonwords which differed from the pseudohomophones by only two letters.

Each of the 4 lists of stimuli consisted of 20 words and 20 nonwords.

Day 2. The same lists were used as above, but the nonwords were positioned with a different set of words to provide a different context.

The pseudohomophones for Experiment 2 were taken from Pring, L. (1984). A comparison of the Word Recognition Processes of Blind and Sighted Children.

Child Development, 1984, 55, p.1865-1877.

The pseudohomophones and the legal and illegal nonwords for Experiment 3 were taken from:

Besner,D and Davelaar, E. (1983).Suedohomofoan Effects in Visual Word Recognition: Evidence for Phonological Processing.

Canadian Journal of Psychology, 37, 1983, p 300-303.

APPENDIX11b . EXPERIMENT 2. WORD AND NONWORD STIMULI.

REGULAR WORDS.		IRREGULAR WORDS.	
hand	seen	knee	sure
likes	idea	love	light
make	mark	touch	built
bring	trade	both	looks
game	nice	mind	dead
give	cannot	your	heart
happy	same	move	break
shop	march	might	books
deal	fresh	sign	caught
inch	yard	said	high

PSEUDOHOMOPHONES		NONWORDS	
braik	trooth	aead	myxz
phact	tipe	kpee	gearx
snoe	helth	kovx	skryp
koast	boddie	govw	pight
munney	trane	uxalz	phroxn
praze	hoatel	foxei	figkes
bloo	feer	wrope	bioys
brooze	grait	xighe	fygnt
battel	cherch	paxght	goury
wyne	gurl	yreax	meddeo.

APPENDIX 11b . STUDY 2. EXPERIMENT 3. WORD STIMULI.

REGULAR WORDS.

make	will	bus	dog
song	thin	for	can
test	with	this	mum
back	fast	help	park
home	after	from	feed
lunch	ugly	swim	this
think	stand	will	seem
target	helps	duck	eggs
behind	before	shall	truck
bigger	second	shock	boots

IRREGULAR OR INCONSISTENT WORDS.

girl	crew	you	out
door	load	some	eat
come	move	city	road
book	your	here	iron
talk	sign	dirt	work
eight	fight	prove	sure
fruit	field	goat	glue
friend	prove	night	right
school	pretty	heart	where
woman	church	witch	bread.

APPENDIX 11b, STUDY 2 . EXPERIMENT 3. NONWORD STIMULI.

DOUBLE PSEUDO - HOMOPHONE	LEGAL NONWORD	DOUBLE PSEUDO - HOMOPHONE	ILLEGAL NONWORD
ile	ite	cort	bbrt
wun	jun	floo	zloo
rie	kie	ahms	phns
bor	bon	mone	mobl
bild	sild	bloo	plqo
borl	birl	waid	bgid
hele	hege	wate	jatc
kord	korm	hoal	xoal
leke	leme	fraze	frzxe
laks	caks	grait	gratk
bair	gair	tode	dodm
woar	woal	grone	brgne
taks	thane	porze	cokse
soal	soat	braik	bmait
horl	dorl	stawk	stquk
brude	trude	chuze	yhuze
throo	phroo	wurld	mvrld
flore	flere	boald	lpaled
peeze	deeze	brooze	drdoze
praze	prane	throan	ghroan

APPENDIX 11 c

Word stimuli for the lexical decision tasks performed by PS and FS subjects in Study 2. Experiments 4 and 5.

Experiment 4.

There were 4 sets of word stimuli in each of Sets One and Two.

a) consisted of one set of 10 irregular words and 10 nonwords in which FSUs were intact.

b) consisted of one set of 10 regular words and 10 nonwords in which FSUs were disrupted.

c)consisted of one set of 10 irregular words and 10 nonwords in which the FSUs were disrupted.

d) consisted of one set of 10 regular words and 10 nonwords in which the FSUs were intact.

Experiment 5.

There were 2 sets of 80 word stimuli per set.

Each set consisted of :

10 regular words and 10 matched illegal nonwords

10 irregular words and 10 matched illegal nonwords

10 regular words with intact FSUs

10 regular words with disrupted FSUs

10 irregular words with intact FSUs

10 irregular words with disrupted FSUs.

APPENDIX 11c, STUDY 2 . EXPERIMENT 4.

REGULAR WORDS INTACT FSUs	REGULAR WORDS DSRPTED FSUs	REGULAR WORDS INTACT FSUs	REGULAR WORDS DSRPTED FSUs
INSide	iNsIdE	zeBRA	zEbRA
roVER	RoVeR	hUNGry	hUnGrY
heLLO	HeLlO	famILY	faMIlY
swIMS	SwImS	THRee	ThReE
LiCKed	lICkeD	lETTer	lEtTEr
yELLow	yElLoW	abOUT	aBoUT
ESCape	EsCaPe	trEES	TrEeS
ALwayS	aLwaYS	hELPs	HelpS
HorSE	HOrSe	TEEth	TeEtH
SiLLy	sIlLy	dOCTor	dOcToR

IRREG WORDS INTACT FSUs	IRREG WORDS DISRUPT FSUs	IRREG WORDS INTACT FSUs	IRREG WORDS DISRUPT FSUs
diRTY	DiRtY	ROUgh	rOuGh
FLowER	FlOwEr	COLour	CoLoUr
HEArd	HeArD	spoNGY	sPoNgY
peoPLE	PeOpLe	oRANge	oRaNgE
frIEnd	FrIeNd	FALse	fAlSe
lOves	LoVeS	toDAY	ToDaY
AUTumn	aUtUmN	brEAKs	bReAkS
coACH	CoAcH	preTTY	pReTtY
riGHTs	rIgHtS	squEAK	sQuEaK
guESS	GuEsS	MAGic	MaGiC

APPENDIX 11c, STUDY 2. EXPERIMENT 4.

NONWORDS WITH INTACT AND DISRUPTED FUNCTIONAL SPELLING UNITS.

INTACT FSUs	DISRUPTED FSUs	INTACT FSUs	DISRUPTED FSUs
krAST	KrAsT	hORTel	hOrTeL
praZT	PrAzT	PHRoan	pHrOaN
tiBE	TiBe	plOOR	pLoOR
TRAke	tRaKe	grALT	gRALt
mUNTey	mUnTeY	KNOpan	kNoPaN
troLTH	tRoLtH	sEAUte	sEaUte
DRooZE	dRoOzE	prAZT	PrAzT
trOAN	tRoAN	hoRTel	hOrTeL
CHErf	cHeRf	klICHt	kLiChT
GRalt	gRaLt	LAUth	LaUtH
SNol	sNoL	HeLlsh	HeLlsH
FReeN	FrEeN	PHIct	pHiCt
prAIK	pRAiK	TWYnt	TwYnT
WRYker	wRyKEr	bODDil	BoDdiL
bANTel	bAnTeL	frEEN	fReEN
brOUP	BroUP	prAIK	PrAiK
PHLayp	pHLaYp	PLooR	pLoOr
piGHT	pIgHt	mUNTey	MuNteY
chERF	cHErF	gUREs	gUrEs
TWYnt	TwYnT	whOLP	wHOlP

APPENDIX 11c, STUDY 2. EXPERIMENT 5.

REGULAR WORD	REGULAR WORD	REGULAR WORD	REGULAR WORD
INTACT FSUs	DISRUPTED FSUS	INTACT FSUs	DISRUPTED FSUs
TIme	tIMe	lOTs	LoTs
LIke	LIKe	SiSTer	sIsTeR
SUnnY	sUnNy	DeeP	dEeP
thICK	ThICk	apART	ApArT
obJEct	ObJeCt	goING	GoInG
shIP	sHiP	fiSH	FiSh
smALL	SmAlL	CReep	cReEp
TRick	tRiCk	SPend	sPeNd
duMP	DuMp	LOng	lOnG
aniMAL	AnImAl	INseCT	InSeCt

IRREG WORDS	IRREG WORDS	IRREG WORDS	IRREG WORDS
INTACT FSUs	DISRUPTED FSUs	INTACT FSUs	DISRUPTED FSUs
TonS	tOnS	PEOple	PeOPlE
NewS	nEwS	MEdal	MEDal
eiGHty	eIgHtY	WHat	wHAt
drEW	DrEw	KNow	kNOw
QUeen	QuEeN	doING	DoiNG
wrITE	wRiTe	MONey	moNEy
haVE	HaVe	sEWs	SEws
OTHer	oThEr	sAId	SAid
RouGH	RoUgH	BOUght	boUGhT
CAstLE	CaStLe	NurSE	nuRsE

APPENDIX 11c, STUDY 2. EXPERIMENT 5.

UNALTERED WORDS		MATCHED NONWORDS.	
quick	wrong	qzick	wrpng
circle	orange	cprcle	orznge
right	head	rpght	heqd
door	none	dqor	nsne
ought	either	xught	eqther
might	saws	mzght	syws
night	knee	nmght	knbe
death	pieces	deqth	pseces
when	month	whxn	msnth
build	soul	bzild	sqol
doll	songs	drll	srngs
they	smile	thpy	smple
less	always	lnss	alwyys
shop	think	shzp	thmnk
tips	train	tmps	trsin
cream	green	crqem	grzem
invent	speed	xnven	spzed
lion	dine	lpon	dtne
apple	food	mpple	fodx
summer	leap	snmmer	leqp

APPENDIX 12. THE SPELLINGS OF PARTIALLY SIGHTED CHILDREN.

Table 22. Exception/variant words written correctly by PS and FS subjects.

	PS (n=11)	FS (n=22)
OF	7	18
DO	10	19
ME	11	22
LOUD*	3	6
FIGHT	3	6
DONE	4	6
ANY	0	7
GREAT	2	8
SURE	1	2
WOMEN	0	2

Table 23. Words containing silent letters written correctly by PS and FS children. Numbers refer to subjects. (* Denotes a regular word.)

Word.	PS (n=11)	FS (n=22)
THE	11	22
ARE	8	19
WHO	5	15
HERE	9	17
FIRE*	4	15
DATE*	5	11
EYE	4	14
FRIEND	2	11
ANSWER	0	2
BEAUTIFUL	0	1

Of the exception words presented in Table 22, the PS wrote 26 incorrect versions, and of these the following were clear 'phonic strategy ' attempts:

ov (of), lowd, lawd,(loud), fite (fight), eaney, enne, ene, eny, (any), greate, grate, (great), shar, shauy, shor, (sure), wimin, wimen, wmmen (women).

There was evidence, here also, of silent letters being recorded:

eaney (any), seur (sure), lound (loud), woman (women).

The larger FS sample wrote these words incorrectly 60 times. The following incorrect versions show evidence of a 'phonic strategy':

lawd, (loud), dun, (done), eney, ene, en, e-, (any), share, sho, shour, shar, shure, shor, shaw, shune (sure), wimen (women).

Many misspellings by the FS showed evidence of the recording of the silent letter:

fright, fihgt (fight), don, (done), ane (any), grat, geante (great), womon, woman, woau, wone, (women).

Turning now to Table 23, it showed that words containing a silent letter were written incorrectly 47 times by the larger FS sample. The following versions, though incorrect contained the silent letter:

how (who), hoe (here), hene (here), daeit (date), eae, (eye), find, frint, frind, freid, (friend), anwer, ansaw, asewer, ansewr, aws- (answer), beatfil, beatiful (beautiful).

The same words were written incorrectly 24 times by the PS, the following versions, although incorrect did contain the silent letter.

whow (who), fiyer, fiure (fire), dade, (date), eyd (eye), frenid, faird, (friend), aw- (answer), beatful (beautiful).

APPENDIX 12

SPELLING LEVELS FOR FULLY AND PARTIALLY SIGHTED CHILDREN MATCHED ON READING AGE AND CHRONOLOGICAL AGE.

THE DANIELS AND DIACK GRADED SPELLING TEST.

TEST WORD.	PS 7y	FS 7y	FS 7y	PS 7y	FS 7y	FS 7y
on	on	no	on	on	on	on
hot	hot	h	hot	hot	hot	hot
cup	cup	kp	cap	cup	cup	cup
van	van	va	van	van	fran	van
jam	jam	j m	jam	jam	garm	jam
lost	losh	l d	l	lost	lass	lost
sit	sit		set	sit	sit	set
plan	pal		plan	pland	barm	plan
mud	mud		mad	mud	mad	mud
beg	beg		beg	beg	baig	beg
the	the	the	the	the	the	the
go	go	go	go	go	go	go
for	f	fo	fo	for	for	for
so	so	so	so	so	so	so
me	me	me	me	me	me	me
are	ard	r	are	are	are	are
of	ov	f	of	of	fo	of
do	bow	do	do	do	do	do
who	hoh	ho	who	who	ho	how
here	here	he	hene	here	here	hear
ship			sipe	ship	ship	ship
food			food	fowd	food	fode
fire			fild	fiyer	fir	fire

thin	tine	thin	fan	thin
date	deht	date	dayt	dat
chop		chop	jop	cop
seem		ceen		sem
dart		durd		dot
loud		lowd		lud
form		fowm		fom
eye				
fight				
friend				
done				
any				
great				
sure				
women				
answer				
beautiful				

TEST WORD	PS 7y	FS 7y	FS 7y	PS 7y	FS 7y	FS 8y
on	on	on	on	on	on	
hot	hot	h	hot	hot	hot	
cup	cup	cpp	cap	cup	cup	
van	van	f	van	van	van	
jam	jam	jan	jam	jam	jam	
lost	lost		lost	lost	lost	
sit	sit	kt	set	sit	set	
plan	plan	pnn	plan	plan	plan	
mud	mud	mat	mud	mud	mud	
beg	beg	b c	beg	beg	beg	
the	the	the	the	the	the	
go	go	goe	go	go	go	
for	f	fo	for	fore	for	
so	so	kko	so	so	so	
me	me	me	me	me	me	
are	are		are	are	are	
of	of	of	over	of	of	
do	do	d	do	do	do	
who			who	hoy	who	
here	here	h	har	hir	here	
ship			sep	shiq	ship	ship
food			foof	food	food	food
fire			fire	f	f	fire
thin			fin	fin	thin	thin
date			dat	dade	d	date
chop			cop	choq	chop	chop
seem			sem	seem	semm	sem
dart			dart	dard	dat	dart

loud	lawd	lawd	l	lawd
form	form	fom	f	form
eye	eye			eye
fight	fit			fihgt
friend	friend			freid
done	don			don
any	ane			e
great				great
sure				shar
women				woau
answer				anwer
beautiful				bettyfly

TEST WORD.	PS 8y	FS 8y	FS 8y	PS 8y	FS 8y	FS 8y
on						
hot						
cup						
van						
jam						
lost						
sit						
plan						
beg						
the						
go						
for						
so						
me						
of						
are						
do						
who	whow				ho	
here	here				here	
ship	ship	ship	ship	ship	ship	ship
food	food	food	food	food	food	food
fire	fiure	fire	fire	fire	fire	fire
thin	thin	thin	thin	thin	thin	thin
date	date	date	date	date	date	date
chop	chop	chop	chop	chop	cop	chop
seem	seem	seem	seem	seem	seme	seam
dart	dart	dart	dart	dart	drt	dart
loud	loud	load	louid	loud	lod	laod

form	form	from	form	form	form	foem
eye	eye	eye	eye	eyd	eae	eye
fight	fite	fight	fight	fight	fit	fight
friend	friend	friend	friend	friend	friend	frind
done	done	done	done	done	dun	dun
any	any	any	any	eaney	eney	ene
great	greate	great	great	grate		grat
sure	shar	share	shure	seur		shor
women	wimin	womon	womon	wimen		wemen
answer	nansea	anser	ansaw	ansar		asewer
beautiful	benful	beatfil	butiful	butifal		butful

TEST WORD	PS 9y	FS 8y	FS 9y	PS 9y	FS 9y	FS 9y
on	on	an				
hot		hont				
cup	pup	cope				
van		thane				
jam		jame				
lost		lose				
sit	c	sent				
plan		plen				
mud		mondl				
beg		best				
the	the	the				
go	g	go				
for	f	for				
so	so	so				
me	me	me				
are	r	ar				
of	o	ofe				
do		dot				
who		hot				
here		hoe				
ship			ship	ship	ship	ship
food			food	food	food	food
fire			fire	fire	fire	fire
thin			thin	thin	fin	thin
date			date	date	date	date
chop			chop	chop	chop	chop
seem			seem	seem	seem	seem
dart			dart	dart	dart	dart

loud	loud	lound	load	lo
form	form	form	form	form
eye	eye	eye	eye	eye
fight	fight	fight	fight	fight
friend	friend	frenid	friend	friend
done	done	done	d	d
any	any	enne	eney	
great	great	great	great	great
sure	shaw	sure	sho	sor
women	women	woman	woman	weman
answer	ansewr	aw	anser	aws
beautiful	beautiful	beatful	buetful	bru

	PS 9y	FS 9y	FS 9y	PS 9y	FS 9y	FS 9y
on		on		on	on	
hot		hot		hot	hot	
cup		cap		cop	cip	
van		van		van	vin	
jam		jam		jam	jen	
lost		lost		lost	lous	
sit		sit		sit	set	
plan		plan		plt	pert	
mud		mud		mid	mend	
beg		baegg		beg	dire	
the	the	the		the	the	
go	go	go		go	go	
for	for	for		fo	for	
so	sow	so		so	so	
me	me	me		me	me	
are	are	are		rt	are	
of	ov	of		ot	of	
do	do	do		do	did	
who	who	who		ho	ha	
here	here	here		here	here	
ship	sipe	ship	ship		siep	ship
food	food	food	food		food	food
fire	fire	fire	fire		fire	fire
thin	thin	thin	thin		thath	thin
date	date	daiet	date		dit	date
chop	cope	chop	chop		cap	chop
seem	seem	semm	seem		seem	seed
dart	deite	drit	dart		dite	daet

loud	lohd	loud	loud	loud	lond
form	form	fr	form	fuoom	fand
eye	eye	eye	eye	eye	eye
fight	fight	fright	fight	fist	firent
friend	faird	friend	friend	find	frint
done	done	don	done	din	done
any	ener	en	any	in	any
great	great		great		geante
sure	shauy		sure		shune
women	wmmen		wimen		wone
answer			answer		ansen
beautiful			buetiful		blurful

	PS 10y	FS 9y	FS 9y
ship	ship	ship	ship
food	food	food	food
fire	fire	fire	fire
thin	thin	thin	thin
date	date	dat	date
chop	chop	chop	chop
seem	seem	seem	seem
dart	dart	dart	dart
loud	loud	loud	loud
form	form	foorm	form
eye	eye	eye	eye
fight	fite	fight	fight
friend	freaind	friend	friend
done	done	dun	done
any	eny	any	any
great	groit	great	great
sure	shor	shour	sure
women	wimin	whemen	women
answer	anser	anser	answer
beautiful	butifull	beutiful	beatiful

APPENDIX 13

A COMPARISON BETWEEN PS SPELLING AGE (S.A.) AND CHRONOLOGICAL AGE (C.A.) AT THE BEGINNING AND AT THE END OF THE STUDIES.

SUBJECT.	SPELLING TEST 1		SPELLING TEST 2	
	GAP OF 12 - 14 MONTHS.			
	C.A.	S.A.	C.A.	S.A.
1.	5y 9m	no score	7y 1m	6.4y
2.	6y 1m	6.5y	7y 2m	7.5y
3.	6y 7m	6.5y	7y 4m	7y
4.	6y 2m	no score	7y 5m	7.3y
5.	7y 1m	5.4y	8y 1m	8.7y
6.	7y 9m	8.7y	8y 11m	9.2y
7.	7y 11m	no score	9y 5m	5.5y
8.	8y 2m	8.1y	9y 5m	9.5y
9.	8y 3m	7.1y	9y 6m	8.2y
10.	8y 3m	5.2y	9y 6m	6.4y
11.	8y 10m	8.2y	10y	9y

The gap between C.A. and S.A. decreased by the end of this Study in 7/11 cases, and this is particularly evident amongst the younger writers.

A COMPARISON BETWEEN THE READING AGE (R.A.) AND CHRONOLOGICAL AGE (C.A.) OF THE PS SUBJECTS AT THE BEGINNING, IN THE MIDDLE AND AT THE END OF THE STUDIES.

	C.A.	TEST FORM A	TEST FORM B	TEST FORM C
1.	5y 9m	no score	below 6y	6y 7m
2.	6y 1m	6y 9m	7y 1m	7y 11m
3.	6y 2m	below 6y	6y 6m	6y 10m
4.	6y 2m	no score	6y 2m	7y 2m
5.	6y 10m	6y 1m	6y 9m	8y 5m
6.	7y 9m	8y 3m	9y 10m	9y 8m
7.	7y 10m	no score	no score	1 word
8.	8y 2m	7y 9m	8y 10m	9y
9.	8y 3m	8y 2m	8y 3m	8y 7m
10.	8y 3m	BAS WRA 5y	6y 2m	6y 6m
11.	8y 9m	9y 3m	9y 4m	9y 10m

Of the 11 readers, at the outset, 9 had a reading age below their chronological age. The second reading test was administered 9 months later. The third reading test came 14 months from the beginning of the Study, and by then, 8 still had a gap between reading age and chronological age but this gap had narrowed.

APPENDIX 14.
IDENTIFICATION OF PHOTOGRAPHS AND LINE DRAWINGS BY PS CHILDREN.

A full face photograph was taken of each PS child in class, and photographs were also taken of familiar places and objects in their classrooms and in the school, in general. These were people and places or objects the children would see every day. The photographs were inspected a day or two after they were taken to achieve the scores below.

	CORRECT IDENTIFICATION OF PHOTOGRAPHS OF FAMILIAR PEOPLE.(max 11)	CORRECT IDENTIFICATION OF PHOTOGRAPHS OF FAMILIAR OBJECTS / PLACES.(max 11)
S1.	10	9
S2.	11	6
S3.	11	11
S4.	11	11
S5.	11	11
S6.	7	7
S7.	11	9
S8.	11	11
S9.	11	11
S10	11	11
S11.	11	11
mean no. correct	10.5 s.d. 1.2	mean no. correct 9.8 s.d. 1.7.

The correct identification of so many of these photographs belies the difficulty of the task. Transcripts of the tape recordings confirm that many correct identifications were only arrived at after several attempts. The major difficulty with identification lay with Subjects 1,2,6 and 7.

THE IDENTIFICATION FROM PHOTOGRAPHS OF MOODS AND EMOTIONS ACTED OUT BY THE PS CHILDREN.(Correct identification expressed as percentages) In this task Subjects 1,2,3,4,5, and 7 had to act out the emotions 'proud or pleased', 'puzzled' and 'cross', whilst Subjects 6,8.9.10, and 11 also had to act out 'happy', 'sad' and 'worried'. They were photographed as they acted the emotion and then inspected the photographs a day or two later to achieve the scores below.

	CORRECT IDENTIFICATION OF EMOTION.PHOTOGRAPHS OF SELF.(max 3 or 6 per subject) % correct	CORRECT IDENTIFICATION OF EMOTION.PHOTOGRAPHS OF FRIENDS.(max 18) % correct
S1.	67	44
S2.	100	67
S3.	100	44
S4.	100	44
S5.	100	56
S6.	100	61
S7.	100	44
S8.	17	22
S9.	100	56
S10	100	22
S11.	100	61
% correct	89%	% correct 47%

IDENTIFICATION OF LINE DRAWINGS FROM THE TROG TEST (Bishop 1983)

40 of the TROG line drawings were used, depicting people (man, woman, girl, boy), animals (dog, cow, sheep, elephant etc), objects (book, food, drink, hat etc) and activities (jumping, pushing, carrying etc). The PS children were asked to inspect each line drawing and name it. The Test for the Reception of Grammar from which these line drawings were taken is for children aged 4 years - 8 years 11 months.

The figures below represent the percentage of correct names given by each child.

Subject.	**Percentage correct picture names.**
1.	50
2.	65
3,	75
4.	90
5.	95
6.	45
7.	78
8.	90
9.	90
10.	73
11.	78
mean % correct	75%
s.d.	15.7
range correct	45 - 95

APPENDIX 15.

VISUAL RECOGNITION - A SHORT TERM VISUAL MEMORY TASK FROM THE BRITISH ABILITY SCALES. .

This visual recognition test is for the age range 2 1/2 - 7 years 11 months. It was carried out by the PS subjects of Studies 4 and 5 under the standard study conditions of 5 seconds, viewing time, and also under a second condition of unlimited viewing time. The results are tabulated for each child under the two time conditions.

	5 seconds viewing time			Unlimited viewing time.	
Subject	Raw	Ability	Centile	Raw	Study time taken in seconds.
1.	2	26	below 1st	4	10.3
2.	10	80	39-44	13	3.5
3.	3	72	14-16	13	4.9
4.	11	84	59-64	13	5.2
5.	12	88	63	12	3.6
6.	6	overage	for the test	10	7.9
7.	9			7	9.6
8.	11			17	6.7
9.	12			13	3.6
10.	8			10	7.2
11.	13			17	4.7

The average extra time taken per child, under the unlimited viewing condition, was 6.1 seconds.

Numbers of correct responses against each item under the two time conditions.

Item	5 seconds viewing time	Unlimited time	Nature of display
1.	10	11	1 toy and 3 distractors
2.	10	11	1 toy and 4 distractors
3.	10	10	1 toy and 5 distractors
4.	10	10	2 toys and 4 distractors
5.	9	11	2 toys and 5 distractors
6.	10	10	2 toys and 6 distractors
7.	6	4	3 toys and 5 distractors
8.	4	9	3 toys and 6 distractors
9.	2	5	3 toys and 7 distractors
10.	3	7	1 design and 5 distractors
11.	8	6	1 design and 6 distractors
12.	5	3	1 design and 7 distractors
13.	5	7	1 design and 8 distractors
14.	5	8	2 designs and 5 distractors
15.	2	5	2 designs and 6 distractors
16.	3	3	2 designs and 7 distractors
17.	0	3	2 designs and 8 distractors

Under the second condition of unlimited viewing the subjects often used less than 5 seconds and yet still achieved many correct responses.

APPENDIX 16.

SAMPLES OF PS AND FS SUBJECTS FOR EXPERIMENTS WITH PICTURE STIMULI.

PARTIALLY SIGHTED SAMPLE.

	Gender	Age	BAS Auditory Memory. raw score (Digit Span)	Ability.
1.	girl	7y	21(6)	IQ 107
2.	girl	7y 2m	20 (5)	IQ 108
3.	boy	7y 4m	20 (5)	IQ 106
4.	girl	7y 4m	12 (4)	IQ 109
5.	girl	8y 0m	13 (6)	IQ 97
6.	boy	8y 11m	24 (7)	IQ 117 -18
7.	boy	9y 1m	17(5)	IQ 78
8.	boy	9y 4m	23 (6)	IQ 111
9.	girl	9y 6m	16 (5)	IQ 104
10.	girl	9y 6m	13 (4)	IQ 80
11.	boy	10y	19 (6)	IQ 117

FULLY SIGHTED SAMPLE.

12.	girl	6y 8m	19 (5)	average
13.	girl	7y 2m	19 (6)	slightly below average
14.	boy	7y 1m	20 (5)	average
15.	girl	7y 3m	13 (5)	average.
16.	girl	8y 1m	13 (4)	well to slightly below ave
17.	boy	8y 11m	22 (6)	well above average
18.	boy	9y	18 (6)	slightly below average

	Gender	Age	BAS Auditory Recall	Ability
19.	boy	9y 7m	26 (7)	well above average
20.	girl	9y 8m	15 (6)	average
21.	girl	9y 8m	12 (4)	well below average
22.	boy	9y 9m	19 (6)	average
23.	girl	7y	16 (5)	IQ 120
24.	boy	7y	17 (5)	IQ 109
25.	boy	7y 1m	15 (4)	IQ 110-111
26.	boy	8y	19 (5)	IQ 112
27.	girl	8y 8m	21 (6)	IQ 112
28.	boy	8y 1m	22 (6)	IQ 120
29.	girl	9y 0m	15 (4)	IQ 82
30.	boy	9y 7m	18 (7)	IQ 113
31.	girl	9y 7m	12 (5)	IQ 103 - 4
32.	girl	9y 1m	12 (5)	IQ 96
33.	girl	10y 3m	24 (6)	IQ 105

PS mean age 8y 6m (s.d. 1y 1m) PS mean Auditory Memory Score 18 (s.d. 4)

PS mean IQ 103 (13 points) PS Digit Span 4-7 digits.

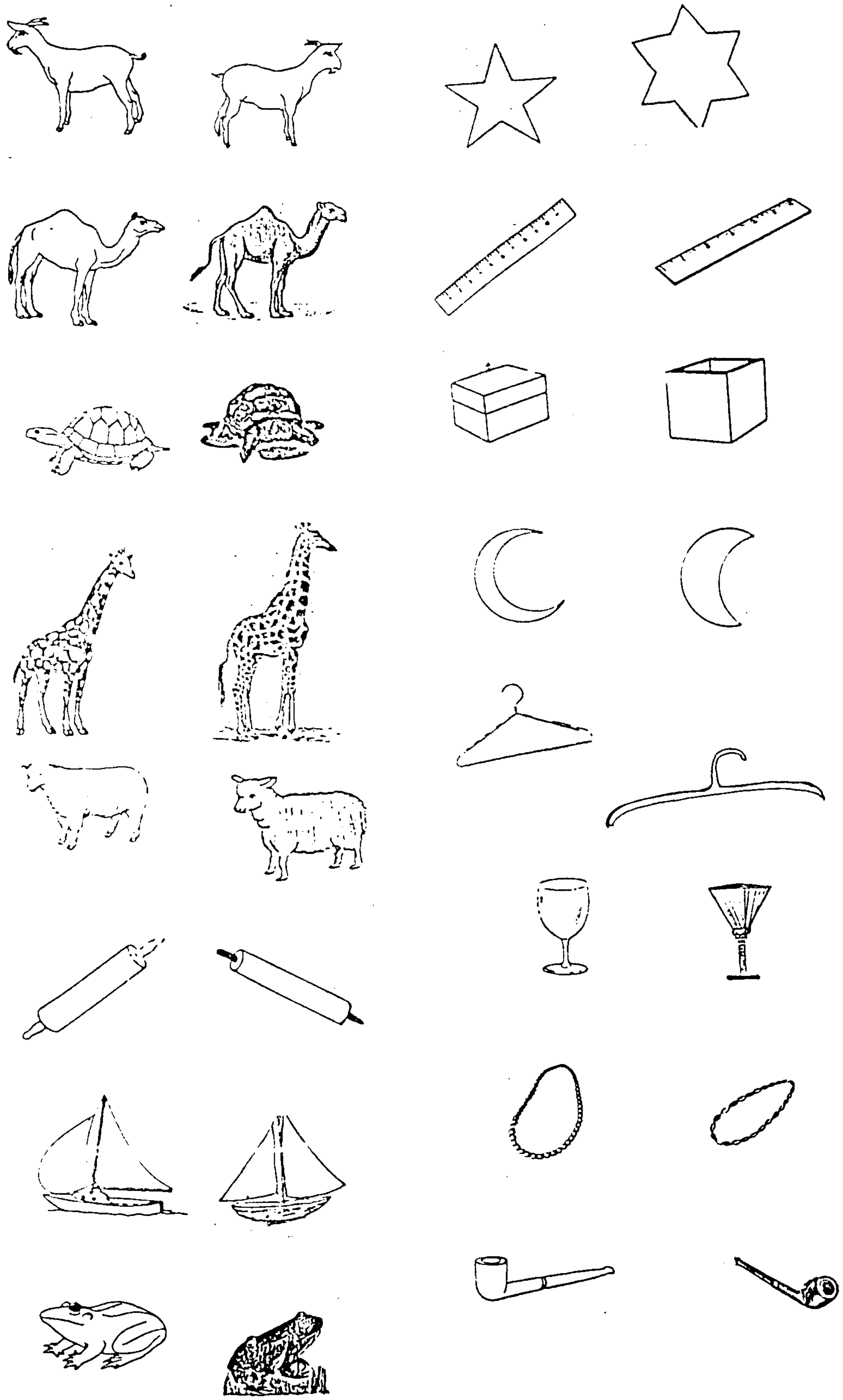
FS mean age 8y 6m (s.d. 1y 1m) FS mean Auditory Memory Score 18 (s.d. 4)

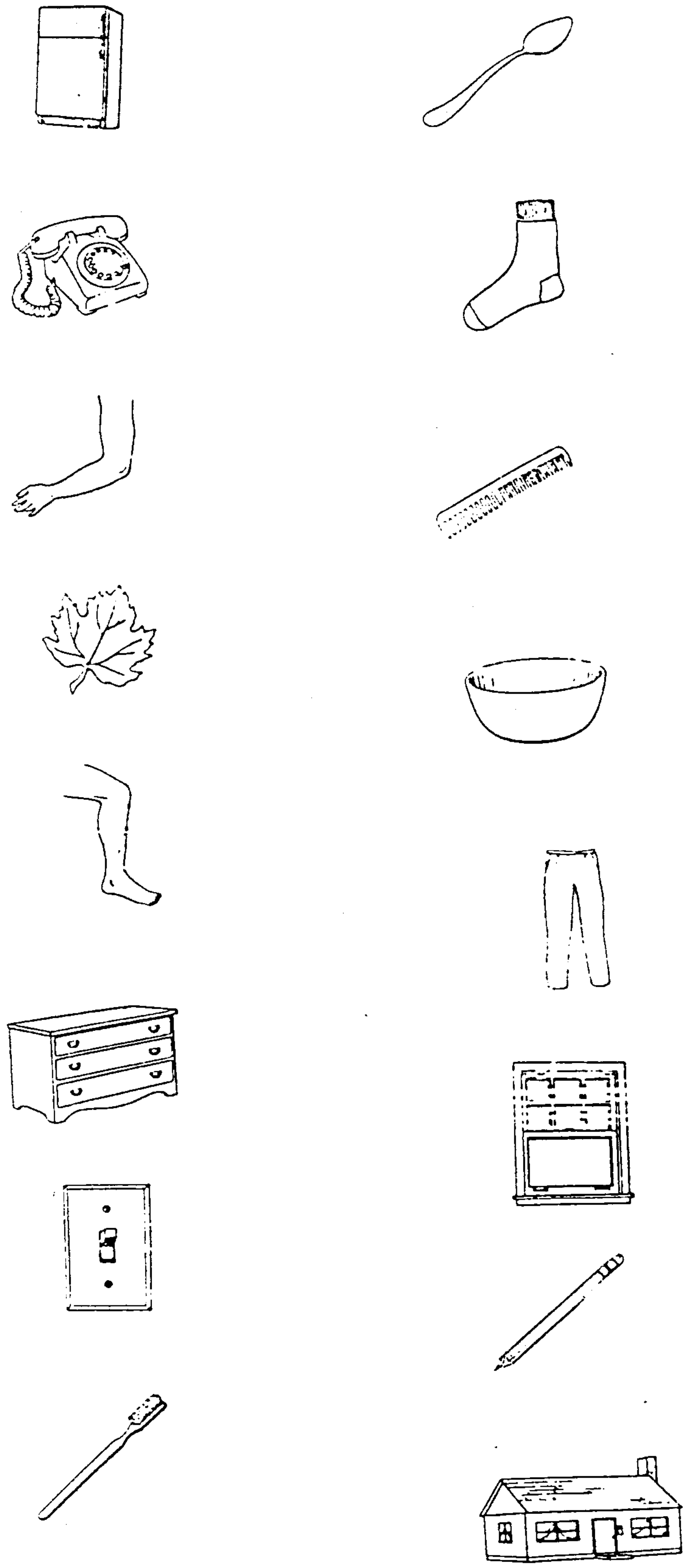
FS mean IQ 107 (10 points) FS Digit Span 4-7 digits.

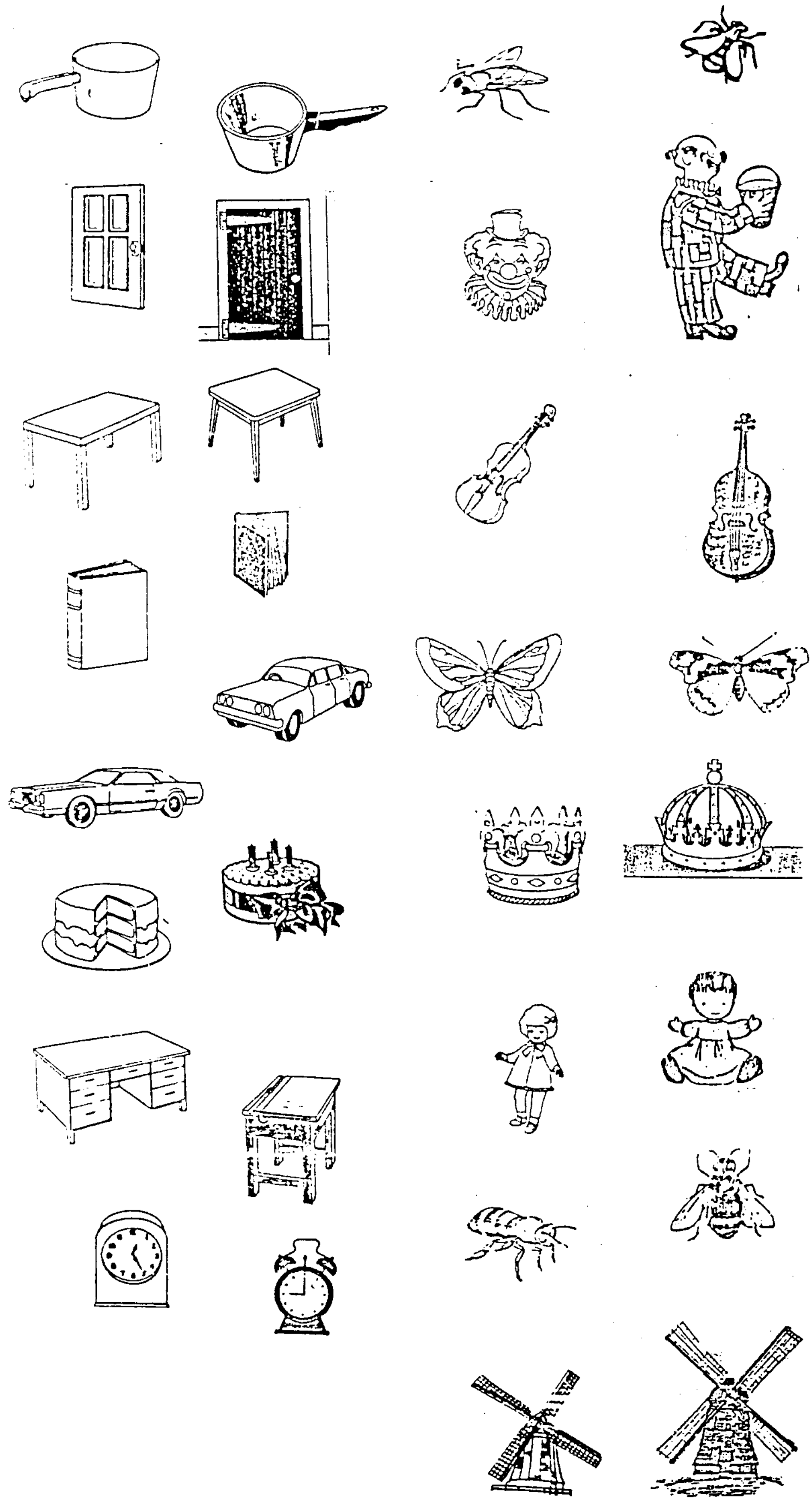
APPENDIX 17.

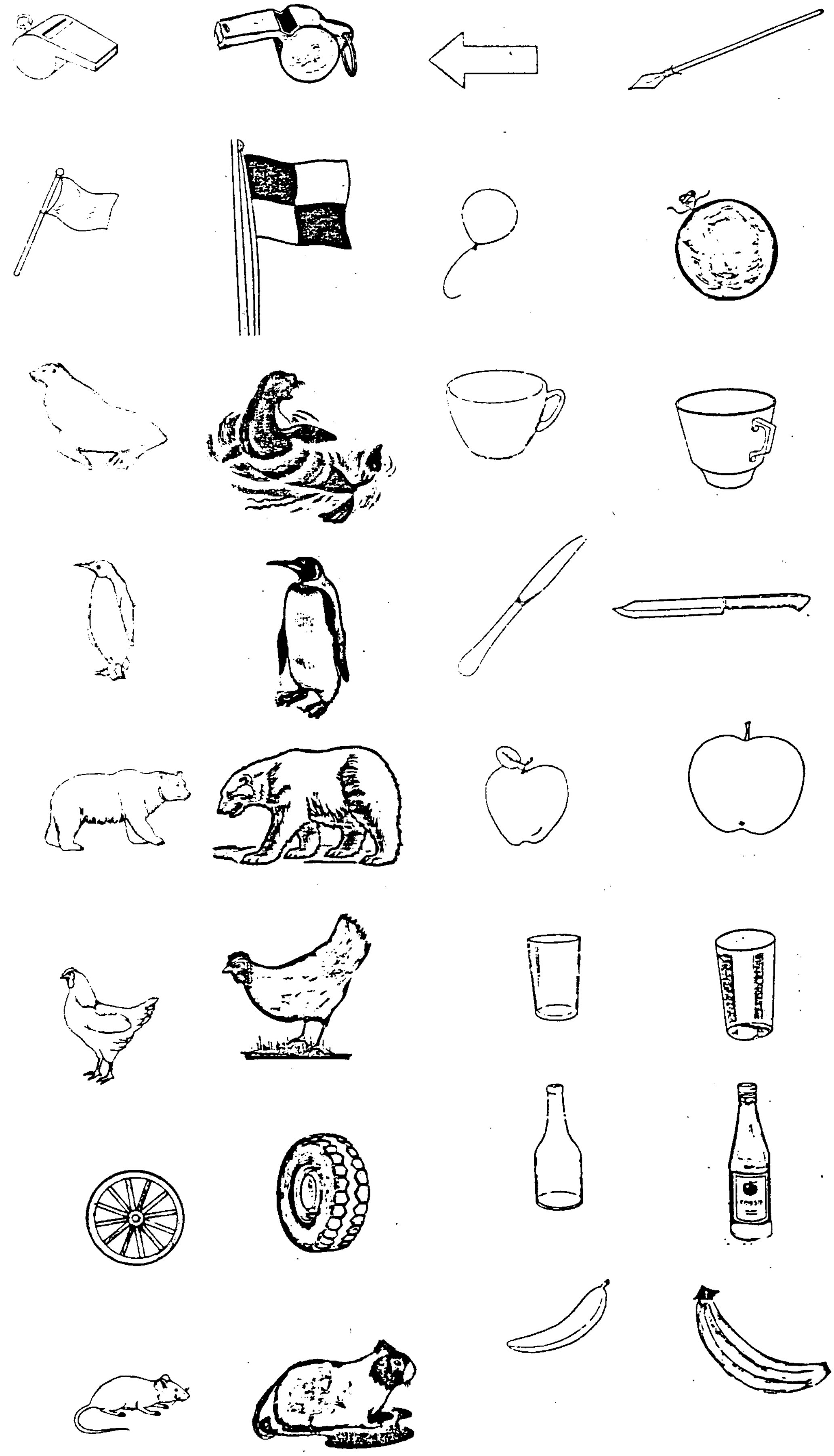
PICTURE STIMULI FOR EXPERIMENT 6.

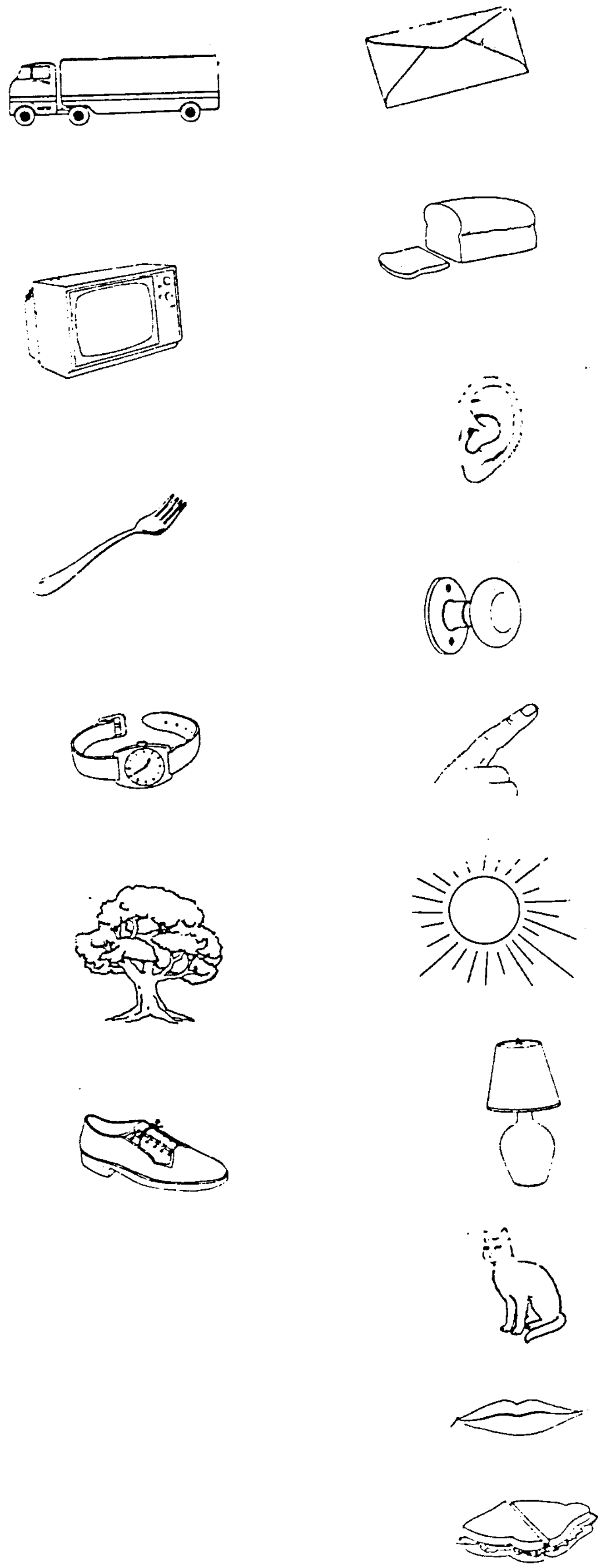
TAKEN FROM SNODGRASS AND VANDERWART (1980), WITH MATCHED PAIRS MADE UP FROM CHILDREN'S BOOKS AND DICTIONARIES.











APPENDIX 18.

In this test of visual recognition memory, no comparison is made between the 3 conditions. The fact that the task was repeated three times means that any effect of the naming of the pictures is confounded with the effect of greater familiarity with the materials and the task.

An ANOVA analysis of the data must be undertaken with caution for the following reason. The data arising from the sorting of the cards into three piles is not entirely independent. It could be the case that a subject put all Physical and Name Match cards into one pile and would gain 100% correct for that pile but 0% correct for another. In other words, the response to one pile has influenced the response to another. Inspection of the data revealed that only twice did the raw scores show such an imbalance.
Consultation about the legitimacy of the use of ANOVA in these circumstances was undertaken (personal communication with Professor Jonkheere and Associates at the Psychology Department, University College, London.) and the view expressed that it could be used but with caution.

Table 25. The means and standard deviations for the correct recognition by PS and FS children of pictures in the LOOK study condition, Experiment 6, when recognition is immediate and delayed (max 32 per cell).

	PHYSICAL MATCH		NAME MATCH		NEW	
(correct scores)	PS	FS	PS	FS	PS	FS
LOOK mean.	24.5	22.0	15	16	31	27
IMM. S.D.	4.0	6.0	8	5	1.8	6.8
LOOK mean	19.5	18.1	18.8	16.2	25.6	27.6
DEL s.d.	5.4	5.6	5.7	5.0	5.5	4.2

Table 25b. An analysis of variance of the means for the correct recognition by PS and FS children of pictures in the LOOK study condition, Experiment 6, immediate and delayed recognition.

ANOVA SUMMARY..

Source (LOOK condition)	d.f.	F.	p
A (Group)	1	1.02	
B (Time Interval)	1	5.3	*
C (Picture type)	2	60.14	**
A x B (Group X Time Interval)	1	0.89	
A x C (Group x Picture Type)	1	0.15	
B x C (Time Interval x Picture Type)	2	4.78	*
A x B x C (Group x Time Interval x Picture Type)	2	8.2	**
Error Terms			
A x Subjects in Groups	31	66.6	
B x Subjects in Groups	31	17.3	
C x Subjects in Groups	31	35.6	
Subjects within Groups	62	16.7	

* $p < .05$, ** $p < .01$.

Table 26. The means and standard deviations for the correct recognition of pictures by PS and FS children in the NAME study condition, Experiment 6, when recognition is immediate and delayed.(max 32 per cell)

		PHYSICAL MATCH		NAME MATCH		NEW	
(correct scores)		PS	FS	PS	FS	PS	FS
NAME	mean	21	22	23.5	22.3	31.6	27.9
IMM	s.d.	6.0	6.0	6.3	6.0	0.8	6.
NAME	mean	20	22.5	21.3	21.2	30.7	27.4
DEL.	s.d.	5.7	5.6	4.5	5.7	2.3	6.6

Table 26b. An analysis of variance of the means for the correct recognition of pictures by PS and FS children in the NAME condition, Experiment 6, when recognition was immediate and delayed.

ANOVA SUMMARY

Source (NAME Condition)	d.f.	F.	p.
A (Group)	1	0.34	
B (Time Interval)	1	1.08	
C (Picture Types)	2	26.77	**
A x B (Group x Time Interval)	1	0.5	
A x C (Group x Picture Types)	1	2.6	
B x C (Time Interval x Picture Types)	2	1.03	
A x B x C (Group x Time Interval x Picture Types)	2	0.17	
Error Terms			
A x Subjects within Groups	31	82.96	
B x Subjects within Groups	31	22.26	
C x Subjects within Groups	62	40.4	
Subjects within Groups	62	6.8	

* $p < .05$, ** $p < .01$

Table 27.The means and standard deviations for the correct recognition of pictures by PS and FS children in the GENERATE condition, Experiment 6, when recognition is immediate and delayed. (max 32 per set).

		PHYSICAL MATCH		NAME MATCH		NEW	
(correct scores)		PS	FS	PS	FS	PS	FS
GENERATE							
IMM	mean	25.2	24.4	23.5	23.1	30	28.7
	s.d.	8	6.4	5.1	4.9	2.3	5.3
GENERATE							
DEL.	mean	22.5	23.5	21.2	22.8	27.6	27.8
	s.d.	5.4	6.8	4.6	5.7	4.6	6.1

Table 27. An analysis of variance of the means for the correct recognition of pictures by PS and FS children in the GENERATE condition, Experiment 6, when recognition is immediate or delayed.(max 32 per cell).

ANOVA SUMMARY

Source (GENERATE condition)	d.f.	F.	p.
A (Group)	1	0.0006	
B (Time Interval)	1	1.48	
C (Picture Types)	2	16.68	**
A x B (Group X Time Interval)	1	.6	
A x C (Group x Picture Types)	2	0.13	
B x C (Time Interval x Picture Types)	2	0.06	
A x B x C (Group x Time Interval x Picture Types)	2	0.026	
Error Terms			
A x Subjects within Groups	31	68.41	
B x Subjects within Groups	31	54.92	
C x Subjects within Groups	62	35.98	
Subjects within Groups	62	18.78	

* $p < .05$, ** $p < .01$

A NEWMAN-KEULS COMPARISON OF CORRECT RESPONSES TO PHYSICAL MATCH, NAME MATCH AND NEW PICTURES. EXPERIMENT 6.

(Tables 25, 26, 27).

LOOK study condition. Immediate Recognition.

Between Physical and Name Match pictures studentised range df 2,33 = 12.3 $p < .01$

Between Physical Match and New pictures studentised range df 2,33 = 21.4, $p < .01$

Between Name Match and New pictures studentised range df 3,33 = 9.9 $p < .01$

LOOK study condition. Delayed Recognition.

Between Physical and Name Match pictures studentised range df 2,33 = 1.7 $p > .05$

Between Physical Match and New pictures studentised range df 2,33 = 12.8 $p< .01$

Between Name Match and New pictures studentised range df 3,33 = 14.4 $p< .01$

NAME study condition. Immediate Recognition.

Between Physical and Name Match pictures studentised range df 2, 33 = 2.5 $p> .05$.

Between Physical Match and New pictures studentised range df 3,33 = 15 $p< .01$

Between Name Match and New pictures studentised range df 2,33 = 13.7 $p< .01$

NAME. study condition. Delayed Recognition.

Between Physical and Name Match pictures studentised range df 2,33 = 0 $p> .05$

Between Name Match and New pictures studentised range df 2,33 = 15.6 $p< .01$

Between Physical Match and New pictures studentised range df 3,33 = 15.6 $p< .01$

GENERATE study condition. Immediate Recognition.

Between Physical and Name Match pictures studentised range df 2,33 = 3 $p> .05$

Between Physical Match and New pictures studentised range df 2,33 = 19.1 $p< .01$

Between Name Match and New pictures studentised range df 3,33 = 22.1 $p< .01$

GENERATE study condition. Delayed Recognition.

Between Physical and Name Match pictures studentised range df 2,33 = 2 $p> 05$

Between Physical Match and New pictures studentised range df 2,33 = 9.4 $p< .01$

Between Name Match and New pictures studentised range df 3,33 = 11.4 $p< .01$

VISUAL RECOGNITION OF PICTURES - MISPLACED PICTURES.

Table 28. The means and standard deviations for the pictures misplaced by PS and FS children in the LOOK condition, immediate and delayed recognition (max 32 per cell for PM and NM, 16 per cell for New).

	PHYSICAL MATCH		NAME MATCH		NEW	
Immediate Recognition — LOOK condition.						
	Name Match	New	Physical Match	New	Physical Match	Name M.
PS means	4.5	3.2	3.9	13.1**	0.1	0.5
s.d.	3.9	3.0	3.9	7.1	0.3	0.6
FS means	7.0	3.0**	4.8	11.3**	1.3	1.3
s.d.	4.4	2.5	3.9	5.1	2.4	1.7
Delayed Recognition — LOOK condition						
	Name Match	New	Physical Match	New	Physical Match	Name M.
PS means	9.1	3.5**	5.4	7.8*	1.1	1.9
s.d	4.7	2.8	3.2	5.0	1.3	2.3
FS means	8.1	5.7**	5.0	10.8**	1.0	1.2
s.d	3.9	4.5	3.3	4.7	1.3	1.2

** p< 01, * p < .05

VISUAL RECOGNITION OF PICTURES - MISPLACED PICTURES.

Table 29. The means and standard deviations for the pictures misplaced by PS and FS children in the NAME condition, immediate and delayed recognition (max 32 per cell for PM and NM, 16 per cell for New).

Immediate Recognition NAME condition.

	PHYSICAL MATCH		NAME MATCH		NEW	
	Name Match	New	Physical Match	New	Physical Match	Name M
PS means	7.5	2.0**	5.6	2.9**	0	0.6
s.d	5.1	1.95	5.1	2.3	0	1.1
FS means	7.9	2.14**	3.6	6.1**	1	1
s.d.	4.9	2.3	4.4	4.2	2	1.2

Delayed Recognition. NAME condition.

	PHYSICAL MATCH		NAME MATCH		NEW	
	Name Match	New	Physical Match	New	Physical Match	Name M
PS means	9.5	2.5**	6.9	3.8**	0.8	1.4
s.d.	5.5	2.3	4.9	2.9	1.2	1.5
FS means	7.7	1.6**	6.2	4.6*	1.3	1.0
s.d.	5.2	2.2	4.6	3.8	2.3	1.4

** $p < .01$, * $p < .05$

VISUAL RECOGNITION OF PICTURES - MISPLACED PICTURES.

Table 30. The means and standard deviations for the pictures misplaced by PS and FS children in the GENERATE condition, immediate and delayed recognition.(max 32 per cell for PM and NM, 16 for New).

Immediate Recognition. GENERATE Condition.

	PHYSICAL MATCH		NAME MATCH		NEW.	
	Name Match	New	Physical Match	New	Physical Match	Name
PS means	5.8	1.0**	4.0	4.5	0.4	0.6
s.d	6.8	1.7	4.8	2.0	0.6	0.8
FS means	6.3	1.4**	3.7	5.2*	0.7	0.9
s.d	5.8	2.1	3.2	3.4	1.3	1.5

Delayed Recognition. GENERATE condition.

	PHYSICAL MATCH		NAME MATCH		NEW.	
	Name Match	New	Physical Match	New	Physical Match	Name M
PS means	9.3	1.7**	5.5	5.3	0.6	1.5
s.d.	6.2	1.4	3.6	3.2	1.2	1.4
FS means	6.3	1.6**	4.6	4.5	1.3	0.8
s.d	5.2	2.2	3.4	3.3	1.9	1.5

** $p<.01$, * $p< .05$

APPENDIX 19. VISUAL RECALL

There are 19 designs in this British Ability Scales subtest, following the three initial practice ones for which feedback is given. Exposure time for each design is 5 seconds,after which it is concealed and the child draws it from memory.

Two conditions were used here:
first, 5 seconds viewing time
second, at least a week later, unlimited viewing time.

The BAS Handbook states:
'Performance on this scale requires not only visual perceptual encoding and retention, but also an adequate level of motor skills. However, the drawings are such, that they should not cause major difficulty in themselves for children with normal motor development. It is, of course, possible to code the designs verbally to a certain extent, and performance may therefore be aided by efficient verbal coding. Poor performance may be attributed to poor short term visual recall but may also be influenced by poor motor skill or by poor verbal encoding strategies.'

It is clear that given an exposure time of 5 seconds, PS children are able to score over the full range of the scale. Of the 19 items, 5 children completed 16 or more, 1 only completed 5 designs, the remaining children completed intermediate numbers.

With unlimited viewing of the design, there was a general increase in score except in two cases, but recall was still not perfect. If extra study time is available, the child has to know what to do with the time. Frequently, here as elsewhere, some children had to be slowed down and encouraged to use the available time to its full extent.

BAS TEST OF THE VISUAL RECALL OF DESIGNS.

RECALL OF DESIGNS _ 5 secs exposure. RECALL OF DESIGNS - any chosen length of viewing.

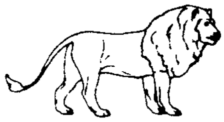
Subject	Age	Raw Score.	Centile	Raw Score	Average Study Time
1.	6y 1m	0	below 1st	2	11.8 secs
2.	6y 3m	3	51-53	6	11.3 secs
3.	6y 5m	7	87-88	13	14.3 secs
4.	6y 5m	3	51-53	9	11.2 secs
5.	7y 1m	2	23-24	2	14.5 secs
6.	8y	10	74-76	12	13.8 secs
7.	8y 2m	2	13	2	20 secs
8.	8y 6m	8	51-53	25	15.4 secs
9.	8y 6m	5	28-29	14	11.7 secs
10.	8y 7m	0	below 1st	3	14.2 secs
11.	9y 1m	11	62-64	12	14.9 secs

Each of the 19 designs could gain 1 or 2 points. If all 11 subjects had gained the maximum for each design, the total score for the group would have been 418 points. As it was, the total for the group was 50 points for 5 seconds viewing time, and 99 points for the unlimited viewing time.

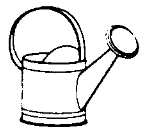
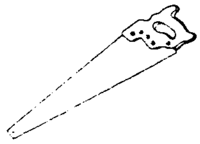
Unlimited viewing time did lead to increased recall scores, but this was in the main so for 2 subjects who raised their scores considerably. Benefitting from increased time, does involve knowing what to do with it when it is available, having good looking and scanning skills. Extra time, per se, will not bring benefit, if it is not well used.

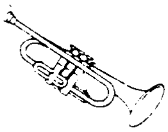
APPENDIX 20.

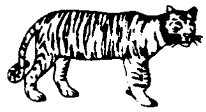
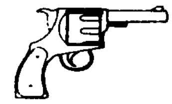
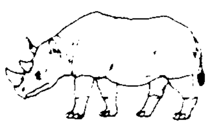
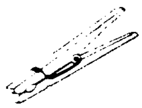
PICTURE SETS FOR THE RECALL TASKS, TAKEN FROM SNODGRASS AND VANDERWART (1980)

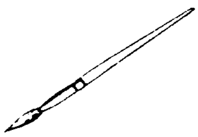
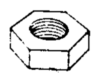
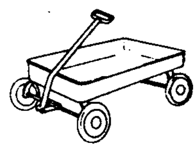


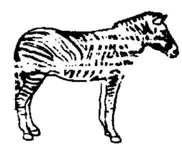





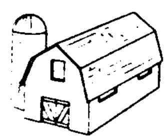





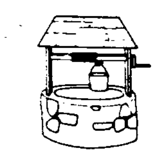


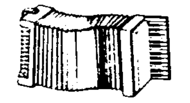
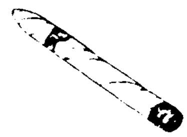
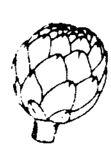
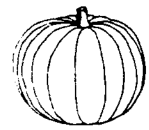
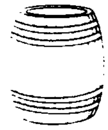




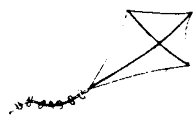
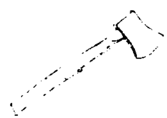
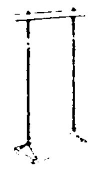



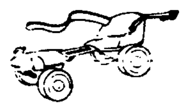


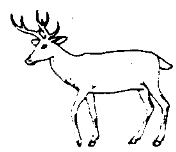









APPENDIX 21. THE RECALL OF PICTURES - EXPERIMENTS 7a, 7b, 7c.

Table 34. An ANOVA of the means for the correct Recall of pictures by PS and FS children, Experiment 7a, immediate and delayed recall (max 8 per cell).

ANOVA SUMMARY (Table 34)

Source.	d.f.	F.	p.
A (Group).	1	.16	
B (Time interval)	1	12.36	**
A x B (Group x Time interval)	1	.023	
Error terms			
A x subjects within groups	31	2.2	
B x subjects within groups	31	1.5	

* $p < .05$ ** $p < .01$

Table 36. An ANOVA of the means for the correct Recall of pictures (max 8 per cell) by PS and FS children in Experiment 7b, when stimulus presentation was preceded by Physical or Semantic Orienting Questions, immediate and delayed recall.

ANOVA SUMMARY (Table 36)

Source	d.f.	F.	p.
A (Group)	1	6.28	*
B (Orienting Question)	1	3.3	
C (Time Interval)	1	69.88	**
A x B (Group x Or.Q.)	1	.3	
A x C (Group x Time)	1	.26	
B x C (Or.Q. x Time)	1	4.9	*
A x B x C (Grp x Or.Q. x Time)	1	1.9	
Error terms			
A x subjects within groups	31	3.2	
B x subjects within groups	31	1.3	
C x subjects within groups	31	1.56	
B x C x subjects within groups	31	1.8	

* $p < .05$ ** $p < .01$

Table 39. An ANOVA of the means for the correct Recall of pictures (max 8 per cell) by PS and FS children in Experiment 7c when stimulus presentation is followed by a relevant or irrelevant elaborative sentence.

ANOVA SUMMARY (Table 39)

Source.	d.f.	F.	p.
A (Group)	1	4.9	*
B (Sentence Type))	1	5.7	*
C (Time Interval)	1	48.5	**
A x B (Group x Sentence Type)	1	0.7	
A x C (Group x Time)	1	1.1	
B x C (Sentence Type x Time)	1		
A x B x C (Group x Sentence x Time)	1	1.7	
Error terms			
A x subjects within groups	31	5.02	
B x subjects within groups	31	1.6	
C x subjects within groups	31	2.2	
B x C x subjects within groups	31	1.38	

* $p < .05$ ** $p < 01$

APPENDIX. 22. A diagram showing some examples of the links made by PS children between their descriptions of 2D pictures and their stored knowledge.

2D Object.	**Shape.**	**Features.**	**Search for category. Key words - 'kind of- ' like' - 'sort of -'**	**Stored knowledge. Key words 'used in -**
ostrich	along at the back	head two legs	like a horse	animate- fish insect reptile mammal bird 'bird with long legs.' 'ostrich'. inanimate
caterpillar	long pretty thing	six legs		animate - fish insect 'insect'. reptile etc. inanimate
accordion	angle square shape			animate- fish insect reptile etc inanimate- inside - work - play- 'music thing'. 'in - out' - outside
lobster	2 long thin things	long thing	like a face	animate - fish insect reptile etc. inanimate
axe	slanting thing	pole, flag at the end	like a flag	animate- fish insect reptile etc. inanimate inside-
helmet	half round at the front		like a mushroom	animate - fish insect reptile etc. inanimate - inside - work- - play - outside -
grasshopper	2 things sticking out at front	a body		animate - fish insect 'insect', 'greenfly' reptile etc. inanimate
chisel				animate- fish -insect etc. inanimate - inside - work- 'thing you use in wood-work'. - play - - outside

At any point in the visual analysis above, a phonological connection could be generated. If the response was fast, correct and automatic, it was not always clear what shapes or features had been identified, but it was evident, from some responses given, that the candidate names for identified objects could come from either the shapes, the feature bank, the category divisions or the category members. Often the category membership was not well differentiated by name, so a near miss was selected ('horse' for 'zebra', 'elephant' for 'rhino') Internal representation may have been imprecise or it could have been that insufficient detail was identified and used in the response selection. The correct name may have been inaccessible, as in the case of the child who identified '2 horns' but named the animal an 'elephant' instead of a 'rhino'.

After consideration of the partial information available from stored knowledge, it seemed that occasionally the child's focus was on only limited sensory information - perhaps one feature was overemphasised - the 'head like a horse' of the 'ostrich', or the 'flag' shape of the 'axe'. When this happened, it was harder to locate the required candidate, for it is the combination or bundles of features, which forms the uniqueness and distinctiveness of the finally located item, not just one feature. Some indication of what features belong to the internal representations can be uncovered by drawings or from verbal descriptions - in the case of PS children, drawings were not available but verbal descriptions were and did show a paucity of distinctive detail.