

BINOCULAR EFFICIENCY AND AUDITORY ANALYSIS

SKILLS IN GOOD AND POOR READERS

by

Mary Lou Riederer, O.D.

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APPROVAL

Name: Mary Lou Riederer
Degree: M.A. (Education)
Title of Thesis: Binocular Efficiency and Auditory
Analysis Skills in Good and Poor
Readers

Examining Committee:

Chairman: P. Winne

B. Wong
Senior Supervisor

J. Tuinman
Professor

J. Rosner
Professor
College of Optometry
University of Houston
Houston, Texas
External Examiner

April 20, 1982

Date Approved

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BINOCULAR EFFICIENCY AND AUDITORY ANALYSIS

SKILLS IN GOOD AND POOR READERS

Author: _____

(signature)

Mary Lou Riederer

(name)

April 20/82

(date)

ABSTRACT

Optometrists have generally stressed the importance of efficient visual function (in the physiological sense) to learning. Many in addition have stressed the importance of visual perceptual performance based on the perceptual deficit theory. However, because of increasing empirical refutation of the effectiveness of visual perceptual training, the visual perceptual deficit theory has been severely criticized. Nevertheless, with a few notable exceptions such as Rosner, optometrists still promote visual perceptual training programs. Instead of emphasizing visual perceptual skills in reading, Rosner emphasizes the importance of specific auditory perceptual skills. A major criticism of most studies of auditory perceptual ability, however, concerns the lack of control for the influence of IQ. There has also been much controversy as to whether binocular skills are important to academic success.

This study, therefore, examined both of these issues. Part 1 was designed to test the hypothesis that, after partialling out the influence of IQ, auditory analysis test performance would still explain a significant percentage of the variance in vocabulary scores on the Gates MacGinitie Reading Test Primary B. Rosner's auditory analysis test (TAAS) was used to assess the phonemic awareness of 68 children in grade two. The results indicated that auditory analysis test scores explained approximately 40% of the variance in reading scores whereas IQ accounted for only 17% of the variance. Moreover, IQ and auditory analysis test scores had a low correlation of $r = .23$. A multiple regression analysis using vocabulary score as the dependent measure indicated that with IQ partialled out auditory analysis scores explained a further 31% of the variance in reading scores. Part 2 of this study tested the hypothesis that a poor reader group of 38 grade two children would show a higher incidence of binocular deficiency than a group of 30 good readers of the same grade, IQ, and socioeconomic background. Contrary to expectation, only deficiency in one of the eight subtests of binocularity (ie. stereoacuity) occurred significantly more often in the poor reader group ($p < .01$). The educational and research implications of these findings are discussed.

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TABLE OF CONTENTS

CHAPTER	PAGE
APPROVAL	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	v
I INTRODUCTION	1
II REVIEW OF THE LITERATURE	3
Part 1: The relationship between auditory and reading achievement	3
Part 2: The relationship between binocular efficiency and reading achievement	12
III METHOD	18
Subject Selection	18
Instruments	18
Procedure	21
IV RESULTS AND DISCUSSION	23
V CONCLUSION	36
APPENDICES	39
BIBLIOGRAPHY	42

LIST OF TABLES

TABLE	TITLE	PAGE
1	Sample Characteristics: Means and Standard Deviations for all Variables of the Total Sample	24
2	Intercorrelations between Test Scores on Vocabulary (Gates-MacGinitie), IQ (PPVT) and Test of Auditory Analysis Skill (TAAS)	25
3	Regression Coefficients and Tests of Significance Obtained on the IQ (PPVT) and Test of Auditory Analysis Skill (TAAS)	26
4	Summary of Multiple Correlation Statistics	27
5	Means and Standard Deviations for the Reading and IQ Scores of the Good and Poor Readers	29
6	Summary of Phi Coefficients for the Eight Visual Subtests	30
7	Individual Phi Matrices Derived from the Eight Visual Subtests on the Binocular Test Battery	32

IntroductionContext of the Problem

Optometry has been involved in the field of learning disabilities for many years (Lerner, 1976). While generally stressing the importance of efficient visual function (in the physiological sense) to learning, many optometrists have additionally stressed the importance of visual perceptual performance to reading acquisition in particular. Getman's 1965 visuomotor model of intellectual development was presented at a time when many notable educators and psychologists such as Gessel, Frostig, Kephart and Spache were also promoting the use of perceptual motor training programs in reading readiness and remedial reading programs.

In the past decade, however, an optometrist by the name of Jerome Rosner has been advocating that certain auditory perceptual skills are more related to reading acquisition than are visual perceptual skills. Rosner's research has demonstrated an important link between certain specific auditory analysis skills and reading achievement (Rosner, 1972, 1973, 1974a,b). At the same time his research has shown visual perceptual skills to be of minor concern with respect to beginning reading yet of some importance to the development of computational ability. As a result Rosner suggests that optometrists interested in reading disabilities should in addition screen for auditory analysis skill deficiencies and provide guidance for their enhancement.

Rosner's research findings are supported indirectly by research in education and psychology. With regard to reading enhancement, the bulk of research studying the visual perceptual motor approach has failed to prove its effectiveness (Hammill and Larsen, 1975; Martin, 1973; Seaton, 1977; Vellutino et. al., 1972, 1975, 1977, 1979; Bieger, 1974, 1978; Belmont, Glegenheimer, Girch, 1973;). As a result most current texts on the teaching of reading reject the claims made by proponents of the visual perceptual deficit theory (Durkin, 1978). Other researchers have also demonstrated a strong relationship between phonemic awareness skills (similar to Rosner's auditory analysis skills) and reading achievement (Roberts, 1975; Liberman and Shankweiler, 1974, 1977; Goldstein, 1976; Chall, Roswell and Clumenthal, 1963; Wallach, 1977; Richardson and DiBenidetto, 1977; Calfee, Lindamood and Lindamood, 1973; Blank, 1968;

Oakland, 1969).

Despite the evidence to support this relationship between auditory analysis skills and reading development, however, some authorities have expressed reservation regarding its strength (Ehri, 1979; Hammill and Larsen, 1974). Hammill and Larsen's major criticism has been that most studies of auditory analysis skill have not controlled for the influence of IQ. Ehri's criticism has been that the evidence so far presented has been primarily correlational.

Controversy has also surrounded optometry's contention that visual skills in the physiological sense are critical to optimum academic performance. While some researchers have demonstrated that a higher incidence of visual skill deficiency (notably binocular imbalance) characterizes poor readers (Eames, 1959, 1964; Evans, Efron, and Hodge, 1976; Weber, 1980; Bedwell, Grant, and McKeown, 1980; Kephart, 1953; Sherman, 1973; Wilson and Wold, 1970) others have not (Norn, Rindziunski and Skydsgaard, 1969; Goldberg, 1967). A possible consequence of this ongoing controversy is the fact that school visual screening usually consists of no more than a test of distance visual acuity (Shapiro and Pennock, 1980). This is an appalling situation when sole reliance on distance V.A. measures have already been shown to miss 20 - 70% of those cases actually deserving further attention (Spache, 1976; Peters, 1961; Peters, Blum, Bettman, Johnson, and Fellows, 1959).

Statement of the Problem

This study concerned itself specifically with correlates of reading disability. In view of the empirical evidence muting the importance of visual perceptual skill to reading achievement visual perceptual measures were not considered. Instead the study focussed on how reading achievement related to auditory perception (specifically phonemic awareness) and binocular efficiency.



CHAPTER II

REVIEW OF THE LITERATUREpart 1 : The relationship between auditory perception and reading achievement.

Deficiencies in the subskills of visual and auditory perception have been implicated as causes of reading failure for a significant number of children (Williams, 1977). However, studies which have compared measures of auditory and visual perception (Golden and Steiner, 1969; Bruininks, 1969; Rosner, 1973; Calfee, 1977; Robinson, 1972; Blank, 1968) have generally found auditory perceptual skills to be the more significant of the two with respect to learning to read. Rosner (1973) has suggested that visual perception is more related to success in mathematics whereas auditory analysis skills are more crucial to reading success. He perceives the connection between visual perception and arithmetic on the basis that arithmetic programs teach children to use symbolic notations to code the quantifiable characteristics of concrete visual information. Rosner has devised tests to measure visual analysis skills and auditory analysis skill as well as training programs to remediate weaknesses in either of these areas. Initial studies by Rosner have given some support to his claims (Rosner and Simon, 1971; Rosner, 1972, 1973 1974 a, b,).

At this point it is opportune to ponder the question of why insufficiently developed auditory perceptual skills create more trouble for the beginning reader than insufficiently developed visual perceptual skills. The answer lies in a better understanding of reading acquisition.

Though many people think of reading as a largely visual task, visual information is probably of less importance to the fluent reader as compared to the beginning reader (Barr, 1972). It is only the beginning reader (or skilled reader when presented with a new word, especially if given out of context) who has to attend to every graphic detail, noting the sequence and spacial interrelationships of what he is viewing. This task, however, is not particularly difficult for even the beginning reader (Calfee, 1977). It is true that analyzing visual features presented in a two dimensional vs. a three dimensional display does pose certain challenges to the initiate. The property of shape constancy that children apply to 3 D objects in their environment does not apply to 2 D letters. A chair

is a chair whether viewed like this  or this  but a 'b' is not 'b' if written like this 'd' (Frith, 1980). However, children by age six have generally had a lot of practice using their visual processes to examine object stimuli. Once the principle of directionality, left - right sequencing and the rules of punctuation etc. are learned the role of visual discrimination in reading can proceed quite smoothly. Visual perceptual performance deficiencies in tests using reading related materials (Vellutino, 1975; Calfee, 1977) do not commonly delineate poor from good readers. One may assume therefore (as does Rosner) that most children by grade one have acquired the basic visual perceptual skills necessary for reading.

"The visual perceptual demands of the various approaches to teaching primary reading are relatively uncomplicated and similar. A printed whole word is no more than the sum of its parts. Analysis of a printed word into the individual letters that comprises that word is a straightforward, unambiguous task. Hence once the child has acquired the perceptual skills needed to analyze the visual patterns of the manuscript alphabet, as presented in an ordered array, he has also acquired the visual perceptual skills needed to profit from reading instruction." (Rosner, 1973, p.61)

The demands placed on auditory perception in initial reading are in contrast more complex.

"A spoken whole word is often something quite different than the sum of its individual parts; analysis of a spoken word into its component parts can create confusing situation... The teaching convention asserts, for example, that the word 'bat' can be analyzed directly into three separate phonemes. In actuality, of course, this is not so; one cannot vocalize the 'b' sound in isolation - it must be accompanied by a vowel sound." (Rosner, 1973, p. 61)

Written language is not a direct mapping of spoken language. Phonemes cannot be physically abstracted from the sound wave. Yet, many authorities believe that, in order to crack the written code of English language the beginning reader must develop awareness of the segmentation of speech (Rozin and Gleitman, 1977; Rosner, 1973; Savin, 1977; Calfee, Lindamood and Lindamood, 1973).

Rozin and Gleitman, 1977 have related the acquisition of reading to the historical development of our English writing system. They state that our alphabetic system evolved from a series of different writing systems which began possibly as far back as 20,000 B.C. Early writing consisted of symbolic representation of whole ideas (semasiography) then individual

words (logography) then certain sounds (phonography). Though not all cultures advanced to the alphabetic system it is true that no society ever reverted from alphabetic to an earlier form. At each stage the trend was toward decreasing the number of symbols in the script while as a consequence increasing the level of abstraction between the written symbols and their meaning. Rozin and Gleitman assert that proponents of reading instructional methods that deride explicit instruction in decoding (ex. Goodman, 1969; Smith, 1971) are calling for a return back to 'paleolithic semasiographies'. Rozin and Gleitman counter that the alphabet is a useful invention and that what is needed instead is instruction in the phonological principle upon which English is based. While acknowledging that lack of phonemic awareness is not the only obstacle to reading acquisition they assert that it is the major barrier to initial progress in reading. There is some evidence to support this view.

Importance of phonemic awareness to reading development:

In a longitudinal study exploring the relationships among auditory blending ability, reading achievement, and IQ, Chall, Roswell and Blumenthal, 1963, followed forty children from grade one to grade four. With IQ held constant, auditory blending ability in grade one (as measured by the Roswell-Chall blending test) correlated .64 with silent reading ability in grade three. Furthermore auditory blending ability in grade one was not significantly related to IQ ($r = .03$). However, for grades 2 to 4 there was a correlation of approximately .5 between blending ability and IQ for each grade. For each grade auditory blending ability at that grade correlated statistically reliably with reading achievement. With age these correlations decreased somewhat. At each grade auditory blending ability most highly correlated with scores on the Roswell-Chall Diagnostic Reading test of Word Analysis Skills. Thus Chall et. al. concluded that blending ability has a substantial relationship to reading achievement, especially to word recognition and word analysis. Furthermore, they observed that blending ability increased with age for all children but that those with higher IQ's appeared to have made greater gains.

In 1971 Rozin , Poritsky, and Sotsky reported an interesting study where a group of nine grade two reading disabled children had been taught

in a short time to read English material written as thirty different Chinese characters. These children in addition had demonstrated poor ability to blend and segment phonemes. Rozin et. al. concluded that a major factor accounting for the superior learning performance of these children with Chinese characters vs. the English alphabet was the fact that the Chinese system is logographic. The Chinese characters do not map onto speech sounds whereas the English alphabet is largely based on such an attempted mapping. As a result of these findings Rozin et al. suggested that a syllabary approach to teaching reading may be more effective, segmentation of words into syllables being an easier task than phonemic segmentation .

In 1972 Rosner summarized the results of a series of studies designed to validate an individualized perceptual skills program intended for use in kindergarten and as a remedial approach in later grades. The program was founded on the belief that certain perceptual skills are prerequisite to academic success. The first step in the development of the curriculum was to identify those perceptual skills that appear directly related to reading and arithmetic at the primary level.

Academic achievement as measured by the Stanford Achievement Test was correlated with performance on the Rosner designed Auditory Analysis Test (AAT) and Visual Analysis test from Gr. 1 - 6. AAT scores demonstrated a strong correlation with reading achievement in all grades (from .53 - .84) but highest in the earlier grades. Rosner reasoned that this was probably due to the fact that auditory analysis skills are more related to basic decoding ability which is the skill tapped by earlier reading achievement tests. By testing a large number of different aged children and by analyzing the item responses Rosner scaled the relative difficulty of each of the AAT items. From this he identified the common traits of those items of similar difficulty and constructed a series of training procedures in which the training objectives were reasonably sequenced. Failure at a certain difficulty level of the AAT therefore results in placement in the Auditory Analysis Training program at a corresponding level of difficulty. In two studies with beginning grade one children it was demonstrated that, for those children showing substandard auditory analysis skills, auditory analysis training resulted in significantly better reading achievement than a control group that did not receive

similar training. The controls were relatively equal to the experimental group in IQ and AAT scores. In 1974, Rosner provided evidence that auditory analysis skills can be taught to four year old prereaders from an inner city neighbourhood. However, the effects of the training on reading achievement in later grades was not assessed.

Goldstein in 1976 did a study where four year olds were taught to read via two different methods. One stressed word analysis while the other did not. The control group used the same reader but instead were taught letter names rather than sounds. They did not read the stories themselves but were read the stories by the experimenter. It was found that reading achievement with IQ statistically controlled, was reliably higher for the group trained via word analysis. Furthermore synthesis tasks were easier than phonemic segmentation. Results from regression analysis showed that phonemic segmentation and synthesis ability were found to correlate reliably with later reading achievement even after partialing out the influence of IQ. IQ alone accounted for about 34% of the variance in reading achievement but phonemic analysis/synthesis ability contributed an additional 32% to the explainable variance in reading achievement.

The sequential development of phonemic awareness:

Calfee, Lindamood and Lindamood (1973) conducted an investigation into the relationship between phonetic-segmentation ability and reading-spelling achievement in grade K to grade 12. The test used was the Lindamood Auditory Conceptualization test in which the student is asked to arranged colored blocks to represent sound sequences that are discrete units (ex. The sequence 's-b-n') or integrated word like units (ex. 'ips'). The results showed that all students had mastered discrete units by grade 5. Prior to grade 5 poor readers had performed less well than good readers on discrete units. All students found that the integrated units were significantly better for the good readers. Performance on the Lindamood test and the WRAT correlated at each grade level to a .70 or higher degree. Not surprisingly the authors suggested that based upon these findings more attention should be paid to the development of phonological skills in the early grades and that schools should continue teaching these skills until all students master them (regardless of grade). This contrasts with the present practice of dropping training in word attack skills past grade six (if not sooner).

In 1974, Liberman and Shankweiler showed that, though ability in both syllable and phoneme segmentation increased with grade level, word analysis into phonemes was significantly harder and perfected later than word analysis into syllables. The task, used required preschool through grade one children to tap out the number of segments in spoken utterances. No attempt to relate segmentation ability to reading achievement was made.

In 1975 Roberts assessed analysis and blending of spoken phonemes in 40 five and six year olds. Her results indicated that in order of increasing difficulty oral blending ability preceded oral phoneme analysis which preceded the ability to decode the printed word. Roberts suggested that reading teachers should begin by teaching the easier skills of phoneme synthesis then analysis before proceeding to teaching children to decode visual stimuli.

Fox and Routh (1975) also studied the developmental progression of fifty children aged 3 - 7 in analyzing spoken language. Their task consisted of stimulating the child first to repeat spoken sentences, then to divide these sentences into words, the words into syllables, and finally syllables into phonemes. The effects of age on the various types of segmentation were examined by means of a multivariate analysis of variance. They found that phoneme segmentation was the most difficult type of segmentation for the children at all ages but that this skill improved with age. Phoneme segmentation ability was also found to correlate at .38 with PPVT IQ. It also correlated at .50 with reading recognition and at .37 with reading comprehension as measured by the Peabody Individual Achievement test. PPVT IQ correlated .56 with reading recognition and .43 with reading comprehension. However, there was no attempt to determine the relationship of phonemic segmentation ability to reading while controlling for the influence of IQ.

In 1976 Fox and Routh did a follow up study where the effects of phonic blend training on word decoding were compared in two groups of four year old children. One group was proficient at segmenting syllables into individual phonemes while the other was not. Results showed that the group that was poor at phonemic segmentation did not benefit from phonic blend training while the other group did. This suggests that in order for training in phonemic synthesis to transfer to improved word

decoding a child must first possess a certain minimum phonetic segmentation ability. Their conclusion contradicts Robert's (1975) suggestion that phonemic synthesis training should precede phonemic segmentation training.

An additional theory as to why phonemic segmentation ability is a key factor in reading achievement:

Conrad, Mattingly and Savin (1972) as well as Liberman et al. (1977) have suggested that the reason why reading ability is strongly related to phonemic segmentation ability is because short term memory operates best when based upon a phonetic code. Liberman et al. report a study where the ability to recall phonetically confusable vs. phonetically nonconfusable letter strings was compared between superior and inferior readers. Recall was measured under both an immediate and a delay condition. It was found that the delay significantly detracted from the superior readers performance vs. the inferior readers performance. In addition the superior readers while out performing the inferior readers on immediate recall were almost indistinguishable from them on delayed recall of phonetically confusable letter strings. They were still superior on nonconfusable strings though. The authors concluded from this that the superior readers were using a phonetic code in STM. Germane to this belief is the fact that work with deaf children has implied that nonspeech STM codes are less efficient. Moreover, there is evidence that profoundly deaf children have great difficulty in learning to read (Conrad, 1972).

Criticisms against the view that phonemic awareness is critical to reading achievement:

Since most of the research to date has been correlational Ehri (1979) has argued that rather than viewing phonemic awareness as a prerequisite for learning to read one could regard it as a consequence of learning to read. She cites Goldsteins study (1976) as the only one to test this possibility. She noted that his results indicated that, while the initially segmenting children scored best in later reading measures the nonsegmenters still did make some progress in reading. She asserts that in order to properly test the hypothesis that phonetic segmentation is prerequisite to reading acquisition one needs to select prereaders who are not able to

segment, assign them randomly to experimental and control groups, teach the experimental group to segment, then provide reading instruction to both groups and compare their progress. Ehri suspects that rather than being a prerequisite to learning to read phonemic segmentation ability is instead a facilitator in reading progress. Ehri's point is a good one (Mason, 1981). Researchers may be overestimating the importance of phonemic awareness if they claim that without it reading skill cannot develop. However, the fact that some studies have shown it to reliably predict reading success and to respond well to training with reliable transfer to improved reading is encouraging.

Hammill and Larsen (1974) reviewed 33 correlational studies comparing performance on various types of auditory perceptual tests with reading achievement. They categorized the studies into 5 types; those measuring auditory-visual integration, sound blending, auditory memory, auditory discrimination-phonemic and nonphonemic. These five types were further partitioned into those where IQ had been controlled and those where it had not. They then averaged all the correlation coefficients reported within each study to come up with a median correlation coefficient. Their results indicated that where IQ had been controlled none of the median 'r's were important. In studies where IQ had not been controlled, only sound blending and phonemic discrimination were significant yet low (ie. median $r = .40$ and $.32$ respectively). Hammill and Larsen therefore concluded that after IQ has been taken into account auditory skills predict little variance in reading.

Certainly the question these reviewers have raised merits some consideration. Their method of evaluating the issue is surely inadequate however as such indiscriminate lumping together of 'r' values based on a wide variety of measures and research designs is bound to wash out valuable information. For this reason Richardson (1977) made a more detailed review of just one aspect of auditory perception and how it relates to reading achievement. The conclusion from this review was that blending ability has demonstrated important predictive correlations of between $.30$ and $.50$ with later reading achievement and concurrent correlations of between $.40$ and $.60$. Blending ability was found to be significantly related to IQ. However, the few studies controlling for IQ found that

blending ability still demonstrated a lesser but yet important correlation with reading achievement. Finally, one must remember that Hammill and Larsen's review was published in 1974, thus missing some of the most illuminating work in this area.

Part 2: The relationship between binocular efficiency and reading achievement.

Most authorities readily agree that gross binocular errors resulting in profound image confusion (ex. continual diplopia) can, by their distractive nature, lead to attentional problems. The influence of less obvious binocular deficiencies (ie. anisometropias, convergence deficiency etc.) however, is not as well understood. Similarly it is generally agreed that the effort required to overcome lower grade binocular deficiencies can lead to disruptive eyestrain. The net influence of such eyestrain on the individual's academic performance, however, is debatable. The preceding ambiguities have led to conflicting statements in the literature by the two eye care specialties of optometry and ophthalmology. Optometry usually supports the position that binocular deficiencies are an important factor in the poor learning performance of a significant number of children while ophthalmology traditionally downplays the role (Dreby, 1979; Flax, 1972, Martin, 1971). Contingent to optometry's position is their emphasis on the merit of visual training programs for poor academic achievers how also demonstrate visual deficiencies. However, two reviews of the vision therapy literature have concluded that statements regarding the efficacy of vision therapy must be tentative at best (Pierce, 1977; Keogh, 1974). Both authors lament the serious methodological weaknesses that plague most of the few studies in this area.

"In light of the many vision training programs directed at learning disabled children, and especially considering the controversy these programs have aroused, the sparseness and inadequacy of the research literature on this topic is surprising. For the most part the studies are characterized by lack of controls, small number of cases, confused methods, inadequate statistical techniques, and over-interpretation and overgeneralization of the findings. Interpretations often appear to be accepted as fact, thereby becoming assumptions upon which remedial actions are taken. (Keogh, 1974, p.42)

The following are studies which exemplify some of the inadequacies Keogh lists. Friedman's (1967) study and Birnbaum and Birnbaum's (1968) study typify the methodological problems of inadequate control and data analysis. Evans, Efron and Hodge's (1976) study indicates how inadequate definition restricts interpretation and generalization. Improper subject selection invalidates Sherman's (1973) findings.

Friedman in 1967 exposed 31 boys in a remedial reading class to a visual training program lasting six months. The techniques employed concentrated on ocular motor efficiency. Friedman did not describe his sample characteristics adequately. He did not, for example, state what visual deficiencies, if any, existed in the first place. He did not use a control group and he did not submit his data to statistical analysis. He merely stated that over the six month period the boys made between 1.7 and 2.2 years gain in reading as compared to the average class improvement of 1.6 years. He further asserted that improvement in various behaviors was also noted by the staff. Such vagueness in reporting and analysis seriously undermines the value of this study.

Birnbaum and Birnbaum (1968) conducted a study where oral reading rate and errors were compared for each subject under a binocular condition vs. a unocular condition. The authors reasoned that poorer reading under the binocular condition vs. the unocular condition would implicate binocular deficiency as the cause of the poorer reading. The study assessed the performance of 15 grade four good readers and 32 grade two poor readers. To correct for effects due to order of presentation, half the sample received unocular condition first with the other half receiving the reverse. Order of presentation proved to be a significant factor confounding the results ie. the children generally did better under the second condition. In addition, the results showed that the highest percentage of binocular inefficiency problems was found in the best reading group. No statistical analysis was done however. Also the authors gave no operational definition of binocular efficiency. As a result Birnbaum's conclusion that " a significant number of children are reading at a less efficient level binocularly than unocularly " must be regarded with some skepticism.

Evans, Efron and Hodge (1976) found a statistically reliably higher incidence of lateral phoria conditions in a learning disabled group vs. normal achievers. Unfortunately the authors did not define lateral phoria condition ie. surely they are not suggesting that the presence of any degree of phoria will cause eyestrain. If not then what was their criteria in delineating acceptable vs. unacceptable phoria?

Sherman (1973) reported a higher than average incidence (as compared to the Orinda Study norms (1959)) of binocular deficiency in a group of 50 learning disabled children. This sample was chosen however from among learning disabled children who had been referred to optometrists in the first place. No wonder they revealed a high number of visual disorders.

While the claims emerging from the forgoing studies can be viewed with some suspicion the results of the following studies merit further consideration .

Bedwell , Grant and McKeown (1980) found that most static viewing tests did not differentiate between poor and good readers. Stereopsis was the exception. Unfortunately Bedwell et al. did not state their operational definition for acceptable performance on the various static tests. Binocular performance on a dynamic viewing test, however, did demonstrate a high significance in relation to reading difficulty. The problem with the dynamic test they constructed though is that examiner judgements were necessarily highly subjective in nature. Nevertheless Bedwell et al. reported interrater reliability coefficients of between .655 and .853. The dynamic test consisted of videotaping each child while reading then having trained examiners judge the children's visual behavior according to a criterion . The film was judged without sound so that the examiners could not be biased by knowledge of the subject's reading ability. Results showed that the poorer readers displayed a significantly greater number of anomalous visual behaviors than did the good readers.

Bedwell et al. suggest that visual deficiencies affecting reading performance are best revealed under test conditions which reflect the dynamic nature of the reading act. They point out that most routine visual tests merely assess a subject's visual skill over a brief time period whereas reading in contrast demands a sustained amount of visual effort. One problem with Bedwell et al.'s rationale however is that the types of visual behaviors they observed (ie. facial stress, head tilts etc.) could possibly have resulted from the child's struggles with the reading material rather than having been the cause of it. This possibility is not addressed by the researchers.

Unlike Bedwell et al. , (1980), Norn, Rindziunski and Skydsgaard's (1969) study supplied clear operational definitions for each variable.

117 dyslectic children were compared on various visual measures to 117 control children apparently matched for age, IQ and sex. The dyslectics had a reliably higher incidence of unacceptable phoria (i.e.) 6 exo or > 4 eso or > 1 hyper). However none of the other measures (ex. amplitude of accommodation, NPC, fusional reserves) discriminated between the two groups.

Eames in 1959 wrote that in his experience anisometropia occurred in only 6% of the normal population yet occurred in 13% of reading failures. He also cited studies by other ophthalmologists that showed 45% - 48% of poor readers to have binocular incoordination of significance. Additionally he stated that cases of hypermetropia of one diopter or more occurred in 43% of reading failures yet only 12% of unselected school children . Unfortunately no data was presented to support these figures.

In 1964 Eames carried out an interesting study where he compared the reading achievement of 25 anisometric children to a control group of 25 children with balanced refractive conditions. The children's average age was nine and a half, their average IQ was 108 and they were all from the same school. Initially the anisometric group presented a median reading age that was one year below that of the controls. Moreover the initial median reading age of the poor readers in the control group was nine years while the anisometric poor readers initially had a median reading age of seven years nine months. Six months following correction, the anisometric group achieved the same median reading age as the controls. Furthermore while the poor readers in the control group had improved by only one month the poor readers in the treatment group had improved by nine months.

Eames concluded that correction of the anisometropia permitted a number of the children to better achieve their potential. He also suggested that since the reading failures in the control group made little improvement after correction, the causes of their failure must have been mostly non-ocular. Unfortunately Eames neglected to note whether the children had different teachers though he states that 'they were all receiving the same instruction'. He also failed to report means and standard deviations for the children's ages, IQ's and reading performance. Moreover, no statistical analyses of his data were reported.

In 1970 Wilson and Wold conducted a thorough vision screening of Grade 3 - 5 children in the high and low quartiles of reading performance in two schools. Chi Square analysis of the results showed a statistically reliably higher incidence of poor performance in the poor reader group on the following binocular tests only : stereopsis and ocular pursuits as well as horizontal fixations.

Weber (1980) compared 25 poor academic achievers to 25 top achievers in grade 2 - 5 on two measures of visual function. One was the near point of convergence test and the other was Heinsen's Pursuit, Centering and Alignment Test. Weber reported statistically reliably higher incidence of visual deficiency on both measures in the poor achiever group.

This review illustrates some of the important methodological problems associated with the empirical evidence to date. Nevertheless the better studies do provide some valuable information. Some of them suggest that dynamic visual tasks are more discriminatory between good and poor readers (Bedwell et al. 1969; Wilson and Wold , 1970). Yet, a number of them still found certain static viewing tests to be of importance (Eames, 1964; Weber, 1980; Norn et al., 1964).

Statement of the Hypotheses

This study was concerned with auditory analysis skills and binocular efficiency in so far as they relate to reading achievement.

Hypothesis one states that a multiple regression analysis with vocabulary achievement as the dependent variable and IQ and Auditory Analysis Test scores as the independent variables, will demonstrate that a statistically reliable amount of the explainable variance in vocabulary achievement will be accounted for by auditory analysis scores even after the influence of IQ has been taken into consideration.

Hypothesis two states that a reliably higher incidence of binocular deficiency will exist in a group of poor readers versus a group of good readers of same age, IQ and socioeconomic background. No interaction between the binocular deficiency and auditory analysis variables was postulated because the research to date has not suggested any such link.

The Test of Auditory Analysis Skills (TAAS) designed by Rosner was used in the study. It is very straight forward, easy to administer and

useful because it leads to positive remedial steps which are themselves clearly laid out (Rosner, 1975). Several notable authorities have favorably reviewed Rosner's testing and training program (Gibson and Levin, 1975; Williams, 1977; Rozin and Gleitman, 1977; Fox and Routh, 1975). The TAAS is also currently in wide use by Optometrists involved in the learning disabilities area.

The binocular tests used were chosen so as to encompass the complete spectrum of binocularity ie. refractive imbalance, muscle imbalance, accommodative insufficiency and ocular pursuit ability. Though these tests are all optometric, variations of them can be performed by properly trained paraprofessionals or teachers and as such could form a part of a school vision screening test battery.

CHAPTER III

METHODSubject Selection

The Gates MacGinitie Reading Test Primary B was given to four grade two classrooms from two schools in the lower middle class district approximately 40 miles from Vancouver. From the initial 104 students 68 who met the following criteria were chosen:

- a) had an average PPVT IQ between 90 - 109.
- b) had no history of emotional disturbance, speech or hearing defects as determined by teacher questionnaire.
- c) had obtained a total reading score of less than or equal to a grade equivalence of 2.5 or greater than or equal to a grade equivalence of 2.8. In addition a small number of extremely high or low scoring subjects were not included. Children who scored ≥ 2.8 were operationally defined as good readers and children who scored ≤ 2.5 were defined as poor readers.

InstrumentsThe Peabody Picture Vocabulary Test

The PPVT is a widely used verbal ability measure that can be used as an indicator of intelligence. It is acknowledged to have acceptable validity coefficients in comparison with other recognized intelligence tests that rely on verbal ability (PPVT, 1965). The test consists of the subject selecting one picture from a group of four to represent a word spoken by the examiner (Appendix 1).

The Gates MacGinitie Reading Test (Canadian Edition, 1978) - Primary B

The Gates-MacGinitie Reading tests are a series of group administered reading tests designed to measure individual and group reading achievement from Kindergarten through grade 12. Primary B is designed for use in the second grade. The test consists of two parts: Vocabulary and Comprehension. The items in the vocabulary section require the child to select from a list of four words the one word which best goes with the given picture. The

items in the comprehension section require the child to select from a list of four sentences or paragraphs the one which goes best with the given picture. The K-R20 reliability coefficients as reported in the manual range from 0.85 - 0.94 for the Vocabulary sections of the series and from 0.85 - 0.92 for the Comprehension sections of the series.

The Auditory Analysis Test (Appendix 2)

The AAT was developed in 1972 by J. Rosner as a part of an extensive study done at the Learning Research and Development Center, University of Pittsburgh. The original test consisted of 40 items. Each item required the subject to repeat a word spoken by the tester but with specific phoneme(s) deleted. For example:

Tester: "Say meat; now say it again, but don't say the 'm' sound."

The items start out with simple syllable deletion progressing in difficulty to deletion of part of a consonant blend. The AAT was developed because the author found that with the exception of Chall's phoneme blending test,

"... most auditory perception tests were primarily concerned with hearing acuity or, at best, discrimination skills (Wepman, 1958; Murphy and Durell, 1949; STAP, 1969). These tests usually require responses limited to 'yes-no', 'same-different' or the like. Such responses provide a minimum of information concerning the processes used to produce the assessed behaviors." (Rosner, 1971, p.40)

Furthermore, the AAT was designed to be used in conjunction with the Auditory Analysis Training program developed by the authors to teach those skills used in analyzing spoken words into their component parts.

Studies by the authors have shown that there is a high correlation between AAT and language arts achievement (with IQ held constant) particularly for grades 2 - 5 (ie. 0.5, p .01; Rosner, 1971; 1971, 1973). The Auditory Analysis Training program has also been shown to effectively teach Auditory Analysis Skills to prereaders (Rosner, 1974a). One study (Rosner, 1971) has also shown that inclusion of Auditory Analysis training in a grade one reading program resulted in statistically reliably better reading achievement for those children who received the training and whose entering Auditory Analysis skills had been substandard.

In 1975 Rosner published a revised Test of Auditory Analysis Skills in his book Helping Children Overcome Learning Difficulties. This test

consisted of 13 items and it is this test that is commonly used by optometrists, parents and educators (see Appendix 2). Therefore the shorter TAAS was employed in this study. The administration and scoring procedure followed was the one advised by Rosner and is given in Appendix 2.

Binocular Skills Tests

refractive imbalance - This refers to the optical status of each eye relative to the other. It was determined by static retinoscopy with trial lenses and frame.

amplitude of accommodation - This was determined by the standard uni-ocular push-up method using .37M numbers on an ophthalmic near card. Accommodation can be thought of as focussing ability.

fusional reserves (40cm.) - This was measured using polarised vectograms. This test comprises two photographs that are superimposed and viewed through polarised glasses such that one photo is seen by only one eye while the other photo is visible solely to the other eye. The eyes' ability to diverge and converge relative to one another and still see a single scene in depth can be assessed by moving the vectograms out or in until double vision results.

near point of convergence - This was determined using a .50M letter 'E' on a white pinhead. The break and recovery points are determined objectively by noting when the subject's eyes seize and resume binocular tracking of the target as it is brought toward the bridge of the nose.

stereopsis- This was measured with the Titmus Stereofly test at 40cm.

net dynamic retinoscopy - This was performed using a trial lens set with the subject fixating a .50M black letter E on white at 40cm.

phorias and tropias (40cm) - This was evaluated objectively using the Cover test with loose prisms while the subject fixated a target at 40 cm.

Heinsen's Pursuit Test Parts I and II - This tests ocular pursuit ability at the 40 cm. viewing distance under two conditions.

Part I - The tester slowly moves a .50M letter target 30 - 50 cm. in front of the child in five circular rotations approximately 30 - 50 cm. in diameter. During this time the examiner determines whether or not only the eyes follow the target or whether the head and body follow the

target. If there is head movement the child is asked to hold still and the five rotations are repeated. Jerkiness or irregularity in eye movements is noted.

Part II - This is the same as Part I with the added task of asking the child the following simple questions only once:

1. What is your name?
2. What is your teacher's name?
3. What is the name of your school?
3. What is $1 + 1$?
5. What is $2 + 2$?

The examiner observes whether the child can separate 'centering' (ie. what he is listening to and thinking about) from alignment (ie. what he is looking at).

Procedure

All 68 subjects were tested on the Gates-MacGinitie Reading test, the Peabody Picture Vocabulary Test (PPVT), the Test of Auditory Analysis Skill (TAAS) and the binocular skills test battery. The PPVT, TAAS and binocular skills tests were administered individually by the investigator to the subjects in a private room. In order not to tire the children excessively the PPVT was given at one sitting with the auditory and binocular skills tests given at another on a different day. All testing took place between mid April and mid May, 1981.

To test hypothesis I a regression analysis was performed using the Vocabulary Scores on the Gates - MacGinitie Reading test as the dependent measure. The two independent variables were IQ (as measured by the PPVT) and the Test of Auditory Analysis Skill (TAAS) scores. IQ scores were entered in Step one of the analysis in order to statistically control for the influence of IQ in the relationship between auditory analysis skill and vocabulary achievement.

To test hypothesis II , in keeping with the methods used by other researchers, the scores on the individual binocular skills tests were reduced to a dichotomy of acceptable or unacceptable performance (see operational definitions to follow). A phi coefficient procedure (Downie and Heath, 1959) was used to test the difference in incidence between the good and poor reader groups of deficiency in each binocular skill. For $df = 1$ statistical reliability at the 1% and 5% probability levels the

phi coefficient must be greater than or equal to .31 and .24 respectively.

Based on the standards set by previous researchers (Peters et al., 1959; Bedwell et al., 1980; Weber, 1980) unacceptable performance on each of the binocular skills tests was judged as follows:

refractive imbalance - 1.00 D.S. or Cylinder or greater

lateral and vertical phoria (40cm.) - any tropia

- esophoria of 6^{Δ} or more

- exophoria of 10^{Δ} or more

-hyperphoria of 2^{Δ} or more

stereopsis - 50" or less

near point of convergence - break/recovery of 20cm./25cm. or poorer

positive and negative fusion ability - positive fusion of 8^{Δ} or less

- negative fusion of 6^{Δ} or less

amplitude of accommodation - 6.00 D. or less

net dynamic retinoscopy - +1.50 or poorer

Heinsen's ocular pursuit test - Part I, those children with inadequate performance could not automatically track the target with steady, regular eye movements.

Part II, those children with inadequate performance could not maintain fixation on the target while answering simple questions.

CHAPTER IV

RESULTS AND DISCUSSION

The multiple regression analysis examined the following relationship:

$$y' \text{ (predicted vocabulary scores)} = a + b_1 X_1 \text{ (IQ)} + b_2 X_2 \text{ (auditory analysis skill)}$$

Simple correlations among the three variables showed that the Test of Auditory Analysis Skill and IQ had a relatively low correlation, $r = .23$ (see Table 2). Vocabulary and IQ had a correlation of .41 and Vocabulary and Test of Auditory Analysis Skill had the highest simple correlation of $r = .63$. One should note that the selection of subjects from a restricted IQ range may have attenuated the correlation between IQ and vocabulary. Regression analysis showed that, after the influence of IQ was taken into consideration, the Test of Auditory Analysis Skill scores contributed an additional 31% to the explainable variance in vocabulary scores (Table 4). Together they explained 47.4% of the variance in reading scores. The b weight for both IQ and the Test of Auditory Analysis Skill yielded F ratios significant at $p < .01$ (Table 3). **This tells us that both these variables added statistically reliably to the prediction of vocabulary scores.** Test of Auditory Analysis Skill scores were the most significant of the two however. The F's in the R^2 summary table (Table 4) show that the regression equation at step 1 and at step 2 reliably predicted vocabulary scores for this sample.

One should be aware of the limits of multiple regression analysis. Regression coefficients often will change with different samples. They can have large standard errors and can vary with different numbers of independent variables. To minimize this problem Kerlinger and Pedhazur (1973) advise using sample sizes of no less than 100 and to use independent variables with low intercorrelations. **The sample in this study numbered 68.** The intercorrelation between IQ and Test of Auditory Analysis Skill (TAAS) however was low at .23.

As is traditionally done both in research and clinically in the ophthalmic field, each of the visual measures was reduced to a dichotomy (Unacceptable, acceptable). **As such each was individually analyzed in relation to the reading status of the subjects (good reader, poor**

TABLE 1

SAMPLE CHARACTERISTICS : MEANS AND STANDARD DEVIATIONS FOR ALL VARIABLES OF THE TOTAL SAMPLE

VARIABLE	MEAN	S.D.
vocabulary	26.88	9.94
IQ	101.59	12.42
Test of Auditory Analysis Skill (TAAS)	9.74	2.55

NOTE: sample size = 68

TABLE 2

INTERCORRELATIONS BETWEEN TEST SCORES ON VOCABULARY (GATES MacGINITIE),
IQ (PPVT) AND TEST OF AUDITORY ANALYSIS SKILL (TAAS)

	VOCABULARY	IQ	TAAS
VOCABULARY	1.00	.41*	.63*
IQ	.41*	1.00	.23
TAAS	.63*	.23	1.00

NOTE: sample size = 68

* $p < .01$

TABLE 3

REGRESSION COEFFICIENTS AND TESTS OF SIGNIFICANCE OBTAINED ON THE
IQ (PPVT) AND TEST OF AUDITORY ANALYSIS SKILL (TAAS)

VARIABLE	b	STANDARD ERROR OF b	F
IQ	.22	.07	8.93*
TAAS	2.23	.36	38.16*

NOTE: * p (.01

b refers to the regression weight yielded by the regression analysis ie. $y' = a + b_1X_1$ (IQ) + b_2X_2 (Test of Auditory Analysis Skill).

F statistics here refer to the statistical reliability of the regression coefficients.

TABLE 4

SUMMARY OF MULTIPLE CORRELATION STATISTICS

VARIABLE	R	R ²	R ² change	F
IQ	.407	.165	-----	13.085*
TAAS	.687	.474	.309	29.307*

NOTE: * p (.01

F statistics here refer to the statistical reliability of the regression equation at each step in the analysis.

reader). Differences in incidence of deficiencies between the two reader groups was assessed by a phi coefficient procedure. Table 6 shows that of the eight visual tests only stereo acuity discriminated reliably between the good and poor readers.

Why did only one of the eight visual tests discriminate between good and poor readers? Several reasons present themselves.

This sample of children may have been too small to sufficiently tap that segment of the student population troubled by binocular disturbances. A better way to judge the effect of binocular deficiency on reading performance might have been to choose a group of prereaders all of whom have binocular problems and compare their reading development to a control group without binocular anomalies. Eames did approximately this in his 1964 anisometropia study and netted positive findings.

Also, like most of the research in this area, this study did not examine the possibility of an aptitude treatment interaction between binocular efficiency and a variable like intelligence for example. Pierce (1977) was one of the first optometrists to discuss the serious need for a model which takes into account the adaptive abilities and tolerance levels of the individual. Furthermore it is well known clinically that a visual deficiency which for one person results in severely debilitating performance may have seemingly no effect on another's performance. What attributes enable one individual to handle this anomaly and the other not is a perplexing question which must be addressed in future research.

It is also possible, as Bedwell et al. (1980) suspected, that static visual tests miss binocular anomalies of a lesser yet still impeding nature. Fusion and accommodative ability are dependent upon muscle performance. Muscles can fatigue. Dynamic tests which would demand at least a minute or more of sustained visual effort could conceivably reveal weaknesses that are normally missed when only a brief muscular effort is required. The only subtest which proved to be significant (ie. stereoacuity) required the longest visual fixation. In addition stereoacuity tests tap more than one facet of visual function. Muscle coordination, accommodative ability and refractive imbalances can all affect stereoacuity. The reading act for beginners requires sustained visual concentration on the printed page.

TABLE 5

MEANS AND STANDARD DEVIATIONS FOR THE READING AND IQ SCORES OF THE GOOD AND POOR READERS

	Total Reading Score (Gates MacGinitie)		IQ (PPVT)	
	mean	s.d.	mean	s.d.
Good readers (n = 30)	70.16*	5.94	106.63	10.19
Poor readers (n = 38)	38.37**	10.3	97.61	12.7

NOTE: *corresponds to grade equivalency of 3.6

**corresponds to grade equivalency of 2.0

TABLE 6

SUMMARY OF PHI COEFFICIENTS FOR THE EIGHT VISUAL SUBTESTS [Refraction (1), Dynamic Retinoscopy (2), Amplitude of Accommodation (3), Near Phoria (4), Near Point of Convergence (5), Stereoacuity (6), Fusion (7), Heinsens Ocular Pursuit Test (8)]

	VISUAL SUBTESTS							
	1	2	3	4	5	6	7	8
Phi	.02	.15	- ²	.03	.11	.33**	.13	.09

NOTE: ** significant at p.01
² phi not calculable

Visual testing under conditions which better approximate that demand may yield the expected results.

At this point one may ask why the Heinsen's ocular pursuit test, a seemingly dynamic test, did not differentiate the two groups. In fact, Table 7 shows us that each reading group was almost equally split in their pursuit performance. This is opposite to Weber's 1980 results.

The answer may lie in a closer look at just what the Heinsen's test is measuring. The reading act requires the reader to make successive saccades, fixations and regressions in the horizontal plane while attending to the material being fixated. Heinsen's test Part A and B instead requires the subject to follow a target in a circular path. Part B additionally requires the subject to answer oral questions while following the target. Failure is seen as the presence of head movements, jerkiness of the eyes themselves or looking away altogether. Just what Part b has to do with the reading act is not clear. It is also questionable whether head movement accompanying eye movements poses any impediment to reading. Dynamic visual tests therefore must be measuring a skill germane to the reading act in order to have any bearing on reading performance.

It may also be that for the majority of poor readers binocular deficiencies are not a key factor. This is not to say that binocular anomalies when they do occur bear no relationship to the student's reading disability but rather that the absolute incidence of binocular deficiency may be relatively low even in poor readers groups.

However, in considering the results of the visual date analysis one must also acknowledge certain weaknesses inherent in the research design. When reducing continuous scores to simple dichotomies potentially useful information is always lost. A better way to have evaluated the relationship between binocularity and reading might have been to first develop some type of binocular skills checklist against which the visual abilities of each child could be assessed. A scoring procedure based on a continuous scale could then be used. Moreover, the resultant visual scores along with the reading test raw scores could then be analyzed via a type of correlation procedure. Furthermore, this would allow for the direct comparison of the importance of binocular skills to other variables in reading development by permitting the use of multiple regression techniques.

TABLE 7

INDIVIDUAL PHI MATRICES DERIVED FROM THE EIGHT VISUAL SUBTESTS ON THE
BINOCULAR TEST BATTERY

SUBTEST 1 (refraction)		Readers			
count	tot. %	good	poor		
good	29 42.6%	37 54.4%	66	phi = .02	
poor	1 1.5%	1 1.5%	2		
	30	38			

SUBTEST 2 (dynamic retinoscopy)		Readers			
count	tot. %	good	poor		
good	30 44.1%	36 52.9%	66	phi = .15	
poor	0	2 2.9%	2		
	30	38			

SUBTEST 3 (amplitude of accommodation)		Readers			
count	tot. %	good	poor		
good	30 44.1%	38 55.9%	68	phi not calculable	
poor	0	0			

TABLE 7 (continued)

SUBTEST 4
(near phoria)

	count tot. %	Readers		
		good	poor	
good	28 41.2%	36 52.9%	64	
poor	2 2.9%	2 2.9%	4	
		30	38	

phi = .03

SUBTEST 5
(near point
of convergence)

	count tot. %	Readers		
		good	poor	
good	30 44.1%	37 54.4%	67	
poor	0	1 1.5%	1	
		30	38	

phi = .11

SUBTEST 6
(stereoacuity)

	count tot. %	Readers		
		good	poor	
good	28 41.2%	25 36.8%	53	
poor	2 2.9%	13 19.1%	15	
		30	38	

phi = .33**

TABLE 7 (continued)

SUBTEST 7

(fusion
ability)count
tot.%

good

poor

		Readers		
		good	poor	
	29	34		63
	42.6%	50.0%		
	1	4		5
	1.5%	5.9%		
	30	38		

phi = .13

Subtest 8

(Heinsen's
ocular
pursuit
test)count
tot.%

		Readers		
		good	poor	
	17	18		35
	25.0%	26.5%		
	13	20		33
	19.1%	29.4%		
	30	38		

phi = .09

NOTE:

**significant at p (.01)

In conclusion then of the eight subtests used in this study only one discriminated reliably between good and poor reader groups. While acknowledging that this area merits further investigation it may be that a stereoacuity test could be a useful supplement to the Snellen Chart in school vision screening. Nevertheless, further investigation is needed into the exact nature of the visual skills required by readers. In addition we need more effective ways to evaluate these skills as they pertain to reading.

This study did lend support to the growing realization that phonemic awareness is related importantly to reading achievement. This held true even when the influence of IQ was statistically controlled. However, as an ex post facto correlational design this study cannot be used to assert a causal relationship between phonemic awareness and reading ability. Experimental studies of the nature Ehri (1979) proposes should follow the present one in order to provide insight into the question of causality. Future research should also investigate the possibility of an aptitude treatment interaction between phonemic awareness and various instructional approaches. Such ATI studies are suggested by Richardson's (1977) finding that blending ability correlated more highly with reading ability in a phonics vs. whole word approach in reading instruction. Also, it is possible that the auditory analysis training itself could interact differentially with, for example, a child's intelligence level to produce varying effects.

In conclusion, then, the results of this study provided independent confirmation of some of Rosner's findings. They also helped clarify the importance of the predictive relationship between auditory analysis skill and reading achievement once the influence of IQ has been partialled out.

CHAPTER 5

CONCLUSION

This study examined whether reading achievement in grade two would correlate significantly with performance on an auditory analysis test and a binocular skills test battery. The hypotheses were that poor readers would be weaker than good readers in auditory analysis and binocular skills. IQ was taken into consideration in both cases. The data strongly supported the first hypothesis regarding auditory analysis skill but only weakly supported the second hypothesis regarding binocular efficiency. In view of the results from this study as well as the rest of the research to date what directions may we glean for future research and practical applications.

Ehri's (1979) call for more experimental as opposed to correlational studies is a valid one. The research on both auditory analysis and binocular skills as they relate to reading would benefit from designs which manipulated the skill variable in question in a treatment versus control group manner. Having measured the auditory analysis or binocular skill training effect on reading performance one would be better able to discern more clearly the causal relationship between each skill deficiency and reading failure. It is possible that auditory analysis and/or binocular skills need not function at a high level in all individuals in order for successful reading acquisition to take place. It is highly likely, however, that efficient function of each greatly facilitates the development of reading skill. Research should concentrate on formulating effective ways to measure and enhance auditory analysis and binocular skills pertinent to the reading act. So far no comprehensive study of the comparative effectiveness of the few existing training programs emphasizing phonemic awareness ability has been made (Lewkowicz, 1980).

The importance of individual gains as they relate to individual potential should also be examined. One should not forget that though many children perform adequately in comparison to their peers they are capable of even better individual performance given the removal of subtle handicaps like binocular stress. Future studies should incorporate into their

rationale this appreciation for optimum individual performance.

Clearly the auditory analysis skill issue has a stronger empirical base upon which to build. The binocular skills question could still use some replication of basic correlational data to establish the strength of the relationship between poor reading and binocular deficiency. Definitely the results from this study suggest that auditory analysis skill deficiency is a far greater factor than binocular deficiency in reading failure. Remedial reading teachers in particular should consider the routine assessment and enhancement of auditory analysis skill in problem readers. Moreover, until further evidence is brought to bear upon the influence of binocular skills on reading performance teachers would do well to be alerted to their potential role in reading failure. However, the actual number of children whose reading performance is undermined by binocular stress remains to be clarified by further investigation.

If indeed binocular stress induced reading disability turns out to affect a population segment of about equal to the standard population norms (ie. for those available, anisometropia =12%; high phoria or tropia=7% , Hartstein, 1971; Peters et al.,1959) the argument for more comprehensive school vision screening will still prevail. Clinical experience shows over and over that uncorrected binocular problems can have serious and long term negative educational consequences for individual students. Furthermore, as already suggested even students who are performing adequately in school could experience yet greater academic success if freed entirely from any degree of binocular handicap.

The cost of providing improved visual screening need not be high. As this study intimates the addition of a simple test of stereoacuity perhaps could beneficially augment the value of present school vision screening practices. However, one must be careful not to infer too many conclusions regarding actual test procedures to be used in school vision screening on the basis of this study. The question of what comprises the most reliable, valid and cost effective mode of school vision screening was not the issue under investigation here.

With regard to auditory analysis screening what are the professional implications for optometrists? Certainly this study and others have demonstrated a strong link between adequate auditory analysis skills and

reading development. Optometrists who have distinguished themselves in the area of learning disabilities through the provision of visual perceptual testing and training must acknowledge the cumulative implications of the research literature to date. The addition of auditory perceptual testing to their routine visual assessment of children may be the path to follow. Many optometrists however feel strongly that the responsibility for auditory analysis skill assessment and remediation should lie with the teacher. Many feel that even visual perceptual testing and training are better handled in the educational setting. Dr. Rosner may represent a compromise between these opposing viewpoints. In his opinion testing for visual and auditory analysis skills can be accomplished in about 10 minutes per child by a competent optometric assistant. Furthermore he advocates that training procedures should be carried out at home and in the school by parents and teachers. The optometrists role then is one of providing rudimentary diagnosis and guidance for remediation. Moreover, Rosner does not consider such perceptual testing to lie within the sole domain of Optometry. Rather, he expects all who deal with learning disabled children, be they parents, teachers, psychologists, optometrists or physicians, to be aware of the merits of such a perceptual skills program (Rosner, 1975).

APPENDIX 1

Peabody Picture Vocabulary Test.

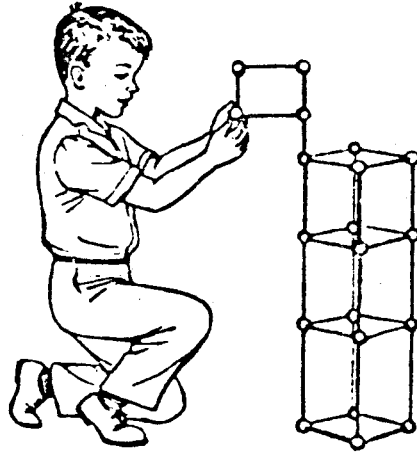
Age: 11.6

Show Me "assaulting."

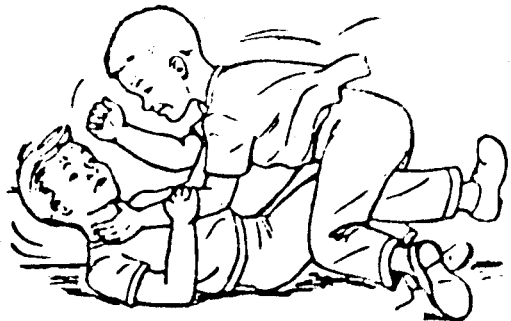
69



1



8



APPENDIX 2

Giving the TAAS

The test starts off with two demonstration items that are intended to show the child what he is expected to do. The first (item A) goes like this: "Say cowboy." (Now pause and allow him to respond. This lets you know that he heard the word.) Then say: "Now say it again but don't say boy." Give him time to respond. (The correct answer, of course, is cow.)

If he gets this one correct, move on to the second demonstration item. If he does not get item A correct, see if you can explain it to him. But if it requires more than a simple explanation, stop testing.

The second demonstration item (item B) is "Say steam boat ." (Pause - wait for his response.) "Now say it again, but don't say steam."

If he answers both demonstration items correctly, start the test with Item 1. If he does not answer both demonstration items correctly, do not administer any more items.

NOTE:

1. Do not give him hints with your lips. Speak distinctly, but do not stress any particular sounds. In other words, do not give him any additional information that might make the task easier. Sure, you want him to do well, but not at the expense of looking better on the test than he really is. The results would be misleading and deprive him of the chance to learn the skills needed for reading and spelling. Just as with the TVAS, this test gives you a way to determine if the child's auditory skills are up to the demands of his classroom instructional program, what skills he already knows, and which ones he should learn next.
2. Remember, when you get to the items that ask the child to "Say the word, but don't say / .. / [a single sound]" you are to say the sound of the letter, not the letter name.
3. Stop testing after two successive errors - two incorrects in a row - and record the number of the last correct item before those two errors. That is his TAAS score. For example, if he was correct with items 1,2, 3,4, and 5, then incorrect on items 6 and 7, his TAAS score would be 5. If he was correct on 1,2, and 3, incorrect on 4, correct on 5 and 6, then incorrect on 7 and 8, his TAAS score would be 6.

TAAS

		answer
A Say cowboy	Now say it again, but don't say boy	cow
B Say steamboat	Now say it again, but don't say steam	boat
1 Say sunshine	Now say it again, but don't say shine	sun
2 Say picnic	Now say it again, but don't say pic	nic
3 Say cucumber	Now say it again, but don't say cu (q)	cumber
4 Say coat	w say it again, but don't say /k/ (the k sound)	oat
5 Say meat	Now say it again, but don't say /m/ (the m sound)	eat
6 Say take	Now say it again, but don't say /t/ (the t sound)	ache
7 Say game	Now say it again, but don't say /m/	gay
8 Say wrote	Now say it again, but don't say /t/	row
9 Say please	Now say it again, but don't say /z/	plea
10 Say clap	Now say it again, but don't say /k/	lap

- | | | |
|---------------|-------------------------------------|------|
| 11. Say play | Now say it again, but don't say /p/ | lay |
| 12. Say stale | Now say it again, but don't say /t/ | sale |
| 13. Say smack | Now say it again, but don't say /m/ | sack |

(Rosner, 1975, pp.77,78)

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