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A Longitudinal Study of Visual Selective Attention, Auditory Selective Attention, IQ, and Reading Readiness as Predictors of Reading Achievement

Naomi F. Garwood

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A Longitudinal Study of
Visual Selective Attention, Auditory Selective Attention,
IQ, and Reading Readiness as Predictors
of Reading Achievement

THESIS

Submitted to the Graduate Committee of the
Department of Curriculum and Instruction
Faculty of Education
State University College at Brockport
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Education

by
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Abstract

The purpose of this study was to investigate the predictive validity of four factors tested in a kindergarten sample—visual selective attention, auditory selective attention, IQ, and reading readiness. This study was to investigate which of the four factors was the most accurate predictor of reading achievement at the end of first grade and fifth grade, and which of the testing elements form the best combination for accurately predicting reading achievement.

The original studies, investigating the visual and auditory selective attention abilities of children completing a kindergarten program, were conducted by Cuccu and DeChristopher in 1978. The original number of subjects attending a suburban western New York public school was 50.

The four tests used as predictor variables were given during the kindergarten school year 1977-78. Visual selective attention was determined using a sorting task designed and administered by Cuccu. Auditory selective attention was determined by using dichotic listening tapes administered by DeChristopher. Verbal IQ was determined using the Peabody Picture Vocabulary Test administered by the classroom teacher, and reading readiness was determined using the pre-reading skills composite score on the Metropolitan Readiness Test (MRT) administered by the classroom teacher.

One year later, 34 of these children remained in the school for their first grade year and 31 were included in this follow-up study. First grade reading achievement was determined using the total reading score on the Metropolitan Achievement Test, Primary I Level. In 1983,
16 of the original kindergarten sample completed their fifth grade year, and 15 were included in this study. Fifth grade reading achievement was determined using the total reading score on the Metropolitan Achievement Test, Intermediate Level.

Multiple stepwise regression revealed that reading readiness was the best single predictor of reading achievement at the end of first grade. The best combination of predictor variables was reading readiness and visual selective attention. IQ was found to be the best single predictor of reading achievement at the end of fifth grade, and the best combination of predictors was IQ, visual selective attention, and reading readiness.

Tests of selective attention are not regularly administered in kindergarten. Results of this study indicate that visual selective attention tested in kindergarten may be a useful additional screening procedure and could be important in determining the type of formal reading instruction most appropriate for the beginning reader.
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Chapter I

Statement of the Problem

Purpose

During kindergarten, some measurement of IQ and reading readiness is usually obtained. Even though attention is a necessary condition for learning, a measurement of visual and auditory selective attention is seldom obtained. The purpose of this study, which is a follow-up of selective attention studies conducted by Cuccu and DeChristopher in 1978, was to investigate the predictive validity of visual selective attention, auditory selective attention, IQ, and reading readiness on reading achievement. This study investigated which of the four factors tested in a sample of kindergarten children was the most accurate predictor of reading achievement at the end of first and fifth grade. Which of the testing elements formed the best combination for accurately predicting reading achievement was also studied.

Need for the Study

At any given moment a person receives stimuli from a great many sources and through every sense receptor. Visual, auditory, tactual, kinesthetic, and proprioceptive nerve fibers are constantly carrying impulses which often
demand conflicting, mutually incompatible responses. Behavioral chaos would result if the person were not able to select among these impulses and to attend to one or a limited number at a time. Selective attention is thus a highly adaptive capacity, and a defect in using this capacity would be a considerable handicap (Ross, 1976).

Gibson (1969) emphasizes the optimization of attention as an important trend in perceptual development. Optimal attending is a skill that develops in the child from "capture" at the earliest stages to flexible, adaptive, controlled exploration in the adult. In its development, attention becomes more exploratory and less captive, the exploratory search becomes more systematic and less random, attention becomes more selective, and attention becomes more exclusive (Gibson, 1969).

Selective attention, focusing on the wanted information, seems to mature developmentally. In the development of a mature level of selective attention, a child passes through two earlier stages, overexclusive attention and overinclusive attention (Ross, 1976; Ross, 1977).

In the very young child, the dominant mode of attention can be described as overexclusive. One aspect of a stimulus "captures" the child and he attends to it to the relative exclusion of all others. Eye movement studies (Vurpillot, 1968) demonstrate that until about age six,
children generally restrict the scanning of a stimulus to a limited area.

If a child were to continue to function in this manner after an age when most other children develop beyond this mode, the child would be disadvantaged in any task where adaptive behavior demands more thorough exploration of the stimulus complex. Ross (1976) suggests that an extreme of this developmental retardation in children is early infantile autism. Newsom and Lovaas (cited in Ross, 1976) stress that attention is a learnable skill which autistic children have failed to acquire. Ross also suggests that a milder form of developmental lag in attention may be associated with reading disability. Vande Voort, Senf, and Benton (1972) found that poor readers have difficulty with selective attention tasks. Satz, Rardin, and Ross (1971) reported that children with reading difficulties have trouble with dichotic listening tasks, a form of selective attention.

Some children with reading difficulties may be having trouble because their way of attending to a stimulus is immature and resembles the overexclusive attention of a much younger child (Ross, 1976). With their development thus retarded, such children may also experience difficulty in the next stage, overinclusive attention. In the overinclusive attention phase, the normal child seems to
attend to many aspects of a stimulus situation. The child attends to more than the minimum essential for efficient detection of distinctive features. A child who attends to many irrelevant stimuli will progress in learning more slowly than one who has developmentally progressed to the phase of selective attention.

Stevenson (1972) points out that in reading, a child must attend to the relevant aspects of letter combinations and disregard their irrelevant features, such as color or size. Siegel (1968) found that good readers show less incidental (task-irrelevant) learning than normal readers. This finding may reflect that good readers are less overinclusive in their attention or that they have already moved on to the next developmental phase. Ross (1976) speculates that some poor readers are such because, arriving at the overinclusive phase late, their attention to irrelevant stimuli handicaps their reading acquisition. Disabled elementary and junior high school readers have more difficulty focusing on relevant information than do normal readers (Cotugno, 1981; Ricks, cited in Santostefano, 1978; Santostefano, Rutledge, & Randall, 1965).

Available research suggests that incidental learning shows a decline after about age 12. This decline is probably the complement of the individual's increasing ability to engage in selective attention, that is, to
focus on those aspects of a stimulus complex which carry the distinctive feature. Ross (1976) suggests that the learning disabled child, and particularly the disabled reader, may be slow in acquiring this skill. Such a child might still be using the overinclusive mode of attention when peers are functioning at the level of selective attention. Such children might respond to all manner of irrelevant stimuli, making them appear impulsive, distractible, and hyperactive.

In summary, selective attention is probably one of the most basic skills required for reading. The child must be able to select from the many stimuli in the environment the limited few that are critical for reading. If a child has not yet acquired the capacity for sustaining selective attention, reading could be difficult or impossible.

Many studies have been conducted to identify in young children early competencies or characteristics as predictors of later reading achievement, but few longitudinal studies have been carried out. IQ and reading readiness measures have been predictor variables in other studies but as yet, no published study has investigated visual and auditory selective attention as predictors of reading achievement.

Cuccu (1978) and DeChristopher (1978) investigated
the visual and auditory selective attention abilities of children completing a kindergarten program. They have called for a longitudinal study of those children to determine if performance on selective attention tasks is a valid and reliable indicator of later reading achievement.

It has been generally accepted that standardized tests of mental ability accurately predict classroom performance in traditional academic areas of study. A reasonably impressive predictive relationship has been found between students' scores on IQ tests (as measured by individually or group-administered standardized tests) and performance in traditional academic areas of study (as measured by teacher evaluation or achievement test scores) (Hartlage & Steele, 1977; McCandless, Roberts, & Starnes, 1972; Meesé, Crano, Meesé, & Rice, 1979).

Measures of intelligence correlated with reading readiness and reading achievement generally have reported IQ measures to be of value in making such predictions. The Slosson Intelligence Test (SIT) given to three samples of pre-kindergarten pupils yielded reasonably stable scores which were moderately predictive of academic achievement in kindergarten, first, and second grades (Klein, 1978). Hale, Douglas, Cummins, Rittgarn, Breed, and Dabbert (1978) found that the Slosson IQ significantly
predicted Wide Range Achievement Test (WRAT) standard scores of 95 school-age children referred for psychological testing. Studies correlating scores obtained by kindergarten children on the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) with measures of reading achievement in first grade report significant findings (Feshbach, Adelman, & Fuller, cited in Massoth & Levenson, 1982; Lieblich & Shinar, 1975). In a study of 155 school-age children referred for psychological evaluations, Hale (1978) found that the Wechsler Intelligence Scale for Children-Revised (WISC-R) Verbal IQ was a significant predictor of WRAT Reading and Arithmetic subtests. Wickoff (1979) investigated the validity of the WISC-R IQs as predictors of achievement as measured by the Peabody Individual Achievement Test (PIAT). The Verbal IQ, Performance IQ, and Full Scale IQ were each a significant predictor of each of the PIAT subtests.

A number of critics have questioned the validity of IQ tests as accurate predictors of classroom performance for elementary school children, especially as it applies to minority-group and other economically disadvantaged or culturally diverse children (Crockett, Rardin, & Pasewark, 1976; Goldman & Hartig, 1976; Mercer, cited in Meesé et al., 1979; Rankin & Henderson, 1973). Mercer (cited in Meesé et al., 1979) maintained that the use of standardized
IQ and achievement tests inflated the observed IQ-achievement correlation as a result of common methods variance (Campbell & Fiske, 1959; Mellon & Crano, 1977). In their investigation, Gerard and Miller (1975) reported a relatively weak average correlation ($r = .21$) between several IQ tests and individual reading and arithmetic grades for approximately 1300 elementary school children.

Predictive studies of IQ measures and academic achievement reveal a lack of consensus in the findings. Differences in methods and subject population probably account for the contradictory data pattern. The relative unreliability of teacher evaluations (classroom grades) may affect those studies where teacher evaluation was the criterion measure of academic performance (Meese & et al., 1979). More studies need to be conducted to investigate the value of standardized IQ measures as predictors of reading achievement.

Reading readiness tests, given in late kindergarten and early first grade, have included demographic, intellectual, perceptual, linguistic, attitudinal, and instructional factors. These tests generally present coefficients of correlation of .40 to .60 with reading success a year later (Dykstra, 1967). The Metropolitan Readiness Test (MRT), used most often in the public schools (Naitland, Nadeau, & Nadeau, 1974) has an
average correlation of .59 with first grade reading attainment (Greenlaw & Moore, 1978). In this study, the MRT was the predictor variable used as a measure of reading readiness.

Questions

For the purpose of this study, the following questions were posed:

1. Given measurement in kindergarten of visual selective attention, auditory selective attention, IQ, and reading readiness, which was the most accurate predictor for reading achievement at the end of first grade?

2. Given measurement in kindergarten of visual selective attention, auditory selective attention, IQ, and reading readiness, which was the most accurate predictor for reading achievement at the end of fifth grade?

3. Which of the testing elements form the best combination for predicting reading achievement?

Definitions of Terms

Selective attention — focusing on the wanted information; an ability which seems to mature developmentally (Gibson, 1969); or, the aspect of attention which involves the ability to focus attention on one part
of a stimulus input and filter out or ignore another part (Samuels & Edwall, 1981); or, the ability to focus and attend to specific, relevant information in the presence of irrelevant, distracting or contradictory information (Cotugno, 1981). In this study, visual selective attention was determined by performance on a card sorting task, and auditory selective attention was determined by performance on a dichotic listening task.

**Dichotic listening** - a task whereby the subject is given two different auditory messages which are usually delivered through earphones, one to the left ear and one to the right ear. The subject is instructed to remember what is said in just one ear.

**Central learning** - that which is task-relevant. The subject is given a central (primary) task to which he should attend. Any learning that arises from this task produces a central score.

**Incidental learning** - that which is task-irrelevant. Any learning that arises from the task which the subject was instructed to ignore produces an incidental score.

**Overexclusive attention** - attending to only one part of a stimulus combination. In the overexclusive stage of attention development, there is little or no incidental learning.

**Overinclusive attention** - attending to too many
irrelevant parts of a stimulus combination. In this stage between overinclusive attention and selective attention, incidental learning is at its highest point. The child attends to more than the minimum essential for efficient detection of distinctive features.

Limitations of the Study

This study was limited by the size of the follow-up samples and by generalizability of findings using one suburban school in western New York.

Summary

Recent attempts to identify in young children early competencies or characteristics as predictors of later reading achievement are found in the literature, but few longitudinal studies have been carried out. There is no clear answer as to which variables are the best predictors of later school success. Studies of standardized IQ measures as predictors of academic achievement report conflicting findings, and no published study has been reported using visual and auditory selective attention as predictor variables.

Selective attention is an important ability to bring to the reading task, and Cuccu (1978) and DeChristopher (1978) have suggested the need for a longitudinal study to determine if performance on selective attention tasks
in kindergarten is a valid and reliable indicator of later reading achievement.
Chapter II

Review of the Literature

Introduction

Of the four predictor variables investigated in this study, probably less is generally known of visual and auditory selective attention than of IQ and reading readiness. Therefore, a large portion of this review of the literature will provide information on attention. One section is devoted to studies of reading achievement prediction.

History of Attention

The concept of attention has had an uneven career in the history of academic psychology. While today most psychologists view this construct as one of the more important variables which influences the course of learning and memory, this has not always been the case.

As early as the first century B.C., the Roman textbook on memory Rhetorica and Herennium stated that a prerequisite for the recall of information was the need to pay attention. The scientific origin of research on attention began in the nineteenth century. In 1908, Titchener (cited in Kahneman, 1973) wrote that the doctrine of attention was the nerve of the whole psychological
system. James (1890) identified a number of components of attention, explained how they functioned, and was of the opinion that the study of attention was essential to explain the nature of learning. Huey (1908), in his classic book on reading, recognized the centrality of attention and had numerous keen insights into the role of attention in reading.

Within a few years of Titchener's pronouncement, the most vital movements in psychology were the Gestalt and Behaviorist schools, and both movements attempted to do without the concept of attention. Behaviorism tended to emphasize that which was directly observable and measurable, and many aspects of attention were not directly observable. The dominant theorists of the day found attention to be of little value.

By the end of the 1950's, the situation had altered radically, and the newly legitimized concept of attention was a central topic in an emergent cognitive psychology. Many psychologists began to realize that between the directly observed stimulus and response, critical and essential processes were taking place within the human mind. Within the framework of cognitive psychology, the components of attention occupy a central role for understanding how stimuli, such as print and words, are transformed and comprehended.
Theories of Attention

There are two main types of attention theories currently used to explain the processing of information. The structural or bottleneck model, associated first with Broadbent, emphasizes the structural limitations on the mental system. The capacity model emphasizes the limitations of capacity on cognitive activity.

Broadbent's (1958) filter theory helped explain that there is a limit to the amount of information an individual can handle at one time. When the available information in a stimulus complex exceeds this limit, the individual must select part of the information and reject part. The Broadbent model postulates that there are hypothetical filtering mechanisms which permit selective attention. Incoming information is filtered as it comes in through the receptors. Whatever is allowed to pass through filters is held in short term memory for a time and then passes through more filters after which it is subjected to further processing or analysis. Information which is ignored is not so processed and is forgotten.

Mueller and Hallahan (1974) derived two developmental predictions from the structural model: (a) Improvement in certain cognitive processes occurs with age due to a better ability to filter information at both receptor and short term memory levels; and (b) when the individual
is overloaded with information, task irrelevant or incidental information is ignored.

In the capacity model, an assumption is made that there is a general limit on an individual's capacity to perform mental work. Different mental activities impose different demands on the limited capacity. An easy task demands little effort, and a difficult task demands much. When the supply of attention does not meet the demands, performance falters, or fails entirely.

Both the structural and capacity model predict that activities going on at the same time are likely to be interfering, but they ascribe the interference to different causes. In a structural model, interference occurs when the same mechanism is required to carry out two incompatible operations at the same time. In a capacity model, interference occurs when the demands of the two activities exceed available capacity. Studies of selective attention indicate that the deployment of attention is more flexible than is expected under the assumption of a structural model, but is more constrained than is expected under the assumption of free allocation of capacity. A comprehensive treatment of attention must therefore incorporate considerations of both structure and capacity (Kahneman, 1973).
Aspects of Attention

Samuels and Edwall (1981) include arousal, alertness, vigilance, capacity, and selectivity as aspects of attention. They caution that it would be incorrect to think that additively these subunits of attention comprise attention or that attention is the sum of its parts.

Mueller and Hallahan (1974) regard attention span and selective attention as the two major aspects of attention of relevance to school learning. Generally, it can be hypothesized that greater selectivity of attention, with concomitant screening out of extraneous stimuli, is associated with longer attention span.

Samuels (1971) considers overt attentional processes and focal attention to be two important dimensions of attention related to the reading task. Overt attention involves direction of gaze and attending to the activity prescribed by the teacher. Focal attention involves selection of cues which help determine relevant dimensions of a stimulus complex.

Development of Attention

Nyklebust (1957) traces from infancy the development of auditory attention skills. At birth the infant cannot select sounds from the environment which are immediately pertinent to needs and circumstances. Rather, the auditory world impinges upon the baby in a
conglomerate, unselected and unstructured manner. As the infant begins to associate meaning to the auditory world, he gradually learns to select those sounds which are most useful for immediate needs and adjustment. In maturing, the baby is able to select his mother's voice and the sounds associated with feeding.

Before an infant can acquire inner, receptive or expressive language it is necessary to select speech sounds from the total conglomerate of sounds. Interactions with an adult through gesture and speech are essential factors in the child's development. Yendovitskaya (1971) has observed that the child's developing capacity for speech plays a vital role in voluntary selective attention. Gestural and vocal language of the socializing adult are related to the child's learning a means for organizing his attention and is far more efficient than the language of gesture.

In Gibson's view (cited in Bee, 1978), there are four major principles in the strategy of attention:

1. From Capture to Activity. Young infants have their attention "captured" by things; gradually attention becomes more voluntary. A child progresses from looking at corners and edges of figures to scanning the whole figure.
2. From Unsystematic to Systematic Search. From the earliest hours of life there is some system to the child's visual searching, but the very young infant and even the child of two or three does not examine an entire figure systematically, but rather tends to fixate on a particular part.

3. From Broad to Selective Pickup of Information. With increasing age, children become more able to focus on a single aspect of a complex situation.

4. Ignoring Irrelevant Information. Focusing attention on one source of information is not the same thing as shutting out everything else. It is possible both to focus attention and to pick up a lot of additional information as well. But in complex situations the ability to shut out completely the unwanted information and focus on the wanted information may become important, and this ability is referred to as selective attention.

The developmental course of selective attention may begin in infancy, where the dominant mode of attention can be described as overexclusive. This level is followed by an increasing attention to a great variety of stimuli, a mode termed overinclusive. As the child grows older and nears adolescence, the capacity to focus on a limited number of stimuli, as demanded by the situation, seems to reach the mature level designated as selective attention.
Given the individual differences in the rate of development, one can expect some children to be slower and some advanced in attaining selective attention.

**Studies of Attention**

Maccoby's work is representative of work done in the auditory mode. She conducted studies to determine if children's ability to attend to one kind of message and filter it out from the total auditory input increased with age (Maccoby, cited in Gibson, 1969; Maccoby & Konrad, 1966). The method involved presenting the subject with two messages concurrently, coming over a loudspeaker or through earphones. When children listened to a man's voice and a woman's voice speaking words at the same time, with instructions to report only what one of the voices was saying, the number of correct reports of the words spoken by the specified voice increased with age. Maccoby concluded that six-year old children do have the ability to select wanted information from a complex stimulus display, though they do so less efficiently than older children.

Selective attention studies involve central and incidental learning, and the basic visual model can be described by the following situation. A child is shown a stack of cards on each of which is a picture of an animal and a picture of a common household object. The
child is instructed to sort these cards so that all of one kind of animal are in one pile. The instructions focus the child's attention on the animals and on the location of the respective species. This aspect is known as the central task. The number of cards correctly sorted can be used as a score on the central task, the central score.

After the child has completed this sorting the experimenter asks which household object went with the lions, which with the cows, and so on. Anything noticed about the household objects would be incidental to the central task. This aspect of the procedure is termed the incidental task and the number of associations correctly stated is the incidental score. The higher the incidental score, the lower selective attention; the lower the incidental score, the higher selective attention.

In Cuccu's (1978) study of kindergarten children performing a visual selective attention card-sorting task, she found an inverse relationship between a child's central and incidental score. DeChristopher (1978) tested the same children's auditory selective attention ability and also found that the greater the selective attention to the central task, the lower the incidental score.

In a variety of experimental situations, Hagen and his colleagues found a developmental increase in the
ability of normal children to attend to central information
and to ignore incidental material (Druker & Hagen, 1969;
Hagen, 1967; Hagen & Huntsman, 1971; Hagen & Sabo, cited
in Hallahan & Kauffman, 1975; Maccoby & Hagen, 1965).
Using the central and incidental tasks as repeated
measures, Hagen consistently found an interaction between
type of recall (central versus incidental) and age. The
major change usually occurred at about twelve to thirteen
years of age, when, although the recall of central informa-
tion continued to increase uniformly, incidental recall
generally dropped markedly. Positive correlations between
central and incidental recall were found at the younger
ages, and negative correlations between the two were
obtained at about twelve years. The direction of these
correlations strengthens the assumption that older children
have developed a strategy whereby they give up incidental
information in order to recall central material.

Research generally shows that central learning
increases with age, while incidental learning remains the
same or declines. At least one study (Stevenson, 1954)
found an increase in the amount of incidental learning
with age. The three- to six-year olds were instructed
to find a key in a box in order to get a reward from
another locked box, and later they were asked to identify
other objects that had been in the first box. The older
subjects, who did more incidental learning, showed higher task orientation than the younger subjects. Kausler, Laughlin and Trapp (1963) also found that among seventh and eighth graders, the amount of incidental learning increased under high incentive conditions.

Maccoby and Hagen (1965) suggest that incidental learning increases during an early growth period when children are learning to categorize, code and label objects—processes which should make it increasingly possible to take note of several things at once—followed by a period of development of the ability to shut out undesired stimuli, and hence a decline in incidental learning.

Selective attention studies have been conducted with mentally retarded children as subjects. Zeaman and House (1963) found that institutionalized retarded children had attentional deficits compared with normal children of the same mental age. A study by Hagen and Huntsman (1971) indicated that the attentional deficit may have been a by-product of institutionalization itself rather than mental retardation per se. Zeaman and House (1967) suggest that one reason why there are differences in learning ability between retardates and normals is that for some learning tasks the retardate does not know where to focus attention during early learning trials. Once the
retardate discovers the relevant dimensions, his learning curve is similar to normal's.

Hallahan, Kauffman, and Ball (1973) found learning disabled children of normal intelligence to be deficient in visual selective attention compared to their peers. Ross (1977) reported that the performance of learning disabled children on selective attention assessment measures showed a similarity to the performance of younger, normal children. These studies strongly suggest that learning disability represents a developmental lag in the acquisition of selective attention.

Studies of Attention and Its Relationship to Reading

One dimension of attention that has been related to reading is overt attentional processes, that is, visual orienting behavior or direction of gaze. Lahaderne (1968) found a significant correlation between overt attention and reading achievement in a sixth grade class. She also found a significant relationship between IQ and reading achievement, and IQ and attention for both boys and girls in her sixth grade sample. Cobb (1972) reported that school achievement in a fourth grade sample was related to attention.

In a study of first graders where positive observed attentiveness included task-relevant behaviors, Turnure
and Samuels (1972) found that girls were significantly
($p < .01$) more attentive than boys and achieved higher
word recognition scores ($p < .05$). Word recognition was
found to be significantly related to attentiveness for
the group as a whole ($p < .01$).

Replicating Turnure and Samuels' study, Schultz
(1973) found a significant positive relationship
between reading achievement and attention (attending to
the area of focus and the activity prescribed by the
teacher) for both girls and boys in first grade. Those
students who had the higher reading achievement scores
had the higher scores on attention, and those students
who had the lower reading achievement scores had the
lower attention scores. The data indicated that the
correlation between reading achievement (Stanford
Achievement Test paragraph meaning subtest) and IQ
(Goodenough Draw-A-Man Test) was not significant for
boys, but was significant at the .01 level for girls.
The correlation between attention (modified Jackson
Hudgins Observation Schedule) and IQ was significant for
girls at the .05 level of confidence.

Santostefano, Rutledge, and Randall (1965) investigated
reading disability and selective deployment of attention
in 47 boys, eight to thirteen years of age. On a Fruit
Distraction Test, the poor readers recalled significantly
(beyond the .05 level of confidence) more irrelevant information than the average and above-average readers and took longer to read a distraction card versus a control card. These findings suggest that poor readers tend to have difficulty limiting their attention to elements of the stimulus field defined as critical and relevant.

Ricks (cited in Santostefano, 1978) found that inattentive second grade children who were six months or more below grade level in reading recalled significantly more distracting objects than did attentive, average readers. Cotugno (1981) replicated these studies with young school-age children and confirmed that there were significant and consistent differences between disabled and non-disabled readers on tasks involving peripheral and external distractors. These findings collectively suggest that selectively attending to relevant stimuli and withholding attention from peripheral and contextually irrelevant stimuli is important to the reading process.

A study of good and poor readers among sixth grade boys (Willows & MacKinnon, 1973) and another by Willows (1974) used a technique of Neisser's (cited in Gibson & Levin, 1975) to examine deployment of attention while reading aloud. In the control condition, the subjects were given a multiple choice test for comprehension after reading a passage of text written in black. In an
experimental condition (the selective reading condition) the same black passages were used, but a text of red words appeared between the lines of black type. Though relevant to the story content, the red words were different from those used in the story and contained one wrong answer to the questions that would follow the story in the multiple choice test. The boys were instructed to read and remember the black story and to ignore the red words.

When good and poor readers were compared on oral reading for errors, the poor readers made more errors and took longer in the selective reading condition than in the control condition; but the good readers performed equally well under both conditions. On the multiple choice test, poor readers made more errors of comprehension than the good readers in both the selective reading and control conditions. But a surprising and interesting result was that the good readers in the selective reading condition made more comprehension errors that were intrusions from red lines than did poor readers.

Good and poor readers, it would seem, attended to different aspects of the reading task; their reading strategies differed. The poor readers were affected by the physical presence of the lines, as shown by marked deterioration of their oral reading. They were little affected by the relevant meanings of the distractor words.
Good readers were unaffected in the mechanics of oral reading, but their understanding of the context of the relevant lines was affected by the interlinear material. They were reading for meaning, and there were competing meanings in the text before them (Gibson & Levin, 1975).

Willows (1974) suggests that the good reader need only detect words that fit with his expectancies of the information content of the text. Since the words in the interstitial lines were consistent with the meaning of the text, it was possible for the good reader to validate expectancies in either the black or the red lines, thus leading to intrusion errors.

A good reader seems to attend to the message (meaning) to be extracted from the writing, while a poor (and beginning) reader attends to the medium (letters and words) in which the material is presented (Ross, 1976).

Samuels and Jeffrey (1966) studied beginning readers' ability to focus attention on the relevant dimensions of a stimulus complex. They found that if beginning readers were given words to learn to read which were highly discriminable from each other, learning was rapid because incidental cues such as first letter or last letter only were used. At transfer, when different words having the same first or last letter were presented, the students tended to mistake them for words on the original list.
Samuels and Jeffrey inferred that reading methods which begin with the whole word approach and use words which are easily discriminated from each other, may produce rapid initial learning followed by a plateau. The plateau would represent that point at which the student found that use of irrelevant cues (such as single letters or length) could no longer produce the correct verbal response.

Samuels (1967) found that pictures in basal readers served as distractors for students who had difficulty with selective attention. He suggests keeping pictures to a minimum during beginning stages of reading.

When words were printed in color, some learners focused attention on the color and not the letter shape (Samuels, 1968). Although rate of learning the word in color was rapid, when the incidental color cue was removed and the word printed in black, the correct response was lost. Samuels recommends that design of reading material and methods consider the problems of focal attention and transfer.

**Summary of Attention**

This section of the chapter contained a review of the history, theories, aspects, development, and research concerning attention. It was shown that the concept of attention has had an uneven career in the history of
academic psychology. With the advent of cognitive psychology, attention now plays an important role in understanding how stimuli, such as print and words, are transformed and comprehended. The structural and capacity models are used to explain the processing of information, and a comprehensive treatment of attention should incorporate considerations of both structure and capacity.

Two aspects of attention of most relevance to the reading task are overt attention and selective attention. Overt attention refers to external processes, measured directly by direction of gaze and participation in task-relevant behaviors. Selective attention refers to cognitive processes measured indirectly by methods such as dichotic listening and central and incidental learning tasks. In the development of a mature level of selective attention, a child passes through two earlier modes, overexclusive attention and overinclusive attention. A general conclusion from two decades of research on children's attention is that older children can adapt their attention to the particular demands of each task. When a task calls for attending to relevant material and ignoring irrelevant material, attention becomes more selective and seems to reach an optimal level after about age 12. Most attempts to account for this change in
attention have proposed that children develop strategies which help them allocate their attention to task-relevant information and filter out the less important information.

Studies have found a significant positive correlation between reading achievement and overt attentional processes. Studies involving selective attention and reading have found consistent differences between disabled and nondisabled readers. It has been recommended that reading materials and methods incorporate stimulus arrangements which increase attentional value of relevant cues.

**Reading Prediction**

Demographic, intellectual, perceptual, linguistic, attitudinal, and instructional factors have been analyzed individually and in combination to determine their effect on beginning reading success. As of 1972, aspects of some of these factors have been combined into 29 published tests which purport to measure students' readiness for beginning reading instruction (Buros, 1972). The type and pace of beginning reading instruction which numerous children receive has been regularly decided, at least in part, by their performance on readiness tests. Another purpose of the readiness test has been early detection of future difficulties so that a remediation program
may be instituted before the child is subject to the
effects of academic failure.

At present, the most widely employed method of
assessing reading readiness is group testing in late
kindergarten and early first grade. These tests generally
present coefficients of correlation of .40 to .60 with
reading success a year later (Dykstra, 1967). The
Metropolitan Readiness Test, used most often in the public
schools (Maitland, Nadeau, & Nadeau, 1974) has an average
correlation of .59 with first grade reading attainment
(Greenlaw & Moore, 1978). These correlations are large
enough to warrant predictions of group reading performance,
but caution should be employed when considering specific
actions regarding individual children. Jansky and
deHirsch (1972) note that readiness tests do not predict
accurately for individual children.

Telegdy (1972) concluded that the combination of
the Bender Visual Motor Gestalt Test, human figure
drawing, alphabet subtest of the Metropolitan Readiness
Test, and letters subtest of the Screening Test of
Academic Readiness was the best predictor of overall
readiness. It would thus appear that the basic skills
required for good first grade achievement are: (a) good
visual perceptual ability, (b) letter or alphabet
knowledge, (c) the ability to attend to detail, and (d)
relatively high maturational level.

Bateman and Schiefelbusch (cited in Rust & Rousseau, 1982) criticized the use of a single test for screening. They pointed out that readiness techniques tend to identify only children of low intellectual ability, ignoring children who have perceptual problems.

Rust and Rousseau (1982) administered a screen battery during the first month of first grade to 147 children. Included were the Otis-Lennon Mental Ability Test, Metropolitan Readiness Test (MRT), Bender Visual Motor Gestalt Test, and Visual Memory Technique. The Stanford Achievement Test was administered the last month of school and was the criterion variable. On the basis of stepwise regression equations it was concluded that the Bender Gestalt significantly increased the predictive power of the test battery. The MRT and the Otis-Lennon were found to be the best predictors of reading achievement at the end of first grade.

Predictive validity indices correlating measures of intelligence with reading readiness and reading achievement generally have reported IQ measures to be of value in making such predictions. Studies correlating scores obtained by kindergartner children on the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) with measures of reading achievement in first grade report significant
findings (Feshbach, Adelman, & Fuller, cited in Massoth & Levenson, 1982; Lieblich & Shinar, 1975), while other studies failed to find a significant relationship between WPPSI IQs and tests of reading readiness and reading achievement (Crockett, Rardin, & Pasewark, 1976; Kauffman, 1973; Rankin & Henderson, 1973).

Most research on the prediction of achievement has concentrated on the use of ability and perception measures. However, Blaha (1982) studied the predictive validity of cognitive style variables (field dependence/independence and locus of control) and reading attitudes with reading and arithmetic achievement. Using 324 inner-city Detroit fifth graders, it was found that those children who were willing to acknowledge difficulty in reading achieved lower scores on reading and mathematic achievement measures.

Sexton and Treloar (1982) studied the extent to which a set of fourth grade achievement measures could be predicted from a set of variables collected when the students were in first grade. These results were compared with the results of an earlier phase of the study completed in 1979. Similarities between the two phases indicated that a measure of visual perception (the Motor-Free Visual Perception Test) added significantly to the prediction of achievement. The importance of sex as a predictor depended upon the particular subset of the Science Research
Associates (SRA) Achievement Series being considered.

Feshbach, Adelman, and Fuller (1977) collected IQ scores, scores on the deHirsch-Jansky Predictive Index, and teacher ratings on the Student Rating Scales for two large samples of kindergarten children ($n = 403$ and 364). Each of these measures generally correlated between .4 and .5 with reading achievement scores collected in first, second, and third grade.

Butler, Marsh, Sheppard, and Sheppard (1982) examined how effective the Sheppard School Entry Screening Test (SSEST) given in kindergarten predicted reading achievement in first, second, and third grade ($n = 320$). Multiple correlations, based on the three SSEST factors (figure drawing, language, and perceptual-motor skills) and the two background variables (pupils' sex and whether or not at least one parent spoke English) were .49, .56, and .61 for reading scores in first, second, and third grade, respectively. Most of the predictive variance could be explained by the SSEST factors.

Fletcher and Satz (1982) made a seven-year longitudinal evaluation of a kindergarten screening battery for predicting reading achievement. Four hundred and ninety-seven white boys were tested in 1970 on 14 measures, including the Peabody Picture Vocabulary Test and Frostig's Developmental Test of Visual-Motor Integration. The screening battery
was evaluated against outcome reading levels on a subset of the original population at the end of sixth grade in 1977. Results revealed that the battery retained high utility for predicting achievement outcomes at the end of sixth grade in this sample. Previous studies had demonstrated that this screening battery had predictive validity at the end of Grades 2-5 for cross-validation samples (Satz, Friel, & Rudegeair, 1976).

**Summary of Reading Prediction**

This section of the chapter discussed some of the recent attempts to identify in young children the characteristics or competencies that predict later reading achievement. The predictor variables included sex, and academic, cognitive, and perceptual processes. Low to medium correlations were reported between these predictor variables and various measures of achievement. Studies have generally reported IQ measures to be of value in making predictions of reading readiness and reading achievement, though there is a lack of consensus in the findings. The use of a single test for screening beginning reading instruction has been criticized, and a call has been made for longitudinal and multivariate approaches. There is no clear answer as to which variables are the best predictors of later school success.
Chapter III

Design of the Study

Purpose

The intent of this study was to investigate the predictive validity of four factors tested in a kindergarten sample. Two factors, visual and auditory selective attention, are generally not tested in kindergarten. The two other factors, IQ and reading readiness, are generally tested in most kindergartens. First and fifth grade reading achievement scores were obtained to determine which of the four factors were the best predictors (and combination of predictors) of reading achievement.

Methodology

Subjects

The school district in which this study was conducted is in a middle class suburb in western New York. Fifty students who completed a kindergarten program in 1978 were the subjects employed in the original study undertaken by Cuccu and DeChristopher. The original subjects were screened for adequate vision and hearing. Thirty-four of these students continued in the school and completed their first grade year in 1979. Sixteen of the original testing population continued in the school and completed their
fifth grade year in 1983. In the first grade sample, three subjects were eliminated because they were absent when the Peabody Picture Vocabulary Test (PPVT) was administered in kindergarten. In the fifth grade sample, one subject remained who had no PPVT score. Thus, there were 50 in the original group of kindergarten students (19 males and 31 females), 31 in the subset of first grade students (12 males and 19 females), and 15 in the subset of fifth grade students (5 males and 10 females).

**Instruments**

1. A sorting task was designed and administered by Cuccu in the spring of 1978. Visual selective attention scores for central and incidental learning were obtained from this task. Subjects were instructed to sort 25 stimulus cards according to the central feature, the Greek letter. They were told to ignore the incidental features of card shape, card background color, and color of the Greek letter. The subjects were given a central score for the cards correctly grouped. After completing the task, the subjects were asked to recall the card shapes and card background colors to see if any incidental learning had taken place. Correct answers yielded an incidental score. In this study, the central score was used to assess visual selective attention ability.
2. Four professionally made dichotic listening tapes were administered by DeChristopher in the spring of 1978. Each tape included a female voice and a male voice. Subjects were told beforehand to attend only to the female voice. The subjects were also instructed to listen for certain categories (animals, colors, or musical instruments) mentioned by the female, and each child was given a practice tape to insure that instructions were understood. After each tape, subjects were asked to recall those items mentioned by the female. The number of correct responses was tabulated to yield a central score. The number of correct responses for the conflicting male voice was tabulated to yield an incidental score. In this study, the central score was used to assess auditory selective attention ability.

3. The Peabody Picture Vocabulary Test (PPVT) (Dunn, 1965) was administered by the classroom teacher in the fall of 1977. This untimed, individual test was designed to provide a well-standardized estimate of a subject's verbal intelligence through measuring hearing vocabulary. The stimulus word was read to the subject, who responded by indicating which of the four pictures best illustrated the given word. The total score on the PPVT was converted to a percentile rank, mental age, and a standard deviation IQ with a mean of 100 and a standard deviation of 15. In this
study, the IQ score was used to assess verbal intelligence.

The PPVT correlates moderately well with other tests of scholastic aptitude (verbal intelligence), and it correlates most highly with other measures of vocabulary.

4. The Metropolitan Readiness Test (MRT) (Nurss and McGauvran) was administered by the kindergarten teacher in May 1978. This test was designed to measure readiness for first grade instruction. Six tests were given to obtain a pre-reading skills composite: word meaning, listening, matching, alphabet, numbers, and copying. In this study, the pre-reading skills composite score was used to assess reading readiness.

In a study cited in the teacher's manual for the MRT, eleven school systems' split-half reliabilities for the total reading readiness score ranged from .90 to .95. Predictive validity data have been obtained for a variety of pupil groups and circumstances with the correlations differing across groups and the achievement subtest used as criterion. The MRT had an average correlation of .59 with first grade reading achievement.

5. The Metropolitan Achievement Test, Primary I Level (Durost, Bixler, Wrightstone, Prescott, & Balow) was administered by the first grade teacher in May 1979. These achievement tests were designed to indicate how much pupils learned in important curriculum and skill areas in
in the school curriculum. In this study, first grade reading achievement was assessed using the total reading score of the Metropolitan Achievement Test, Primary I Level. Total reading included word knowledge (35 items measuring the extent of pupils' reading vocabulary) and reading (42 items measuring pupils' comprehension of reading material).

Split-half coefficients, corrected by the Spearman-Brown formula and based on all pupils tested in the fall standardization with Form G at second grade, gave a reliability of .96 for total reading.

6. The Metropolitan Achievement Test, Intermediate Level (Durost et al.) was administered by the fifth grade teacher in May 1983. In this study, fifth grade reading achievement was assessed using the total reading score of the Metropolitan Achievement Test, Intermediate Level. The total reading score included both word knowledge (50 items measuring the extent of pupils' reading vocabulary) and reading (45 items measuring comprehension of literal and inferential material).

Split-half coefficients, corrected by the Spearman-Brown formula and based on all pupils tested in the fall standardization with Form G at sixth grade, gave a reliability of .96 for total reading.
Procedure

The original 50 subjects were administered four tests at different times during their kindergarten year. To obtain visual selective attention scores at the end of kindergarten, Cuucu devised and administered a sorting task. DeChristopher used dichotic listening tapes at the end of kindergarten to obtain auditory selective attention scores. The Peabody Picture Vocabulary Test was given at the beginning of kindergarten to obtain an estimate of verbal intelligence. At the end of kindergarten, the Metropolitan Readiness Test was administered to measure readiness for first grade instruction.

Due mainly to attrition, 34 of the original subjects remained in the follow-up study. At the end of first grade, these 34 were administered the Primary I Level of the Metropolitan Achievement Test. At the end of fifth grade, the Intermediate Level of the Metropolitan Achievement Test was administered to the 16 subjects continuing in the school who were part of the initial sample. Three of these follow-up subjects in first grade and one in fifth grade were eliminated from the study because they were absent when the Peabody Picture Vocabulary Test was administered in kindergarten.
**Statistical Design**

Stepwise multiple regressions were performed to determine which of the four testing elements was the most accurate predictor of reading achievement at the end of first grade and at the end of fifth grade. Which of the testing elements form the best combination for predicting reading achievement was determined, using the Brockport Academic Computing Center's Statistical Package for the Social Sciences (SPSS). Various models of regression on reading achievement using from one to four predictor variables were determined using the Minitab package.

**Summary**

The purpose of this study was to reveal the most accurate predictor of reading achievement in a sample of 50 suburban kindergarten children. Predictor variables (the independent variables) tested in kindergarten were visual selective attention, auditory selective attention, IQ, and reading readiness. Scores on the total reading section (word knowledge plus reading) of the Metropolitan Achievement Test were the dependent variables. The Metropolitan scores used in this study were taken from achievement tests administered at the end of first and fifth grade.

Using the Statistical Package for the Social Sciences
available through the Brockport Academic Computing Center, the factor which was the most accurate predictor of first and fifth grade reading achievement was determined. Also revealed was the combination of factors which formed the best predictor of reading achievement.
Chapter IV

Analysis of the Data

Purpose

It was the purpose of this study to investigate the predictive validity of four testing elements which were obtained from a sample of kindergarten children. The four testing elements were visual selective attention, auditory selective attention, IQ, and reading readiness. First and fifth grade reading achievement scores were obtained to determine which of the factors tested in kindergarten were the best predictors (and combinations of predictors) of reading achievement.

The predictive data of this study were derived from testing 50 kindergarten students in the 1977-1978 school year. A component selection task was administered to establish a measure of visual selective attention. Dichotic listening tapes were administered to obtain a measure of auditory selective attention. The Peabody Picture Vocabulary Test and the pre-reading skills composite score from the Metropolitan Readiness Test were obtained from student records to be used as measures of IQ and reading readiness, respectively.

Criterion data for first grade reading achievement were derived from 31 of the 34 first grade students.
continuing in the school in 1979. The total reading score from the Metropolitan Achievement Test, Primary Level, was obtained from school records. In 1983, 16 of the original kindergarten sample completed their fifth grade year and 15 were included in this study. These students' total reading score from the Metropolitan Achievement Test, Intermediate Level, was obtained from school records as criterion data for fifth grade reading achievement.

In summary, the four predictor variables (also called independent variables) in this study were visual selective attention, auditory selective attention, IQ, and reading readiness. The two criterion variables (also called dependent variables) were first grade reading achievement and fifth grade reading achievement.

Coefficient correlations were calculated among the four predictor variables and the two criterion variables, and between the two criterion variables. Using the Statistical Package for the Social Sciences (SPSS), stepwise multiple regressions were calculated to determine how well the combined set of four predictor variables could predict reading achievement in first and fifth grade. The $R^2$ squared value, adjusted for degrees of freedom, and the standard error were calculated for ten models of regression on first grade reading achievement and for ten models on
fifth grade reading achievement, using Minitab.

**Findings**

Table 1 shows a correlation matrix giving all possible simple correlation coefficients. An analysis of the correlation coefficients among the four predictor variables reveals that the Metropolitan Readiness Test (MRT) and auditory selective attention are the most highly correlated. Among the four predictor variables and first grade reading achievement, the MRT is most highly correlated with the Metropolitan Achievement Test, Primary Level, followed by visual selective attention. Among the four predictors and fifth grade reading achievement, IQ is most highly correlated with the Metropolitan Achievement Test, Intermediate Level, followed by the MRT.
Table 1
Correlation Coefficients Among the Four Predictors and Reading Achievement, and Between First and Fifth Grade Reading Achievement

<table>
<thead>
<tr>
<th></th>
<th>VSA</th>
<th>ASA</th>
<th>IQ</th>
<th>MRT</th>
<th>MAT(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA</td>
<td>.530</td>
<td>.676</td>
<td>.486</td>
<td>.539</td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>.257</td>
<td>.536</td>
<td>.738</td>
<td>.538</td>
<td>.637</td>
</tr>
<tr>
<td>MRT</td>
<td>.539</td>
<td>.676</td>
<td>.486</td>
<td>.538</td>
<td>.637</td>
</tr>
<tr>
<td>MAT(P)</td>
<td>.637</td>
<td>.538</td>
<td>.565</td>
<td>.738</td>
<td></td>
</tr>
<tr>
<td>MAT(I)</td>
<td>.698</td>
<td>.741</td>
<td>.764</td>
<td>.756</td>
<td>.702</td>
</tr>
</tbody>
</table>

p < .05
Table 2 is a summary table of a stepwise multiple regression of the Metropolitan Achievement Test total reading scores, Primary Level, on the four predictor variables (n = 31). These results indicate that the MRT accounts for about 53.9% (52.34%, adjusted for degrees of freedom) of the variation in first grade reading achievement. If just this one independent variable were to be used for predictive purposes, the equation would be \( \bar{Y}_p = 30.46 + (.535) X_1 \) where \( \bar{Y}_p \) is the predicted score on the primary level test and \( X_1 \) is the known MRT score. The error in the prediction would be 12.25.

In terms of additional predictor variables, the one which results in the largest reduction in the unexplained variance is visual selective attention. With the addition of visual selective attention, the degree of correlation is increased from .734 to .786. The explained variation is increased from 52.3% to 59.1%, and the error in the estimate is decreased from 12.25 to 11.34. The multiple coefficient of correlation is found to be significant at the .05 level.

The degree of relationship (multiple R) increased from .734 for the MRT to .787 for all four predictor variables and the Metropolitan Achievement Test total reading scores, Primary Level. And, the proportion of the variation in the Primary Level test explained by the
predictor variables increased from about .54 for one
variable to about .62 for all four. There was an
extremely small change in the proportion explained after
the second independent variable was brought in; that is,
the MRT accounted for over 53% of the variation in the
Metropolitan Achievement total reading test. The second
predictor, visual selective attention, reduced the
unexplained variation by 7.9%, but thereafter the change
was extremely small (less than 1%).

The addition of the third variable, auditory selective
attention, did not result in a change in the explained
variation and did increase the standard error of the
estimate. The addition of auditory selective attention
did nothing to reduce the unexplained variation. The
Peabody IQ can also be omitted because it did not add
anything significant to the equation.

Consequently, on the Metropolitan Achievement Test,
Primary Level, the MRT and visual selective attention
together yield the most accurate predictions. The best
regression equation is \( \text{MAT}(P) = 25.0 + .175 \text{(VSA)} +
.404 \text{(MRT)} \).
Table 2
Stepwise Multiple Regression of the Metropolitan Achievement Test, Primary Level, on the Four Predictor Variables

<table>
<thead>
<tr>
<th></th>
<th>Standard Error</th>
<th>Multiple R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>R SQ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRT</td>
<td>12.25</td>
<td>.734</td>
<td>.539</td>
<td>.523</td>
<td>.539</td>
</tr>
<tr>
<td>VSA</td>
<td>11.34</td>
<td>.786</td>
<td>.619</td>
<td>.591</td>
<td>.079</td>
</tr>
<tr>
<td>ASA</td>
<td>11.55</td>
<td>.787</td>
<td>.619</td>
<td>.576</td>
<td>.000</td>
</tr>
<tr>
<td>IQ</td>
<td>11.76</td>
<td>.787</td>
<td>.619</td>
<td>.561</td>
<td>.000</td>
</tr>
</tbody>
</table>
Table 3 is a summary table of a stepwise multiple regression of the Metropolitan Achievement Test total reading scores, Intermediate Level, on the four predictor variables \((n = 15)\). These results indicate that the Peabody Picture Vocabulary Test IQ accounts for about 55% (51.5%, adjusted for degrees of freedom) of the variation in fifth grade reading achievement. If just this one independent variable were to be used for predictive purposes, the equation would be \(\bar{Y}_p = -87.2 + (1.65) X_1\), where \(\bar{Y}_p\) is the predicted score on the Metropolitan Achievement Test, Intermediate Level, and \(X_1\) is the known IQ score. The error in the prediction would be 18.39.

In terms of additional predictor variables, the one which results in the largest reduction in the unexplained variation is visual selective attention. With the addition of visual selective attention, the degree of correlation is increased from .741 to .880. The explained variation is increased from 51.5% to 73.7%, and the error in the estimate is decreased from 1.82 to 1.34. The multiple coefficient of correlation is found to be significant at the .05 level.

The degree of relationship (multiple \(R\)) increases from .741 for the Peabody IQ to .904 for all four predictor variables and the Metropolitan Achievement Test total reading scores, Intermediate Level. The proportion of the variation in the Intermediate Level test explained by the
predictor variables increased from about .55 for one variable to about .82 for all four.

The addition of the third predictor, the MRT, reduced the standard error of the estimate by .04. The addition of the fourth predictor, auditory selective attention, did not result in a significant change in the explained variation and did increase the standard error.

Consequently, on the Metropolitan Achievement Test, Intermediate Level, the Peabody IQ, visual selective attention, and the MRT together yield the most accurate predictions.

Table 3
Stepwise Multiple Regression of the Metropolitan Achievement Test, Intermediate Level, on the Four Predictor Variables

<table>
<thead>
<tr>
<th></th>
<th>Standard Error</th>
<th>Multiple R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>R Square Change</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>1.82</td>
<td>.741</td>
<td>.550</td>
<td>.515</td>
<td>.550</td>
<td>.429</td>
</tr>
<tr>
<td>VSA</td>
<td>1.34</td>
<td>.880</td>
<td>.774</td>
<td>.737</td>
<td>.225</td>
<td>.382</td>
</tr>
<tr>
<td>MRT</td>
<td>1.30</td>
<td>.899</td>
<td>.807</td>
<td>.755</td>
<td>.033</td>
<td>.175</td>
</tr>
<tr>
<td>ASA</td>
<td>1.33</td>
<td>.904</td>
<td>.817</td>
<td>.743</td>
<td>.009</td>
<td>.145</td>
</tr>
</tbody>
</table>
Table 4 shows various models of regression on reading achievement using from one to four predictor variables. The reading scores in this study seem to grow more predictable with the passing of time. This general trend is evident in each of the predictor variables and combinations of variables. One variable, IQ, demonstrated a marked increase in its predictive performance, from explaining 10.4% of the variance in first grade reading achievement to explaining 55.2% of the variance in fifth grade reading achievement.

Visual and auditory selective attention together explain 42.3% of the variance in first grade reading achievement and 64.3% of the variance in fifth grade reading achievement.
Table 4
Various Models of Regression on First and Fifth Grade Reading Achievement Using From One to Four Predictor Variables

<table>
<thead>
<tr>
<th>Model</th>
<th>First Grade</th>
<th></th>
<th></th>
<th>Fifth Grade</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted R Square</td>
<td>Standard Error</td>
<td>Adjusted R Square</td>
<td>Standard Error</td>
<td></td>
</tr>
<tr>
<td>VSA + ASA + IQ + MRT</td>
<td>.568</td>
<td>11.64</td>
<td>.801</td>
<td>12.24</td>
<td></td>
</tr>
<tr>
<td>VSA + ASA + IQ</td>
<td>.415</td>
<td>13.55</td>
<td>.777</td>
<td>12.97</td>
<td></td>
</tr>
<tr>
<td>VSA + ASA + MRT</td>
<td>.584</td>
<td>11.43</td>
<td>.670</td>
<td>15.78</td>
<td></td>
</tr>
<tr>
<td>VSA + ASA</td>
<td>.423</td>
<td>13.45</td>
<td>.643</td>
<td>16.41</td>
<td></td>
</tr>
<tr>
<td>VSA + MRT</td>
<td>.598</td>
<td>11.23</td>
<td>.619</td>
<td>16.94</td>
<td></td>
</tr>
<tr>
<td>ASA + MRT</td>
<td>.514</td>
<td>12.34</td>
<td>.612</td>
<td>17.10</td>
<td></td>
</tr>
<tr>
<td>VSA</td>
<td>.386</td>
<td>13.88</td>
<td>.448</td>
<td>20.40</td>
<td></td>
</tr>
<tr>
<td>ASA</td>
<td>.264</td>
<td>15.19</td>
<td>.514</td>
<td>19.14</td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>.104</td>
<td>16.77</td>
<td>.552</td>
<td>18.39</td>
<td></td>
</tr>
<tr>
<td>MRT</td>
<td>.528</td>
<td>12.16</td>
<td>.538</td>
<td>18.66</td>
<td></td>
</tr>
</tbody>
</table>
Summary

The purpose of this study was to investigate the predictive validity of visual selective attention, auditory selective attention, IQ, and reading readiness on reading achievement. In Chapter I, three questions were posed concerning the predictor variables obtained in kindergarten and reading achievement at the end of first and fifth grade. Stepwise multiple regressions were computed to determine the answers to the three questions.

The answer to the first question, which of the four predictor variables was the most accurate predictor for reading achievement at the end of first grade, is reading readiness. The answer to the second question, which of the four predictor variables was the most accurate predictor for reading achievement at the end of fifth grade, is IQ. The answer to the third question, which of the testing elements form the best combination for predicting reading achievement is reading readiness and visual selective attention for first grade reading achievement; and IQ, visual selective attention, and reading readiness for fifth grade reading achievement.

Using stepwise multiple regression, it was found that 56% (first grade) and 74% (fifth grade) of the variance in reading scores was predictable.
Chapter V

Conclusions and Implications

Purpose

The specific intent of this study was to determine which of four factors tested in a kindergarten sample was the best predictor and combination of predictors for reading achievement at the end of first and fifth grade.

Conclusions

It should be noted that the conclusions drawn in this chapter refer specifically to the children who participated in this study. The small sample size may have affected the statistical analysis, and any generalizations should be applied with these facts in mind.

The results indicated that a measure of reading readiness, the Metropolitan Readiness Test, was the best single predictor of first grade reading achievement. The correlation coefficient between the MRT and first grade reading achievement in this study was .738, indicating a moderate correlation which is consistent with the literature.

An interesting result was that the best combination of predictors was the MRT and visual selective attention. Together these two variables explained 59.1% of the variation in first grade reading achievement scores. It
was somewhat surprising that visual selective attention best contributed to the explained variation because visual selective attention scores varied little amongst the 31 kindergarten children. On a visual selective attention task, the subjects generally could perform the task well or not at all. However, the literature emphasized the importance of selective attention in reading, and it made sense that visual selective attention was a relatively strong predictor variable.

The addition of the the variable auditory selective attention did not result in a significant change in the explained variance for first or fifth grade reading achievement. Perhaps auditory selective attention was rejected due to a strong curvilinear relation between it and the Metropolitan Achievement Tests. Or, auditory selective attention may have strong collinearity with the other variables. Perhaps the other predictor variables test for auditory selective attention. For example, a child must selectively attend during the oral administration of the Peabody Picture Vocabulary Test, and during the word meaning, listening, and alphabet sections of the MRT.

Selective attention is required for all instructions in any testing situation.

Results for fifth grade reading achievement indicated that a measure of verbal intelligence, the PPVT, was the
best single predictor of reading achievement. This finding supports literature indicating the value of IQ in predicting academic achievement. It furthers supports the generally held idea that IQ is better as a long range predictor. Once again, visual selective attention is the second variable added to increase the explained variance on reading achievement. It would appear, then, that visual selective attention tested in kindergarten would complement a traditional reading readiness assessment. As seen in Table 4, visual and auditory selective attention kindergarten scores were fairly reliable indicators of later reading achievement.

Table 4 also reveals that the reading scores in this study seem to grow more predictable with the passing of time. It is possible, as Butler et al. (1982) suggest in their study, that the predictors are not doing a better job of predicting, but the criterion is becoming more predictable.

**Implications for the Classroom**

The reading task demands that many incidental aspects of a stimulus situation, such as brightness and size of letters, be ignored and attention concentrated on shape, order, and spacing of letter combinations. A poor reader might be one who attends not only to the central but also the incidental aspects of the printed material and to other
extraneous stimulation. There are studies which demonstrate that compared with good readers, poor readers show more incidental learning (Ricks, cited in Santostefano, 1978; Santostefano et al., 1965; Siegel, 1968). If some children are poor readers because of their overinclusive attention, Ross (1977) suggests limiting the available stimuli to those which are relevant to the task, the words on the printed page. Covering the pictures on the page, exposing only the line on which the child is to read, and screening the child from the distractions in the room have all been used successfully.

Some teachers have made use both of stimulus arrangements which increase attention value of relevant cues and of transfer designs which progress from stronger to weaker cues.

Fernald (1943) suggests the child trace the letter while repeating it aloud to help ensure that the relevant form dimension is being attended to as the verbal response is learned.

Montessori (1926) advocates the use of three-dimensional cutouts in teaching letters and numbers. She cautions teachers not to present or draw attention to irrelevant details and describes ways of making the relevant aspects as prominent as possible. She recommends an easy-to-hard sequence of training: "One should proceed from
few stimuli strongly contrasting, to many stimuli in gradual differentiation, always more fine and imperceptible" (p. 184).

An effective strategy (for young children) for enhancing selective attention to the relevant aspects of the reading material has been the verbalization of relevant aspects of a stimulus. It appears that children who are able to label relevant aspects of a stimulus but are not yet of an age where such labels are spontaneously used in arriving at a discrimination can benefit if taught to use labeling. Through demonstration, the child learns that verbal labeling is a more effective way to achieve success. On the other hand, children who have already acquired a fairly efficient use of selective attention seem to be distracted when forced to verbalize labels since they may be using a more effective strategy in their problem solving (Wheeler & Dusek, 1973).

Ross (1977) recommends the introduction of highly similar stimuli in a series of graded steps where the critical features are first presented in isolation and irrelevant aspects added gradually. Presenting the relevant dimension of a stimulus in a variety of examples and in several forms enhances attention. Ross suggests presenting the b-d pair in a variety of sizes and in different degrees of brightness or color, as well as in
different parts of the writing surface or written on different surfaces such as chalkboard, paper, and posterboard. The principle behind this approach is that children are more likely to attend to new rather than familiar stimuli, and novelty increases attention (Berlyne, 1960).

There is a limit to the amount of novelty which can be introduced to a learning task. When there are routine and repetitious situations in which learning is required, Ross (1976) suggests that attention can be maintained and children kept at the task if correct responses are followed by a reinforcing consequence. For older children, knowledge of results may be sufficient; for younger children, a more concrete reward may be necessary.

Results of this study indicate that a test of visual selective attention may be a useful additional screening procedure in kindergarten or first grade. Information obtained from a visual selective attention task could be useful in determining the type of formal reading instruction most appropriate for a beginning reader. For example, the use of stimulus arrangements which increase the attention value of relevant cues, a minimization of distractors, and the use of novelty and reinforcement should be incorporated in a reading program for the child weak in selective attention. Perhaps a program with
auditory and tactile approaches rather than a strong visual approach would be more appropriate for a child weak in visual selective attention.

Implications for the classroom also include the minimization of extraneous noise levels. An investigation to assess processing demands during auditory learning under degraded listening conditions found that introducing competing speech into the listening environment had no effect on learning performance, but resulted in a significant increase in learning effort (Downs & Crum, 1978). This result is an indication that noise present in the home or educational environment may produce adverse effects on the learning performance of children. Increased effort would be required to attend selectively to an auditory signal. If this effort is not expended, there will be a concomitant decrease in learning performance. If this effort is expended but not adequate to fulfill attentional demands of a learning task, performance also may falter. With the prevalence of open-style classrooms in schools, Downs and Crum suggest there could be negative effects from the interaction of reverberation and noise. Because the presence of ambient noise has been shown to increase processing demands during auditory learning, greater emphasis should be focused on acoustical design of educational environments.
Suggestions for Further Research

Replication of this longitudinal study is strongly suggested, beginning with a larger original kindergarten sample to compensate for the attrition rate. Reading achievement scores could be obtained regularly at the end of each school year to investigate any trends that may become evident. In most validity studies, the longer the time interval between the collection of the predictor and criterion variables, the poorer the prediction. Replication of this study may confirm such a trend, or the reading scores may grow more predictable with the passage of time, as in this study. Different measurements of reading readiness, IQ, visual selective attention or auditory selective attention may be used to investigate if findings would differ from those of this study.

An investigation to determine if selective attention can be improved with instruction and practice might be undertaken. Whether training in selective attention given in isolation or using material unrelated to reading leads to an improvement in reading has not yet been investigated. There is some evidence to suggest that poor readers can be helped to improve their performance if, in addition to direct training in reading, they are exposed to a situation aimed at enhancing attention to words and letters (Heiman, Fischer, & Ross, 1973).
References


Cobb, J. A. Relationship of discrete classroom behaviors to fourth-grade academic achievement. *Journal of Educational Psychology*, 1972, 63, 74-80.


McCandless, B. R., Roberts, A., & Starnes, T. Teachers' marks, achievement test scores, and aptitude relations with respect to social class, race, and sex. *Journal of Educational Psychology*, 1972, 63, 153-159.


Rust, J. O., & Rousseau, M. A. Predicting reading and arithmetic achievement by using Bender Gestalt and visual memory technique. *Reading Improvement*, 1982, 19, 74-83.


Telegdy, G. A. The effectiveness of four readiness tests as predictors of first-grade academic achievement. *Psychology in the Schools, 1975, 12*, 4-11.


