CRITICAL READING ABILITY AS RELATED TO
ABILITY IN MATHEMATICS, GENERAL READING ABILITY,
AND INTELLIGENCE

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by
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ABSTRACT

This study sought to determine whether three levels of critical reading ability are significantly associated with intelligence, ability in mathematics as measured by three arithmetic subtests of the Metropolitan Achievement Tests and ability in general reading as measured by the vocabulary and comprehension subtests of the Canadian Test of Basic Skills and to determine the degree of correlation between critical reading ability and each of the factors of mathematical ability, general reading ability, and intelligence.

The subjects of this study were 161 fifth grade pupils from the Saskatoon public school. Each pupil was given the Ohio State University Critical Reading Test and the mathematics computation, concepts and problem solving subtests of the Metropolitan Achievement Tests. C.T.B.S. vocabulary and comprehension scores as well as Lorge-Thorndike intelligence scores were obtained from school records.

Groups of upper 27%, middle 46% and lower 27% achievers in critical reading were formed. A two way analysis of variance was undertaken to test for significant differences in intelligence, computation, concepts, problem solving, vocabulary and comprehension when subjects are
classified by the three levels of critical reading ability and sex. Pearson product moment correlational matrices were determined.

The analysis of the data indicated the following:

1. Grouping children by critical reading abilities differentiates ability in computation, concepts, problem solving, comprehension and vocabulary as well as intelligence.

2. Boys are superior to girls in vocabulary. No other significant sex differences were shown to exist.

3. Positive correlations, ranging from moderate to substantial, exist between critical reading and intelligence, mathematics computation, mathematics problem solving, C.T.B.S. vocabulary and C.T.B.S. comprehension. Comprehension shows the highest correlation with critical reading and computation the lowest. Although the differences between the correlations were not significant, the females tended to have higher coefficients of correlation among the variables than the corresponding ones for the male group.
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Chapter I

INTRODUCTION AND SIGNIFICANCE

Although the ability to read critically is ranked high in importance in the school curriculum, only partial answers as to its nature and development are presently available. Wolf, Huck and King (1967) comment that there is "... insufficient research evidence regarding both the abilities inherent in the skill of reading critically and the factors related to such competency." (p. 9)

Researchers have attested to the importance of the content areas in the development of critical reading skills. Sochor (1959), studying critical reading in the social studies recommended: "... investigation of ... critical reading comprehension with other content areas and between content areas." (p. 359) Ennis (1963) similarly advocated the investigation of critical reading relative to the entire curriculum. He made particular mention of mathematics: "... mathematics seems more conducive to the development of facility with deduction than to judging reliability of evidence and authorities". (p. 19)

That mathematics may be related to critical reading ability is indicated by Sullivan's (1973) research into the relationship of critical reading ability to convergent and divergent thinking. It was found that one of the measures of
convergent thinking, mathematical problem solving, was highly related to critical reading. Sullivan suggested that "exercises in arithmetic reasoning be used to teach critical reading". (p. 377)

A review of the literature reveals that the relationship of reading to mathematics has been explored in some detail. However, the paucity of investigations into critical reading ability as related to mathematics indicates a need for further exploration.

THE PROBLEM

This study sought to determine the relationship of critical reading ability to ability in mathematics, general reading, and intelligence. Specifically, the following null hypotheses were tested:

1. There are no significant differences in mathematics scores, reading scores, and intelligence when three critical reading ability groups are formed.

2. There are no significant differences in boys' and girls' mathematics scores, reading scores, and intelligence when three critical reading ability groups are formed.

3. There are no significant correlations between critical reading scores and scores in each of: arithmetic concepts, problem solving, computation, vocabulary, comprehension, and intelligence.
THE STUDY

Subjects

The subjects were a sample of fifth grade boys and girls enrolled in the Saskatoon public schools.

Measurement Devices

To measure critical reading ability, a test developed for a project known as "Critical Reading Ability of Elementary School Children" (Wolf, Huck and King, 1967) was administered. The Ohio State University Critical Reading Test measures critical reading ability in terms of "logic", "literary", and "general" skills. It was chosen because of both the substantial population utilized in the development of test norms and the consultation of fourteen American reading experts in the creation of the operational definition of critical reading.

In order to obtain diverse measures of mathematics achievement, the three mathematics subtests of the Metropolitan Achievement Tests (Intermediate Battery) were utilized. Although numerous achievement batteries are available, the clear distinction of skills as well as the recent copyright justified its use in this research. The computation subtest involved ability to perform the operations of multiplication, division, addition and subtraction on natural numbers and fractions. The problem solving subtest also required the performance of mathematical operations, however the questions involved the interpretation of verbal material. Basic mathematical understandings were
measured by the concepts subtest.

The **Canadian Long-Thorndike Intelligence Test** scores (combined verbal and nonverbal), as well as **Canadian Test of Basic Skills** (hereafter referred to as **C.T.B.S.**) vocabulary and comprehension grade equivalent scores were obtained from school records.

**Analysis of the Data**

The following parametric statistical procedures were used in the analysis of the data:

1. A two-way analysis of variance design to test the effects of achievement in mathematical computation, mathematical concepts, mathematical problem solving, vocabulary, comprehension; and sex, on the criterion, **The Ohio State University Critical Reading Test**. To test for significant differences between various group pairings, the **Scheffe's multiple comparisons technique** was utilized.

2. A Pearson product-moment correlation matrix to show relationships among the following variables: critical reading, arithmetic concepts, problem solving, computation, vocabulary, comprehension, and intelligence. To determine significance of differences between correlations, the **Fischer's transformation to "z"** was used.

The level of probability for rejecting the null hypotheses was .05.
ASSUMPTIONS

As a basis for conducting this study, the following assumptions have been made:

1. Critical reading ability can be defined and measured.
2. Mathematical ability may be measured in terms of separate components, such as computation and problem solving.
3. The vocabulary and comprehension subtests of the C.T.B.S. measure general reading ability.
4. Intelligence can be assessed through group intelligence tests such as The Canadian Lorge-Thorndike Intelligence Test.
5. The population from which the sample is drawn is normally distributed.
6. The data reported for the development of the standardized instruments used in this study are sufficient to consider the instruments valid and reliable.

DEFINITION OF TERMS

Critical Reading - "... an analytical, evaluative type of reading in which the reader analyses and judges both the content of what is stated and the effectiveness of the manner in which the material is presented." (Wolf, Huck and King, 1967, p. 3)

Computation Ability - The ability to perform numerical operations in the absence of verbal (story problem type) information to determine the answers to basic number facts
and problems representative of skills reflecting the basic algorithms. (researcher's definition)

**Problem Solving Ability** - "... an understanding of important mathematical principles and relationships. Items cover laws and properties of number systems, geometry and measurement, place value, inequalities, sets, estimation, etc." (Durost et al, 1971, p. 2)

**Intelligence** - "... the ability to work with ideas and the relationships among ideas." (Lorge, Thorndike and Hagen, 1966, p. 1)
Chapter II

REVIEW OF THE LITERATURE

INTRODUCTION

In the following review of the literature, the areas of concern in the preparation of this thesis are presented in four main categories.

The first section deals with reading as related to mathematics and includes studies related to: general reading ability and mathematics; specific reading factors and mathematics; reading and high school mathematics; and critical reading in mathematics.

The second section deals with critical reading and includes: problems of definition; critical reading and reading comprehension; thinking and critical reading; and critical reading in the elementary school.

The third section deals with differences of achievement between the sexes in general reading, critical reading and mathematics.

The fourth section deals with intelligence as it relates to general reading, critical reading, and mathematics.
Barney (1973) wrote: "Many children do not fare well in arithmetic . . . [that is] . . . often due to a lack of reading skill". (p. 57) Teachers in general have found this to be the case in their classrooms, providing impetus for much research into the relationship between these two R's.

Whether reading and mathematics are similar because they both require the manipulation of symbols or because of the thinking involved in that manipulation has not been resolved. For example, Hickerson (1959) argued that

". . . since arithmetic is a system of symbolisms, just as language is a system of symbolisms, why shouldn't the accepted principles underlying the understanding and use of language symbols also apply to the understanding and use of arithmetic symbols? (1959, p. 241)

On the other hand, Thorndike (1917) saw the relationship between mathematics and reading in terms of similarity of cognitive functioning. After analyzing children's responses to questions based on paragraphs, he concluded: "Understanding a paragraph is like solving a problem in mathematics". (p. 431)

Monroe's (1933) study of disabled readers, _Children Who Cannot Read_ showed that children who had reading problems had lower grade equivalents in that subject than in arithmetic. On the basis of this and correlations between mathematics computation and reading comprehension, a reading index was formulated. It consisted of the ratio of a child's reading age to the average of the chronological, mental, and
arithmetic ages. Otto, McMenemy and Smith (1973) describe the rationale of this method of assessing reading potential:

Arithmetic computation does not require reading ability; consequently, a measure of performance in arithmetic computation yields information in a basic skill area not dependent upon reading. (1973, p. 106)

Spache's (1968) definition of mathematics is not restricted to computational operations; but includes aspects such as problem solving, which rely heavily on reading ability. He points out that:

Arithmetic and reading have so many elements in common that it is a questionable procedure to assume that poor readers with good learning capacity will usually do better in arithmetic than in reading. (1968, p. 118)

Fortna (1963) using the SCAT and STEP tests concluded

. . . . the factors reading, comprehension, writing, science, mathematics, recognition and application of mathematical concepts, and social studies) extracted from these tests are not independent (p. 190)

supporting Spache's contention that good readers will likely do well in mathematics and poor readers will show little power in mathematics.

On the other hand, Wrigley's (1958) work lends credence to the existence of mathematical and verbal factors. Using a variety of mathematical (algebra, geometry, mechanical arithmetic, problem arithmetic) and verbal (reading comprehension, grammar, and vocabulary) factors he concluded that "... apart from the influence of general ability, [italics in the original] mathematical and verbal ability are independent". (p. 75) Traxler and Townsend, supporting Wrigley's suggestion, found that differences in
Aiken (1972) admitted that intelligence is an important factor in considering the relationship between reading and mathematics. "General intelligence can account for a substantial portion of the variability shared by verbal and mathematical abilities..." (p. 363) He argued that not all of the overlap is accounted for by an intelligence factor, and hypothesized that reading or linguistic ability could account for the relationship between mathematics and intelligence:

... The correlation between general intelligence and mathematical ability is appreciably reduced when reading ability or scores on other linguistic tests are partialled out. This result might lead one to argue that the pivotal variable is not general intelligence but rather reading (linguistic) ability. (Aiken, 1972, p. 363)

It is evident from the above studies that the interrelationships are extremely complex and their exact nature has not been determined. Indeed, it is difficult to reconcile conclusions of various researchers.

**General Reading Ability and Mathematics**

Correlational studies demonstrating a positive relationship between general reading ability (literal comprehension as measured by commonly used survey tests) and mathematical problem solving ability were reported by Stevenson (1925), Coffing (1961), Martin (1963), and Scott (1963). The Coffing, Martin, and Stevenson studies found positive correlations between general reading and arithmetic
problem solving, ranging from .32 to .77. Coffing was not able to demonstrate a pattern or trend when correlations between problem solving and general reading at various grade levels were compared. Scott (1963) found a positive correlation between reading gain and improvement in arithmetic reasoning, social studies, and science. Martin held computation constant and discovered lower correlations between problem solving and reading. Stevenson's data on the relationship of problem solving and reading indicated that "... the ability to read problems is not greatly different from general reading ability ...". (1925, p. 97)

A number of researchers have trained children in one content or skill area; for example, computation, and have measured gains in another; for example, reading comprehension. Lessenger (1925) demonstrated a transfer effect of instruction in reading, with no special emphasis in mathematics to precision in computation. The reading emphasized: "... the ability to focus attention upon key words and technical signs, the ability to focus combinations in one eye-pause, to read unimportant parts hurriedly". (p. 289) Sister Gilmary (1967) compared two groups of elementary school children: one received remedial summer instruction in reading, the other in both reading and mathematics. The group receiving remediation in both areas achieved nearly a half grade gain over the group receiving arithmetic instruction. Sister Gilmary concluded: "... the teaching-learning effects of the reading classes had a significant transfer value ...". (1967, p. 20)
Winch (1910, 1931) employed a similar research technique in studies to determine if drill in computational accuracy would affect verbal problem solving ability. A test was devised which involved the solution of problems without numbers. Winch reasoned:

If the arithmetical problems were not worked out numerically, and yet solved rationally, we should have a . . . measure for testing the transfer (if any) of improvement in numerical accuracy to accuracy in arithmetical reasoning. (p. 263)

No transfer of training in accuracy of computation to ability in solving purely "verbal" problems was found.

Two studies (Cleland and Toussaint, 1962; Koonker, 1941) also raise questions about transfer. Cleland and Toussaint analyzed intermediate grade pupils' ability in reading, listening, and arithmetical computation and found that "the measure showing the lowest relationship with reading was arithmetical computation". (p. 229) Koonker showed that there were no differences in comprehension ability between good and poor computers of long division in grade six.

Although there are inconsistencies among the studies investigating general reading and mathematics, there is consensus regarding the interrelatedness of reading ability, computation, and problem solving. Halow's (1964) conclusion points to the complexity of the problem solving process: "... For a given level of computation ability, problem solving increases . . . for any given level of reading ability, problem solving increases as computation ability increases." (p. 22)
Specific Reading Factors and Mathematics

Some researchers have been leery of comparisons of general reading achievement with mathematics and have studied the relationship of various kinds of reading tasks to achievement in mathematics. Treacy (1944) states: "... research on the relationship of reading and problem solving in arithmetic should be in terms of specific reading skills rather than in terms of general reading ability." (p. 94)

Treacy (1944), Chase (1960), and Muscio (1962) found significant positive correlations between mathematics achievement and ability to note details. As a measure of mathematical ability, Chase and Muscio used a test of problem solving; Treacy, quantitative understanding. On the other hand, Hansen (1944) after studying a number of mathematical and reading factors, did not find noting details to be related to mathematical problem solving ability.

A number of studies (Hansen, 1944; Treacy, 1944; Eagle, 1948) have examined relationships between reading and mathematical achievement. Eagle discovered differences in the relationship of rate of reading and success in mathematics (determined by the average performance of computation and arithmetic reasoning subtests) according to variation in mental age and general reading ability. In the group obtaining higher mental age scores along with high comprehension scores, the faster readers were better in
mathematics, while "... in the average comprehension--average mental age groups, the slower readers were better in mathematics." (p. 176) Hansen, after studying two measures of reading rate, concluded that speed in reading to predict outcomes was a significant factor in problem solving ability, while speed in noting details was not. Treacy's study showed that rate of comprehension did not differentiate good and poor achievers in problem solving.

Hansen (1944), Eagle (1948), and Johnson (1944) looked at vocabulary knowledge in relation to mathematics. Eagle reported that level of general vocabulary was not predictive of success in mathematics (as measured by the average of standardized test scores and 8th. and 9th. grade mathematics grades) but that specialized mathematical vocabulary was. Johnson's and Hansen's studies, however, revealed a high relationship between general vocabulary level and problem solving. Johnson suggested that the high relationship of general intelligence to vocabulary may serve to explain his finding.

Fay (1948) investigated the following reading skills in terms of achievement in the areas of arithmetic, social studies, and science: predicting outcomes of certain events; understanding precise directions; general comprehension; reading of maps, graphs, charts, and tables; and the use of an index, reference books and dictionary. When the factors of mental and chronological ages were controlled, none of the reading factors were found to be significantly correlated with arithmetic achievement, as determined by the Stanford
Schriner (1930) and Coulter (1965) found that exercises in the teaching of reading skills related to problem solving resulted in the improvement of the latter ability. Schriner developed booklets of exercises which gave practice in:

- careful reading, analyzing what is read,
- deciding what is required, estimating answers, choosing procedures, interpreting definitions and rules,
- organizing data, extending vocabulary, discovering relationships, verifying results. (Schriner, p. 107)

Coulter's research involved the teaching of twenty, 45 minute lessons in arithmetic reading skills such as vocabulary, identifying essential information and relating problems to everyday life. It was concluded that "... children who receive special instruction in reading arithmetic problems appear to gain in both reading and arithmetic performance, and especially in arithmetic reasoning. . . ." (Coulter, p. 306)

However, Henney (1968) was not able to demonstrate the effectiveness of special instruction in reading upon mathematics. When the effects of special instruction in the reading of verbal problems were compared with supervised study in which the pupils solved problems, no significant differences were found in the groups' ability to solve problems. It was concluded: "Specific reading abilities do not appear to be any more essential for success in solving verbal problems than general reading ability or computational ability". (p. 4377) Monroe and Engelhart (1933) also failed to demonstrate gains in arithmetic
problem solving by means of instruction in the reading of verbal problems.

Reading and High School Mathematics

The bulk of studies investigating the relationship between mathematics and reading have concentrated upon the elementary school. However, some studies investigating high school reading ability and achievement in algebra, geometry, and general mathematics have been reported.

Bond (1938) and Aukerman (1948) studied various measures of high school students' reading ability relative to achievement in different content areas. Aukerman found that while general reading ability differentiated the good and poor achievers in mathematics, none of the specialized reading skills (main ideas, following directions, organization of work and rate of reading) were related to mathematics.

Bond, in contrast, found that skill in "work-study" reading was an important factor in achievement in grade nine algebra and general mathematics.

Forseth (1961) studied the effects of geometry, as opposed to biology, home economics, and industrial arts upon the improvement of reading in high school. Groups were established for each of the subject areas, care being taken to ensure that the effects of intelligence, initial reading ability, and school were removed. The students were tested for reading comprehension, rate and comprehension efficiency.

It was concluded that

. . . the pupils who study geometry improve in reading ability slightly more than do their classmates
of equal initial reading ability and intelligence who study subjects other than geometry. (p. 13)

Forseth cautioned that the factor of intelligence may not have been completely eliminated.

Matching students for intelligence and initial reading ability did not remove entirely the influence of the bright student who could not be matched in the other group and was therefore excluded. . . . (p. 13)

Call and Wiggen (1966) found that a teacher, trained in the field of reading instruction, who had never studied algebra, could achieve better results with his class than the regular teacher of algebra. The groups receiving instruction were matched for initial reading ability, verbal ability, mathematical reasoning ability, and intelligence. The "reading" approach to algebra emphasized "... getting the meaning from the context by seeing the relationship between the parts and the whole". (p. 153) The experiment demonstrated the importance of reading ability in algebra achievement:

If, by teaching reading, instead of mathematics, we can get better results, it seems reasonable to infer that the competent mathematics teacher might get considerably better results if he were trained to teach reading of the kind encountered in mathematics problems. (p. 157)

Clark's (1939) study, which demonstrated the effectiveness of improving algebra achievement by means of remedial reading instruction, corroborates Call and Wiggen's findings.

Both Traxler (1946) and Hamilton (1953) did not demonstrate a strong relationship between reading and high school mathematics achievement. Although reading as such was not measured in Hamilton's study, it was concluded that
because of the low correlation between English and a test of mathematical reading ability, improvement in general reading ability would not facilitate the reading of mathematical material. Traxler concluded that the relationship between reading and mathematics in high school students is low because of higher correlations of reading and "verbal" subjects such as literature, biology, and history.

Critical Reading and Mathematics

This section reports those investigations that make reference to some aspects of critical reading, as defined in this thesis, as well as pointing to the contribution of investigations which are similar to the present one.

Only one study specifically investigating critical reading and mathematics was found. Sullivan (1973) studied mathematics problem solving as one aspect of convergent thinking in relation to literal and critical reading. Arithmetic reasoning and intelligence were reported to be highly significant factors in both literal and critical reading. "General intelligence and arithmetic reasoning account for more than ninety percent of the explained variance of literal and critical reading. . . .” (p. 374)

In view of the importance of critical thinking to the critical reading process, it is significant that mathematics educators often cite the development of critical thinking as an important goal of mathematics education. Ullsvick (1949) lists the following objectives of critical thinking and mathematics:
1. To recognize and formulate the assumptions underlying an argument. 2. To recognize terms that require precise definition. 3. To organize statements in a logical sequence. 4. To recognize the proposition under discussion and to realize when a conclusion has been reached. 5. To discover common flaws not only in reasoning in mathematical and related fields, but in areas inviting emotional bias or requiring propaganda analysis. 6. To recognize a logical structure or plan of an extended series of propositions or a related group of discussions. (p. 447)

Ullsvick's statement emphasizes the importance of mathematics to the development of skills in logic, one aspect of critical reading ability measured by the Ohio State University Critical Reading Test.

An area of concern relevant to the present study is whether or not critical thinking (or reading) skills are specific to certain subject areas. For example, the question may be asked whether thinking in mathematics is similar to thinking in reading. Taba (1964) states:

"There is no doubt that much about thought is generic and highly transferable--However, it is not clear to what extent this is so". (p. 27) Lundsteen and Hackett (1969) emphasize the importance of teaching general thinking skills:

Covington described a process of curriculum development intended to strengthen these cognitive skills basic to all creative thought in the context of complex and meaningful problems which reflect the principal steps in the creative act. (p. 533)

"That method of curriculum construction" refers to the direct teaching of cognitive processes to develop "creative understanding". (Covington, 1967)

Research by Suppes and Hinford (1965) as well as an earlier study reflect an approach to the development of
thinking similar to that of Covington and provide evidence for commonality of thinking in diverse areas. Suppes and Binford found that it is possible for elementary school children to learn the principles of logic equally as well as college students. The effect of this training in terms of over-all achievement is described. "Anecdotal evidence from teachers suggests some carry-over . . . into other fields, especially arithmetic, reading and English." (p. 155)

Hyram concluded that knowledge of logic is an important aspect of critical thinking and recommended that the study of logic be included in the elementary school curriculum. He asserted that " . . . greater insight into and integration of various subject-matter areas . . . " (p. 130) may develop by means of approaches such as the teaching of logic in the elementary school.

Platt's (1967) findings are not as positive in terms of effectiveness of logic training. His dissertation did not demonstrate the superiority of a geometry course emphasizing logic training, over a traditional approach, in terms of geometry achievement or ability in critical thinking.

CRITICAL READING

Problems in Definition

One of the difficulties encountered in the investigation of critical reading is that of definition. Robinson states that " . . . a cursory examination of approximately one hundred references reveals that critical reading is
usually mentioned but seldom defined". (1961, p. 35)
Taschow (1972) wrote, "... critical reading is now a
blanket term sharing a similar fate with 'reading comprehen-
sion' ... " (p. 1-2) Sochor's (1959) analysis categorizes
the numerous definitions that have been developed as follows:

... 1) as a major heading under 'comprehension'
with one or two heading of relatively equivalent
value, each heading including a number of stated or
implied skills 2) as higher level comprehension
abilities in general 3) as a rather specific comprehension
ability. (p. 40)

Wolf, Huck and King (1967) established the following
definition of "critical reading" in the development of the
Ohio State University Critical Reading Test; it is based
upon the work of Russell (1963) and Robinson (1964):

Critical reading is ... an analytical, evaluative
type of reading in which the reader analyzes and judges
both the content of what is stated and the effectiveness
of the manner in which the material is presented. (p. 3)

Nila Banton Smith (1963), Earnis (1968) and Gadway (1973)
define the term similarly, emphasizing the importance of
personal judgement in the act of critical reading.

The term, "creative reading" is often used in
connection with, or as a substitute for "critical reading".
Gainsburg (1961) avoids the term "critical" and advocates
"creative" reading in which ". . . the reader creates a
richer article than the author had ever intended". (p. 186)
Nardelli (1957) and Adams (1968) subsume "critical reading"
to the larger category of "creative reading". Huus (1965)
distinguishes the two terms as follows: "Critical reading
requires . . . interpretation and evaluation . . . creative
reading requires . . . comparison and synthesis". (p. 117)
Critical Reading and Comprehension

Wolf, Huck and King (1967) deal with the question of whether critical reading skills should be considered distinct from literal comprehension. Reviewing studies by Gans (1940), DeBoer (1946), Betts (1950), Gray (1956), McCullough (1957), Artley (1959), and Sochor (1959), it was concluded by them that "... critical reading skills can be distinguished from those required for literal comprehension". (Wolf, Huck and King, 1967, p. 14)

Additional evidence for the distinctiveness of critical and literal comprehension skills is given in studies by Dewey (1935), Haney (1955), Sochor (1958), and Jarvis (1970). Dewey found that "we cannot assume ... the rank of pupils in one sort of reading would be the same or even relatively the same as in the other sort". (p. 348) Maney and Jarvis report that the correlations between measures of literal and critical comprehension were between .30 and .40. Sochor found, by partialling out intelligence, a very low relationship between critical reading in social studies and literal comprehension.

Thinking and Critical Reading

Maney (1958), in her review of the literature on critical reading in science concludes that "reading and thinking are inseparable processes. There is no reading without thinking". (p. 58) Stauffer (1969), discussing the importance of thinking in relation to reading elaborates on this point. "... reading must be viewed as a thinking
process . . . The act of reading does include all of the skills involved in the act of discovery: perceptive keenness, functional memory, creativity, logical reasoning . . ." (p. xiii)

Wolf, Huck and King (1967) point specifically to the interrelatedness of thinking and critical reading. "Critical reading is the application of critical thinking skills to the reading act". (p. 9) Other researchers (Evarts, 1970; R.L. Smith, 1971; Mueller, 1973) have similarly acknowledged the interdependence of critical thinking and critical reading. Stevens' (1932) comment implies that many students experience difficulty in problem solving because of a lack of integration between thinking and reading.

The suggestion which constantly arises . . . is that a large proportion of . . . pupils may be solving reasoning problems in arithmetic by means of type solutions instead of vital reasoning processes. (p. 206)

Critical Reading in the Elementary School

Evidence is accumulating as to the efficacy of fostering the development of critical reading in the elementary school (Russell, 1956; Taba, 1964; Wolf, Huck and King, 1967). Mueller (1973) notes that in the past, researchers have tended to advocate and study the development of critical skills in the secondary schools, ignoring the lower grades. Hazlett suggests:

Piaget's picture of a striking difference between adult and childish thinking is . . . due to an overvaluation of verbal expression as a measure of thinking, and an exaggerated view of the logicality of adult thought. (1929, p. 281)
Taschow (1972) emphasizes that critical reading is developed through teaching, and cannot be left to "incidental learning". He cites the findings of Brownell (1953), Nardelli (1957) and Osborne (1939) to support his advocacy of a planned approach.

Critical reading is a learned, purposeful, planned thinking process over a sustained period of time in which the reader, supported by his reading experience, background, and training enters actively, intelligently and emotionally with the author. (p. 3)

Betts observed that "certain types of critical reading ability can be developed by elementary school children under direct and systematic guidance." (1950, p. 12)

SEX DIFFERENCES IN GENERAL READING, CRITICAL READING, AND MATHEMATICS

The investigation of differences in males' and females' achievement in the area of general reading has been extensively pursued. Konschuh (1971), in reviewing the research, stated:

Research findings indicate that there is a disproportionately larger percent of boys experiencing reading retardation and that girls tend to be better readers than boys at all levels. Although some comparisons show that boys sometimes perform as well as girls do on reading tests, the bulk of evidence is in favor of girls' higher achievement. (p. 10)

Maccoby's (1966) listing of eighteen studies of sex differences in general reading between 1942 and 1965 indicates that ten studies found differences favoring the girls, two favoring the boys, and six discovered no differences. Johnson (1973) cites studies by Monroe (1933), Samuels (1943), Gates (1961), and Balow (1963) which have
demonstrated the superiority of girls' performance in the area of general reading.

Some researchers, studying critical reading or critical thinking have discovered no differences in these abilities between the sexes. Glaser's (1941) study did not show sex to be a significant factor in the determination of good and poor critical thinkers. Wolf, Huck and King (1967) also found no differences.

Children of both sexes benefit equally from instruction in critical reading. The analysis of covariance tests revealed no significant differences between the sexes at any grade level, except on logic for grade five in favor of the girls. (p. 116)

Burgdorf (1966) found no significant differences between the sexes in ability to draw inferences from children's literature.

Alternatively, Eller and Wolf (1966), Platt (1967) and Gadway (1973) showed that boys were superior to girls on the various measures of critical skills considered. Gadway found that boys tended to score considerably below norms on his measure of critical reading, while girls performed above. Eller and Wolf concluded that boys are less pursuasable than girls, while Platt found that there was significantly greater carry over of logic training to critical thinking in boys than in girls.

R.L. Smith (1971) treating "critical thinking" and "critical reading" as one factor found that "critical reading/thinking is more closely related to intelligence, reading aptitude, and grade point average among females than among males." (p. 6229A) Jarvis (1970) analyzed his data in
a similar way and found a somewhat "opposite" relationship. In that study a test of critical reading and critical thinking correlated more highly with reading in boys than in girls. Ritter and Lofland's (1924) findings agree with Jarvis' in that correlations between reading and reasoning were higher for boys than girls. The authors do not offer an explanation of this phenomenon, but point out that it is not explained by the commonly held assumption that "girls read better than boys, but boys reason better than girls". (p. 532)

Maccoby's (1966) compilation of research on sex differences in mathematical abilities showed that of sixteen studies in computation between 1928 and 1963, twelve reported no differences between the sexes, three favored females, one males. In the area of mathematical reasoning (which constitutes research with a variety of tests, including intelligence tests) twenty-one studies spanning 1933 to 1964 are listed. The majority of these studies (eleven) favor males. Nine studies reported no differences, while one study favored females.

Muscio (1962), using a test of quantitative understanding which measured "children's understanding of our number system" (p. 259) found that boys were superior to girls on this measure of mathematical ability. Muscio notes that "neither general intelligence nor computational skill account for this difference". (p. 261)

Kilpatrick (1967) studied mathematical problem
solving by means of introspection. Subjects' verbalizations while solving problems were recorded. The girls demonstrated superior problem solving skills.

There were significant sex differences, all favoring the girls; in saying that one does not know how to solve a problem, in using deduction as opposed to trial and error, in using equations and in stopping work on a problem without a solution. (p. 4360A)

Hamilton (1953) and Henney (1963) indicated sex differences in ability to read mathematical material. Results of the former's testing of two hundred and sixty grade nine students indicated that boys have greater ability in reading mathematics. Alternatively, Henney, whose study has been previously discussed, found that girls scored higher on the reading subtest of her "verbal problems post test". No other sex differences, either within treatment groups or in comparisons by treatment groups, were ascertained.

INTELLIGENCE AND GENERAL READING, CRITICAL READING AND MATHEMATICS

Halovinsky (1961) stated:

Learning to read involves a capacity for abstract reasoning, ability to recognize symbols and to integrate them into a meaningful sequence. This implies a close relationship between intelligence and reading ability. (p. 19)

Numerous empirical investigations reporting a positive relationship between general reading are supportive of this assertion. Pitts (1952), studying the interrelationships of the variables functional competence in mathematics, reading grade levels, mental ability, and chronological age found that the highest coefficient of correlation existed
between reading grade level and IQ. Maney (1958) found that the *Gates Reading Survey Tests* correlated highest (.83) with intelligence when compared with correlations between intelligence and literal science comprehension as well as between literal science comprehension and critical reading comprehension. Sochor's (1958) study in the area of social studies showed results similar to Maney's findings. Traxler (1946) found that the coefficient of correlation between reading ability and intelligence was .75.

Intelligence is widely recognized as being highly related to achievement in mathematics. "There is a close connection between mathematical and general ability; high intelligence is the most important single factor for success in mathematics." (Wrigley, 1958, p. 61) Erickson (1958) compared overall correlations between intelligence and mathematics with correlations obtained by dividing students into upper (27%), middle (46%), and lower (27%) achievement groups. He found that when this division of ability was made the magnitude of the correlations lowered. After emphasizing the significance of this finding in terms of the necessity of considering each child as having a unique complex of abilities, Erickson concluded that "arithmetic ability correlates sufficiently high with IQ, that, with proper interpretation, mental age can be used as a basis of expectation of a pupil's arithmetic ability." (p. 289)

Muscio (1962) found that achievement in "quantitative understanding" was closely related to intelligence. However,
like Erickson, he cautions against a misuse of this relationship.

Substantial relationships exist among the several arithmetic achievement measured and general intelligence. However, the considerable variability shown by individual achievement profiles, is evidence of the apparent lack of any 'general' arithmetic ability. (p. 262)

Leidke (1971) noted that "usually a positive relationship exists between intelligence and mathematics achievement". (p. 151) However, in his comparison of achievement between a group of "self-directed" students and one of "teacher directed" students the former's mathematical achievement was not related to intelligence. "The ability to predict mathematics achievement on the basis of prior knowledge appears to depend on the setting in which mathematics is taught." (p. 151)

The high relationship of both mathematics and reading to intelligence has justified the partialling out of this factor when considering the relationship between the two skills. (Monroe and Engelhart, 1933; Aukerman, 1948; Eagle, 1948; Fay, 1948; Forseth, 1961; Balow, 1964; Gilmary, 1967; Henney, 1968) Balow's and Aiken's comments provide a pertinent summary of the rationale of this statistical technique. "General reading ability does have an effect on problem solving ability . . . however . . . controlling IQ drastically reduces the degree of relationship." (Balow, 1964, p. 22)

. . . the correlation between reading (or other measures of verbal ability) and mathematical achievement may decrease substantially the joint relationship of these two variables when general intelligence is partialled out. (Aiken, 1972, p. 362)
Critical reading also has been found to be positively related to intelligence. Glaser's (1941) study showed that critical thinking correlated with intelligence at .48, while Maney (1958) found a correlation of .67 between intelligence and critical reading in science. In summarizing their project, Wolf, Huck and King found a .79 correlation of critical reading and intelligence.

In general, children of higher intelligence levels perform better on critical reading than middle IQ children who in turn perform better than low IQ children. However, children of all intelligence levels can learn to read critically. (p. 109-110)

Other researchers (Brownell, 1953; Betts, 1956; Nardelli, 1957; M. Gray, 1969; Jarvis, 1972) have alluded to the moderately high relationship between IQ and critical reading. Betts and Gray point out that although intelligence is related to critical reading, it is no guarantee of it.

SUMMARY

1. The search for integration of effort in major skill areas as well as the possibility of using mathematics as a predictor of reading success has led to investigations of the relationship between reading and mathematics.

   In the consideration of this relationship, the possible existence of separate "number" and "verbal" factors has been studied.

2. Generally, researchers have demonstrated a positive moderate relationship between general reading ability and mathematics. There is some contradictory
evidence as to the degree of relationship of computational skills to reading ability.

3. Research investigating the relationship of specific reading skills such as noting details, rate, etc., to achievement in mathematics has tended to be inconclusive, adding little to the understanding of the relationship between reading and mathematics.

4. Research has shown that reading skills are not only related to achievement in elementary school mathematics, but are also important to success in high school mathematics.

5. There is a dearth of research into the relationship of critical reading to ability in mathematics. However, demonstration of the efficacy of the teaching of cognitive skills, such as logic, towards the improvement of critical skills in curricular areas points to the need for such research.

6. A wide variety of diverse definitions of critical reading have been put forth, making for difficulties in the comparison of research findings in the area. There is, however, general acceptance among educators of the importance of higher level comprehension skills.

7. Writers have emphasized the importance of thinking skills in relation to reading.

8. The research literature indicates that there has been a preponderance of studies demonstrating the superiority of females' reading achievement over males'. However, recent cross-cultural studies have cast doubt on
the validity of any genetic explanation of this phenomenon.

9. Investigation of sex differences in critical reading and thinking skills has been limited and inconclusive.

10. A degree of male superiority in mathematics, notably in the area of problem solving, has been shown, but appears not to be as strong as the females' superiority in the area of reading.

11. The factor of intelligence has been shown to be positively related to mathematics, general reading, and critical reading.
Chapter III

SUBJECTS, MATERIALS AND PROCEDURES

This chapter discusses subjects, materials, and procedures used in a study to investigate the relationship of critical reading ability to ability in mathematics, general reading, and intelligence.

SELECTION OF SUBJECTS

A random sample of five classrooms, as well as an additional three alternates, was drawn from a list of fifth grade classrooms within the Saskatoon Saskatchewan public school system in the 1973-74 school year. Classrooms that contained only fifth grade boys and girls in the regular fifth grade program were included in the selection process.

A table of random numbers (Engelhart, 1972, p. 521) was used to select a total of eight classrooms, identified by the teachers' names and the schools in which they were located.

MATERIALS

The following materials were employed to gather information pertinent to this investigation: The Ohio State University Critical Reading Test; the mathematics
computation, concepts and problem solving subtests of
The Metropolitan Achievement Tests Intermediate Battery
(Partial) Form F; The Canadian Lorand-Thorndike Intelligence
Test; and the C.T.B.S. The latter two tests were previously
administered by the school system.

The Ohio State University Critical Reading Test

The Ohio State University Critical Reading Test is based on the following definition:

Critical reading . . . is an analytical, evaluative type of reading in which the reader analyzes and judges both the content of what is stated and the effectiveness of the manner in which the material is presented. (Wolf, Huck and King, 1967, p. 3)

Three categories of items were devised:

The items that tested the subject's ability to detect fallacies and propaganda techniques used in printed materials and his ability to evaluate the internal consistency of an argument were labeled as Logic. Items that evaluate the subject's ability to identify the author's and publisher's point of view and biases, to judge the author's qualifications and to make comparisons of related content from various sources were categorized as General. Items measuring the subject's ability to identify literary forms and to analyze and evaluate story structure, character development, story setting, format and theme of the story and the author's use of literary devices were classified under Literature. (emphasis added) (Wolf, Huck and King, 1967, p. 33)

There are two levels of the primary form of the test and one of the intermediate (suitable for use in grades four, five, and six). The intermediate form has a readability of grade four. The test is divided into two parts and consists of a total of fifty-four questions.

The final test was developed from the administration of trial forms to a sample of 3,017 children. The revised
test was administered to a total of 4,991 students for purposes of norming.

Reliability was determined through the use of the Kuder-Richardson formulae 20 and 21. Split half reliabilities were also calculated. The first norming session (fall) revealed coefficients of .76, .74, and .76 while the spring test administration resulted in values of .84, .82, and .83.

A complete copy of the test form used in this thesis is presented in Appendix C.

The Canadian Lorge-Thorndike Intelligence Test

This intelligence test measures, according to the technical manual, "abstract intelligence . . . [i.e.] . . . the ability to work with ideas and the relationships among ideas". (Lorge, Thorndike and Hagen, 1966, p. 1) There are two batteries, verbal and nonverbal:

The tests are based on the premise that most abstract ideas with which the student in school or college or the working adult in many occupations deals are expressed in verbal symbols, so much so that verbal symbols are the most appropriate medium for the testing of abstract intelligence. Nevertheless . . . a verbal test in English may constitute an adequate basis for appraising an individual's abilities. Consequently, a parallel set of nonverbal tests is provided to accompany the basic verbal series. (Lorge, Thorndike and Hagen, 1966, p. 1)

In addition to separate verbal and nonverbal measures of intelligence, a combined IQ score is also calculated. The latter score was used in this research.

The wide acceptability of this test is pointed out by the following:

The Lorge-Thorndike Intelligence Test has been well received in previous reviews and must generally accepted
standards for test construction and standardization procedures. The reliability coefficients are satisfactory. The verbal battery .83 to .91, nonverbal .80 to .88, from different grades. (Tuttle, 1972, p. 360)

Sample items from this test are presented in Appendix B.

The Canadian Test of Basic Skills

This battery of tests, a Canadian adaptation of the Iowa Every Pupil Test of Basic Skills, measures growth in the basic skill areas of vocabulary, reading, language, work-study, and mathematics for each of six grade levels (grades 3 to 8). The present investigation utilized the vocabulary and reading subtests of the C.T.B.S. They are described in the Manual as follows:

The items of the vocabulary test consist of a word in context followed by four possible definitions. Stimulus words were chosen from the Thorndike and Rinsland word lists, as were words constituting the definitions. (King, 1968, p. 27)

The reading test consists of selections which vary in length from a few sentences to a full page. The passages were chosen in an attempt to represent as completely as possible all of the types of material encountered by the pupil in his everyday reading. (King, 1968, p. 30)

Birch (1972) emphasizes that the C.T.B.S. has grown from the Iowa battery. "The same level of technical sophistication that gave the Iowa test its fine qualities is evident in the design of the C.T.B.S. and the production of norms." (p. 7) An inspection of the split half reliability coefficients for the vocabulary and comprehension subtests reveals a range of .86 to .94, reinforcing the above comment.

Sample items from this test are presented in Appendix B.
The Metropolitan Achievement Tests

The Teacher’s Handbook for the Metropolitan Achievement Tests indicates that rigorous procedures for developing the tests were undertaken. Item analysis was completed for 12,000 items in addition to results of a teacher questionnaire as to the quality of the test. Split half reliability coefficients ranged from 0.84 to 0.96 for the various subtests. Anderhalter (1965) comments favorably as to the construction of this test: "Standardization procedures involving test construction, analyses of items, equating of forms, derivation of norms, appear to have been well planned and carried out". (p. 626)

Validity is supported in terms of curricula by data relating the selection of content at each level, and statistically by correlations between test scores and various mental ability tests. Curricular validity evidence ... is adequate. (p. 628)

The mathematics subtests used in the present study give three measures of mathematics achievement as described by the Teacher’s Directions:

Mathematics: Computation—40 items measure pupils’ ability to compute. Items cover ASMD processes with natural numbers and with fractions.

Mathematics: Concepts—40 items measure pupils’ understanding of important mathematical principles and relationships. Items cover laws and properties of number systems, geometry and measurement, place value, inequalities, sets, estimation, etc.

Mathematics: Problem Solving—35 items measure pupils’ ability to apply knowledge in solving numerical problems. Items include application of ASMD processes in everyday problems, use of measurement concepts, chart reading, and the use of number sentences. (Durost et al., 1971, p. 2)

Sample items from this test are presented in Appendix B.
MATERIAL ASSEMBLY

The Ohio State University Critical Reading Test was reproduced on 3½ x 14 sheets of white paper, from a copy obtained from Prof. Martha L. King of Ohio State University who gave the researcher permission for use of the test in this study. The test booklets were in reusable form, as pupils recorded answers on IBM 1230 answer sheets.

One classroom set of the Metropolitan Achievement Tests, Intermediate Battery (Partial), Form F was ordered from the Harcourt, Brace, Jovanovich Inc. Test Department. However, a delay in receiving the order made it necessary to reproduce the tests on 8½ x 11 sheets of white paper.

The Mathematics Computation Test formed one booklet; the Mathematics Concepts and Problem Solving Tests constituted the other.

PROCEDURES

Dr. R. Wickstrom, director of Planning and Research for the Saskatoon Board of Education, School District No. 13, approved the researcher's request for permission to conduct the study. The fifty two classrooms were listed and enumerated. Using a table of random numbers, five classrooms were determined, as well as three alternates. A memorandum from Dr. Wickstrom's office was sent to the schools to introduce the research project. The researcher contacted each school to schedule times for the tests.

Class lists indicating the test scores for The Canadian
Scores were compiled.

Testing Schedule

Two sessions with each class were required:

1) The administration of the Ohio State University Critical Reading Test.


The tests were administered in the period of time between May 21 and June 5, 1974. All testing took place in the mornings.

As far as possible, the interval between the testing sessions was one week. However some deviations occurred, because of conflicts with field days and other school activities.

In the case of absenteeism during the administration of the Ohio State University Critical Reading Test, copies of the test and answer sheet were left with the teacher to administer at a later time. This procedure was not carried out with the Metropolitan Achievement Tests due to the rigorous timing required.

After two classrooms were tested, it became obvious that the proposed sample size for this project would not be attained due to small classroom populations, absenteeism, and incomplete cumulative folders. Consequently, two of the alternate classrooms were added.
TABLE I
ORDER OF TEST ADMINISTRATION

<table>
<thead>
<tr>
<th>Session I</th>
<th>Administration of the Ohio State University Critical Reading Test (untimed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(day 1)</td>
<td></td>
</tr>
<tr>
<td>Session II</td>
<td>Administration of the Metropolitan Achievement Tests</td>
</tr>
<tr>
<td>(day 2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Mathematics Computation (35 min.)</td>
</tr>
<tr>
<td></td>
<td>b) Mathematics Concepts (25 min.)</td>
</tr>
<tr>
<td></td>
<td>c) Mathematics Problem Solving (25 min.)</td>
</tr>
</tbody>
</table>

TEST ADMINISTRATION

Ohio State University Critical Reading Test

Prior to testing, arrangements were made with the classroom teachers for HB pencils. These along with test materials, were distributed to the pupils prior to the testing session.

The researcher was introduced to the class by the classroom teacher. The pupils were requested not to look at the test materials until they were told to do so. The researcher introduced the test and project to the students. (See Appendix A)

Scoring

The highest possible score on the test was 54. The computer was utilized for the scoring.
Mathematics Computation. Test booklets, answer sheets, pencils, and scratch paper were distributed prior to the writing of the test. Instructions were read to the pupils. (See Appendix A) The students were directed to mark their answers in the identical way as the Ohio State University Critical Reading Test. The same "reminders" were written on the chalkboard with the exclusion of #3.

Mathematics Concepts. After the question booklets and answer sheets were distributed, instructions were read to the students. (See Appendix A)

Mathematics Problem Solving. After new answer sheets were distributed, instructions were read to the students. (See Appendix A)

Scoring

Each of the Mathematics Tests were scored separately by computer.

The maximum possible scores for each of the tests were as follows:

- Mathematics Computation 40
- Mathematics Concepts 40
- Mathematics Problem Solving 35

Compilation of Raw Data

A selection of the top 27%, middle 46%, and lower 27% critical reading groups was made. Each student was assigned a unique four digit numeral which indicated sex
and school. A printout showing the student number, name, and test scores was obtained. The raw scores of the three mathematics tests were converted into grade equivalents, using the Teacher's Handbook of the Metropolitan Achievement Tests.

IBM cards were punched by the researcher, indicating student number, IQ and scores on C.T.B.S. Vocabulary, C.T.B.S. Comprehension, Critical Reading, Mathematics Computation, Mathematics Concepts, and Mathematics Problem Solving Tests.

The analysis of variance and the calculation of the Pearson product moment correlations were carried out by the computer at the University of Saskatchewan using the "Social Sciences Package".
Chapter IV

ANALYSIS OF THE DATA

INTRODUCTION

The subjects in this study were 161 fifth grade students: 78 girls, 83 boys. The following scores were collected for each student: The Canadian Forces-Thorndike Intelligence Test, Canadian Test of Basic Skills (Vocabulary and Comprehension), Ohio State University Critical Reading Test, and the Metropolitan Achievement Tests (Mathematics Computation, Concepts, and Problem Solving). This chapter presents an analysis of this data.

The following null hypotheses were tested:

1. There are no significant differences in mathematics, reading, and intelligence scores when three critical reading ability groups are formed.

2. There are no significant differences in boys' and girls' mathematics, reading, and intelligence scores when three critical reading ability groups are formed.

3. There are no significant correlations between critical reading scores and scores in each of: arithmetic concepts subtest, problem solving subtest, computation subtest, vocabulary subtest, comprehension subtest, and intelligence.
Elicited Data

Table II presents the means and standard deviations of tests used in this study.

**TABLE II**
MEANS AND STANDARD DEVIATION OF TESTS EMPLOYED IN THIS STUDY

<table>
<thead>
<tr>
<th>Variables</th>
<th>Type of Score</th>
<th>Males (N=83)</th>
<th>Females (N=78)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Critical Reading</td>
<td>Raw Scores</td>
<td>23.53</td>
<td>6.72</td>
</tr>
<tr>
<td>Computation</td>
<td>Grade Equivalent</td>
<td>6.45</td>
<td>1.29</td>
</tr>
<tr>
<td>Concepts</td>
<td>Grade Equivalent</td>
<td>6.95</td>
<td>1.72</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>Grade Equivalent</td>
<td>6.29</td>
<td>1.50</td>
</tr>
<tr>
<td>IQ</td>
<td>Full Scale</td>
<td>113.92</td>
<td>11.37</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>Grade Equivalent</td>
<td>5.32</td>
<td>.90</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Grade Equivalent</td>
<td>4.98</td>
<td>.90</td>
</tr>
</tbody>
</table>

**ANALYSIS OF THE DATA**

Comparison of Intelligence Test Scores

Table III presents the means and standard deviations of males' and females' intelligence test scores in three critical reading ability groups.
TABLE III
MEANS OF THE CANADIAN LORGE-THORNDIKE INTELLIGENCE TEST
SCORES CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th></th>
<th>Upper Group</th>
<th></th>
<th>Middle Group</th>
<th></th>
<th>Low Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical</td>
<td>Critical</td>
<td>Critical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reading</td>
<td>Reading</td>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Males</td>
<td>20</td>
<td>120.25</td>
<td>10.41</td>
<td>42</td>
<td>115.44</td>
<td>9.47</td>
</tr>
<tr>
<td>Females</td>
<td>23</td>
<td>125.96</td>
<td>8.32</td>
<td>33</td>
<td>112.13</td>
<td>12.72</td>
</tr>
</tbody>
</table>

An analysis of variance of these scores is shown in Table IV. The interaction effect of sex and critical reading was not significant.

TABLE IV
ANALYSIS OF VARIANCE OF THE CANADIAN LORGE-THORNDIKE
TEST SCORES CLASSIFIED BY SEX AND CRITICAL
READING ABILITY

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading</td>
<td></td>
<td>3776.250</td>
<td>32.335</td>
<td>.01</td>
</tr>
<tr>
<td>Ability</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>220.894</td>
<td>.000</td>
<td>1.00</td>
</tr>
<tr>
<td>Error</td>
<td>157</td>
<td>116.783</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scheffe's multiple comparisons indicated that the high group was significantly superior to the middle group and the middle group was significantly superior to the low group. No significant sex differences in intelligence scores were found.
Comparison of Mathematics Computation Scores

Table V presents the Mathematics Computation scores by sex and critical reading ability groupings.

**TABLE V**

MEANS OF MATHEMATICS COMPUTATION SCORES CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th></th>
<th>Upper Group</th>
<th></th>
<th>Middle Group</th>
<th></th>
<th>Low Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical Reading</td>
<td></td>
<td>Critical Reading</td>
<td></td>
<td>Critical Reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N  Mean SD</td>
<td>N  Mean SD</td>
<td>N  Mean SD</td>
<td>N  Mean SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>20 7.06 1.08</td>
<td>42 6.50 1.32</td>
<td>21 5.78 1.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>23 6.12 1.29</td>
<td>33 6.56 1.46</td>
<td>22 5.85 0.87</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table VI shows the analysis of variance for computation scores. The interaction effect of sex and critical reading ability failed to reach significance.

**TABLE VI**

ANALYSIS OF VARIANCE OF MATHEMATICS COMPUTATION SCORES FOR SUBJECTS CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading Ability</td>
<td>2</td>
<td>36.703</td>
<td>23.296</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>4.955</td>
<td>3.145</td>
<td>.08</td>
</tr>
<tr>
<td>Error</td>
<td>157</td>
<td>1.576</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Scheffe's multiple comparison of main effects revealed a significant difference in mathematics computation scores among the three critical reading ability groups; the
high ability group was superior to the middle group; the middle group scored higher than the low group. Although the females' mean computation scores in each of the three groups was slightly higher than the males', these differences were not significant.

Comparison of Mathematics Concepts Scores

Mathematics Concepts scores for males and females in three critical reading ability groups are presented in Table VII.

TABLE VII
MEANS OF MATHEMATICS CONCEPTS SCORES CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th></th>
<th>Upper Group</th>
<th>Middle Group</th>
<th>Low Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical Reading</td>
<td>Critical Reading</td>
<td>Critical Reading</td>
</tr>
<tr>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>Males 20</td>
<td>8.19</td>
<td>1.50</td>
<td>42</td>
</tr>
<tr>
<td>Females 23</td>
<td>8.42</td>
<td>1.26</td>
<td>33</td>
</tr>
</tbody>
</table>

Results of the analysis of variance for mathematics concepts are given in Table VIII. The interaction effect was not significant.
Use of the Scheffe's multiple comparisons technique revealed that differences in concepts scores among all critical reading ability groups were significant. Mathematics concepts scores in the upper critical reading group were significantly higher than the middle group; the middle group achieved significantly higher in mathematics concepts than the low critical reading ability group. Girls' scores in mathematics concepts were higher in the upper and low groups in critical reading, while the reverse was true for the middle group. However, these differences were not significant.

Table IX shows mean problem solving scores for males and females in the three critical reading ability groups.
TABLE IX

MEANS OF MATHEMATICS PROBLEM SOLVING CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th></th>
<th>Upper Group</th>
<th></th>
<th>Middle Group</th>
<th></th>
<th>Low Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical Reading</td>
<td></td>
<td>Critical Reading</td>
<td></td>
<td>Critical Reading</td>
</tr>
<tr>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Males</td>
<td>20</td>
<td>7.57</td>
<td>1.20</td>
<td>42</td>
<td>6.26</td>
</tr>
<tr>
<td>Females</td>
<td>23</td>
<td>7.79</td>
<td>1.09</td>
<td>33</td>
<td>6.25</td>
</tr>
</tbody>
</table>

An analysis of variance for mathematics problem solving is presented in Table X. The interaction effect of sex and critical reading was not significant.

TABLE X

ANALYSIS OF VARIANCE OF MATHEMATICS PROBLEM SOLVING SCORES FOR SUBJECTS CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading Ability</td>
<td>2</td>
<td>73.516</td>
<td>59.923</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>.661</td>
<td>.538</td>
<td>.46</td>
</tr>
<tr>
<td>Error</td>
<td>157</td>
<td>1.227</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results of the Scheffe's multiple comparisons analysis indicate significant differences among all groups. Mathematics problem solving scores in the upper critical reading group were significantly higher than the middle group and the middle group's problem solving scores were significantly higher than the lower group's. Although sex
differences in problem solving were not significant, females in the upper and low groups tended to score higher in mathematics problem solving as compared to males in those groups. Nearly equal means for boys and girls occur in the middle group.

Comparison of Vocabulary Scores

Table XI shows C.T.B.S. vocabulary scores of males and females in three critical reading ability groups.

<table>
<thead>
<tr>
<th></th>
<th>Upper Group</th>
<th></th>
<th>Middle Group</th>
<th></th>
<th>Low Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical Reading</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>Critical Reading</td>
<td>N</td>
</tr>
<tr>
<td>Males</td>
<td>20</td>
<td>6.10</td>
<td>.62</td>
<td></td>
<td>42</td>
<td>5.38</td>
</tr>
<tr>
<td>Females</td>
<td>23</td>
<td>5.90</td>
<td>.50</td>
<td></td>
<td>33</td>
<td>5.06</td>
</tr>
</tbody>
</table>

The analysis of variance for vocabulary scores is presented in Table XII. The interaction effect of sex and critical reading was not significant.
TABLE XII
ANALYSIS OF VARIANCE FOR VOCABULARY SCORES CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading Ability</td>
<td>2</td>
<td>30.714</td>
<td>53.763</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>3.351</td>
<td>5.867</td>
<td>.02</td>
</tr>
<tr>
<td>Error</td>
<td>157</td>
<td>.571</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Scheffe's multiple correlations technique revealed that differences among all groups in vocabulary scores were significant. Those high in critical reading ability were significantly superior in vocabulary when compared to those in the middle ability grouping. When comparing the middle group's vocabulary achievement to the lower group's, the former was superior to the latter.

Females' mean scores were significantly lower than males'.

Comparison of Comprehension Scores

Table XIII presents C.T.B.S. comprehension scores obtained by males and females in three critical reading ability groups.
TABLE XIII

MEANS OF COMPREHENSION SCORES CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th></th>
<th>Upper Group</th>
<th></th>
<th>Middle Group</th>
<th></th>
<th>Low Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical Reading</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>Critical Reading</td>
<td>N</td>
</tr>
<tr>
<td>Males</td>
<td>20</td>
<td>5.77</td>
<td>.48</td>
<td>42</td>
<td>4.99</td>
<td>.84</td>
</tr>
<tr>
<td>Females</td>
<td>23</td>
<td>5.90</td>
<td>.44</td>
<td>33</td>
<td>4.91</td>
<td>.67</td>
</tr>
</tbody>
</table>

The analysis of variance of these scores is given in Table XIV. The interaction effect of sex and critical reading was not found to be significant.

TABLE XIV

ANALYSIS OF VARIANCE OF COMPREHENSION SCORES FOR SUBJECTS CLASSIFIED BY SEX AND CRITICAL READING ABILITY

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
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<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading</td>
<td>2</td>
<td>30.376</td>
<td>.6619</td>
<td>.01</td>
</tr>
<tr>
<td>Ability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>.056</td>
<td>.124</td>
<td>.73</td>
</tr>
<tr>
<td>Error</td>
<td>157</td>
<td>.454</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Scheffe's multiple comparisons analysis indicated that all differences among the three groups in comprehension were significant. Although none of the sex differences in comprehension were significant, females' mean scores were less than the corresponding males' scores in the middle and low ability groups; in the high critical reading ability
group, the girls' mean was higher than the boys'.

Summary of the Analysis of Variance

A two way analysis of variance demonstrated:

1. Significant differences in mathematics computation, concepts, and problem solving as well as C.T.B.S. vocabulary and comprehension scores among the three ability groups in critical reading.

2. A significant difference, favoring the boys, in boys' and girls' scores in vocabulary.

Correlations Among the Variables

Tables XV, XVI, and XVII present Pearson product moment correlation matrices among the variables studied for the entire sample, males, and females. All correlations were significant at the .001 level.

For the total sample, the relationships among the variables ranged from low to high. The lowest correlation was .39, between vocabulary and computation. The highest coefficient, .76, was between the comprehension and vocabulary subtests of the C.T.B.S.

When comparing correlations for males and females, the coefficient for the females was consistently higher than the corresponding one for males giving the latter a greater range of values than the former. Only in the cases of comprehension and concepts were the correlations equal for males and females. The greatest differences between the sexes occurred with the correlations of computation and the other variables. Use of the transformation of coefficients
<table>
<thead>
<tr>
<th></th>
<th>Computation</th>
<th>Concepts</th>
<th>Problem Solving</th>
<th>IQ</th>
<th>Vocabulary</th>
<th>Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading</td>
<td>.52</td>
<td>.63</td>
<td>.68</td>
<td>.58</td>
<td>.64</td>
<td>.71</td>
</tr>
<tr>
<td>Computation</td>
<td>-</td>
<td>.70</td>
<td>.73</td>
<td>.54</td>
<td>.39</td>
<td>.52</td>
</tr>
<tr>
<td>Concepts</td>
<td>-</td>
<td>-</td>
<td>.75</td>
<td>.66</td>
<td>.60</td>
<td>.62</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.60</td>
<td>.55</td>
<td>.67</td>
</tr>
<tr>
<td>IQ</td>
<td>-</td>
<td>-</td>
<td>.61</td>
<td>-</td>
<td>-</td>
<td>.63</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.76</td>
</tr>
</tbody>
</table>
TABLE XVI
INTERCORRELATIONS OF VARIABLES FOR FEMALES (N=78)

<table>
<thead>
<tr>
<th></th>
<th>Computation</th>
<th>Concepts</th>
<th>Problem Solving</th>
<th>IQ</th>
<th>Vocabulary</th>
<th>Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading</td>
<td>.62</td>
<td>.66</td>
<td>.75</td>
<td>.62</td>
<td>.65</td>
<td>.78</td>
</tr>
<tr>
<td>Computation</td>
<td>-</td>
<td>.75</td>
<td>.76</td>
<td>.64</td>
<td>.50</td>
<td>.64</td>
</tr>
<tr>
<td>Concepts</td>
<td>-</td>
<td>-</td>
<td>.77</td>
<td>.72</td>
<td>.63</td>
<td>.67</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>-</td>
<td>-</td>
<td>.70</td>
<td>.62</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.65</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.82</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE XVII
INTERCORRELATIONS OF VARIABLES FOR MALES (N=83)

<table>
<thead>
<tr>
<th></th>
<th>Computation</th>
<th>Concepts</th>
<th>Problem Solving</th>
<th>IQ</th>
<th>Vocabulary</th>
<th>Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Reading</td>
<td>.40</td>
<td>.60</td>
<td>.61</td>
<td>.52</td>
<td>.65</td>
<td>.64</td>
</tr>
<tr>
<td>Computation</td>
<td>-</td>
<td>.67</td>
<td>.71</td>
<td>.43</td>
<td>.32</td>
<td>.41</td>
</tr>
<tr>
<td>Concepts</td>
<td>-</td>
<td>-</td>
<td>.74</td>
<td>.61</td>
<td>.58</td>
<td>.58</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>-</td>
<td>-</td>
<td>.51</td>
<td>.52</td>
<td>-</td>
<td>.60</td>
</tr>
<tr>
<td>IQ</td>
<td>-</td>
<td>-</td>
<td>.59</td>
<td>-</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td>-</td>
<td>-</td>
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<td>.71</td>
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to Fischer's "z" showed no significant differences between the correlations for males and females.

Summary of Correlations

Considering the total sample, a moderate to substantial relationship between critical reading and the variables is indicated. The C.T.R.S. comprehension scores correlated highest with critical reading, demonstrating a high relationship. The correlation between mathematics computation and critical reading was lower than that between mathematics concepts and mathematics problem solving. Intelligence showed a lower correlation with critical reading than the other variables with the exception of computation.
Chapter V

FINDINGS AND CONCLUSIONS

SUMMARY

The main purposes of this study were to determine whether three levels of critical reading ability in fifth grade children differentiated ability in mathematics and general reading, and to determine the degree of relationship between critical reading and measures of mathematics and general reading ability.

Subjects

The subjects of this study were 161 fifth grade pupils, 78 girls and 83 boys. The following tests were administered to these pupils: The Ohio State University Critical Reading Test and the mathematics subtests of the Metropolitan Achievement Tests. The following additional data were obtained from school records for each subject: Canadian Large-Thorndike Intelligence Tests scores (full scale) and Canadian Test of Basic Skills scores in vocabulary and comprehension.

Analysis of Data

A two way analysis of variance was used to test for significant differences due to sex and critical reading ability on the criteria. Pearson product moment correlations
were also determined.

FINDINGS

The analysis of the data revealed the following:

1. Three levels of critical reading ability differentiated scores in intelligence, mathematics computation, mathematics concepts, mathematics problem solving, C.T.B.S. vocabulary, and C.T.B.S. comprehension. In all cases, the differences among all groups were significant.

2. The males were significantly superior to the females in C.T.B.S. vocabulary. In computation, differences between the sexes approached significance, with the females' scores being higher than the males'.

3. There were no significant interaction effects of sex and critical reading for each of the variables studied.

4. The correlations of critical reading with each of: intelligence, mathematics computation, mathematics problem solving, C.T.B.S. vocabulary, and C.T.B.S. comprehension were positive and ranged from moderate to substantial. C.T.B.S. comprehension showed the highest coefficient of correlation. Intercorrelations for the female group tended to be generally higher than "r's" found for boys, however these differences were not significant.

CONCLUSIONS

Within the limits of this study, the following conclusions seem warranted:
1. When three ability groups in critical reading are formed, superior ability in critical reading is associated with superior ability in the other areas considered in this study. This is also the case when the other two ability groups in critical reading are considered. This finding supports that of Muscio (1962) who found that when ability groups in quantitative understanding were created, levels of functioning were common to the areas of arithmetic computation, arithmetic reasoning, mathematical vocabulary and various measures of reading ability as well as intelligence.

2. Generally, boys and girls perform equally well in the areas analyzed. Of the seven skills measured, only one; vocabulary, showed a significant difference in favor of the boys. This conclusion may be compared to Maccoby's (1966) analysis which indicated that although some studies of sex differences in abilities show superiority of one sex area over another, the cumulative findings indicate a lack of differences.

3. Comprehension as measured by the C.T.B.S. is highly related to critical reading ability as measured by the Ohio State University Critical Reading Test. The magnitude of correlations found between these abilities is somewhat lower than that reported by Wolf, Huck, and King (1967) and considerably lower than those found by Maney (1958) and Jarvis (1972), who found correlations of .30 and .40. Such differences in correlations may be attributed to the tests used to measure critical reading and general reading skills. For example, the manual of the C.T.B.S. describes a wide range of comprehension
items which may have much in common with a critical reading test.

4. Critical reading ability shows a moderate relationship with mathematics computation, mathematics concepts, mathematics problem solving, C.T.B.S. vocabulary, and C.T.B.S. comprehension. The degree of relationship between critical reading and mathematics does not differ from that demonstrated by studies of general reading and mathematics (Stevenson, 1925; Coffing, 1941; Martin, 1963; Scott, 1963; Balow, 1964).

5. Comparisons of boys' and girls' correlations of the variables studied with critical reading substantiates the findings of R. L. Smith: "Critical reading/thinking is more closely related to intelligence, reading, aptitude ... among females than males." (1971, p. 6229A)

6. Intelligence correlates less highly with critical reading than with literal comprehension, corroborating studies by Brownell (1935), Betts (1956), Nardelli (1957), Gray (1969), and Jarvis (1972).

IMPLICATIONS AND RECOMMENDATIONS

1. The relationships among critical reading, mathematics, general reading, and intelligence shown in this study indicate that groups formed by ability in one area are significantly different, one from another, in skills in other areas. Seemingly diverse skills, such as computation and critical reading are similarly differentiated. Pupils who demonstrate a level of competence in one area should be expected to
perform similarly in other areas. However, it is important to note that this study has considered only group trends, not individual differences in patterns of strengths and weaknesses.

Assuming that a classroom group may be more interested in mathematics than reading, the results of this study suggest to the practitioner that ability in critical reading can be fostered by work in mathematics. For example, a problem in mathematics that contains extraneous information which confuses the reader can be utilized as a basis for the reading of a political speech. It is also possible to have pupils call to mind the careful reading that was required in the interpretation of "the fine print" in a credit contract in their work in mathematics.

To explore further the nature of the interrelationships of instruction in one skill area and another, designs similar to those of Forceth (1961), Cali and Wiggen (1966), and Henney (1971) are useful. Pertinent to the present study may be the presentation of a series of lessons, based on the categorization of skills measured in the Ohio State University Critical Reading Test, to determine their effect upon mathematical achievement.

2. Recent research (Klein, 1968; Lockerbie, 1969; Konschuh, 1971; Bewell, 1972; Welliver, 1973) in Saskatoon has shown that differences between boys and girls in various measures of reading ability are negligible. However, comparisons of scores do not indicate whether there are innate differences in the way boys and girls arrive at answers. The correlations found in this study among critical reading, mathematical, general reading, and intelligence factors are higher for girls than for boys.
It is possible that factors not measured in this study, such as attitude and motivation, play a greater role in males' achievement in the various areas than females'. For example, boys' scores may be lower in reading than in mathematics because they may not perceive the reading act as consistent with their sex role, thereby interfering with their performance in this skill. On the other hand, this factor may not be important for girls' success in reading.

Johnson's (1973) recent research has shown that there are sex differences favoring girls in a sample drawn from a Canadian (Winnipeg) and an American (Stoughton) city, on the other hand, boys scores in England and Germany are higher. Johnson suggests that his data emphasizes the importance of culture in the development of sex differences in reading. As Saskatoon has tended to show few sex differences, an interesting study might be to compare matched Winnipeg, Stoughton, and Saskatoon samples of boys and girls in terms of sex differences in reading and mathematics.

3. As many of the variables examined in this study are seemingly diverse in their nature, the demonstration of correspondence of ability in one area to ability in another raises many questions as to the types of mental operations involved in the performance of the various tasks. Factor analytic studies of the skills pursued in the context of work by Fortna (1963) and Wrigley (1958) may be helpful in the answering of these questions.

4. Other variables such as language facility, cognitive
style, and attitude which have not been considered in this study, may be commonly related to many of the variables considered in this study. Research utilizing designs which incorporate these additional factors may aid in the further understanding of the nature of the interrelationships described in this thesis.
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APPENDIX A

INSTRUCTIONS FOR TESTS ADMINISTERED
I'm doing some research for which I need grade five pupils' scores on this test and a few others. You'll be writing a test this morning and three math tests the next time I come.

This test is a special kind of reading test. In writing this test, you have to think about what you read and make some decisions. To see what I mean, turn over your test booklet, like this (demonstrates) so that you have the page of sample questions in front of you. Does everyone see the page of sample questions? (checks) Read sample question 1. to yourself while I read it out loud. (reads) Who would like to pick the best answer for this sample question? (after this question is discussed the procedure is repeated for sample question 2.).

Put your question booklet down and take your computer answer sheet. (shows the answer sheet) I must remind you to be very careful with these answer sheets as they will be read by a computer. Please follow the instructions carefully.

First of all, print your first and last name in the blank near the top of the page marked "name" (shows and waits). In the space marked "college" write the name of your school (waits).

That is all the information you need to put down. Ignore the "optional number" and "student number" spaces.

Find number 1. on your answer sheet. Note that I have drawn on the board, a picture of this. There are five blanks, marked a, b, c, d, and e. In your test, there are only four possible answers given for each question, so you can ignore the "e" space (crosses this out on the chalkboard). The questions in the booklet are marked 1, 2, 3, and 4. So, if you think "1" is the correct choice for a question, mark "a". If you choose "2", mark "b" and so on. Are there any questions?

Now, find question 28, in your question booklet (waits). Notice that there are different directions for the questions in this section. Read these instructions to yourself while I read them out loud (reads).

I have written some important reminders on the chalkboard:
1) Use only an HB pencil to make marks on the answer sheet. 2) If you have to erase, do so COMPLETELY. 3) Do not stop for the second part of the test; work until you are finished. 4) Make no marks on the question booklets.

Are there any questions?

All right, begin your test now. When you are finished, check your answers.

Instructions for the Metropolitan Computation Subtest

This morning you will be taking three mathematics tests. These tests will be timed. The first test, computation, will take thirty-five minutes, the other tests, twenty-five minutes each. Take your answer sheets. Place your name in the "name" space and the name of your school in the "college" blank, as you did the first test I gave you.

The following instructions, from the Teacher's Directions of the Metropolitan Achievement Tests were used.

These are some computation problems. At the top of . . . the . . . page it tells you what to do. Read this silently to yourself while I read it aloud.

You are to work the examples on this page and on the other pages in the same way. When you have finished, you may check your work. Do all figuring on the separate piece of scratch paper you have.

You have 35 minutes to do this part. Are there any questions? (Durost et al., 1971, p. 15)

Instructions for the Metropolitan Concepts Subtest

Place your name and the name of your school in the blanks, as you did for the test you just finished. (wait)

The test booklet you have contains two tests: Mathematics Concepts and Mathematics Problem Solving. You will do the Mathematics Concepts test first. Do not stop at number 40. Find number 40 on page 20. (waits) Remember to go no further than this for this first test.

The following instructions from the Teacher's Directions of the Metropolitan Achievement Tests were read.
These are some questions on concepts in mathematics. Look at the top of page 16 in your booklet where it tells you what to do. Read this silently to yourself while I read it aloud.

When you finish, you may check your answers on this test, but do not begin Test 7 on page 20.

You have 25 minutes to do this part. Are there any questions? (Durost et al., 1971, p. 15)

**Instructions for the Metropolitan Problem Solving Subtest**

Place your name and the name of your school in the blanks, as you did for the test you just finished. (waits)

The following instructions from the Teacher's Directions of the Metropolitan Achievement Tests were read.

Now open your booklet to page 20, Test 7: Mathematics Problem Solving.

These are some problems for you to solve. In the middle of the page it tells you what to do. Read this silently to yourself while I read it aloud.

When you finish the problems, you may go back and check your work on this test. Use your scratch paper for figuring.

You have 25 minutes to do these problems. Are there any questions? (Durost et al., 1971, p. 16)
APPENDIX B

SAMPLE ITEMS FROM TESTS USED IN THIS STUDY
CTBS Comprehension

For apple sauce to serve six people, select eight large, sour apples. Wash, quarter, and core the apples, but do not peel them. Put them in a kettle and add just enough water to keep them from burning. Stew them for about half an hour, or until tender. Rub them through a strainer and add one cup of sugar and one-half teaspoon of cinnamon. Stir the sauce until the sugar is dissolved. Serve hot or cold.

35. How are the apples cooked?
   1) Baked
   2) Boiled Rapidly
   3) Boiled Slowly
   4) Fried

37. In preparing the apples for cooking, which of these things do you do first?
   1) Remove the cores
   2) Wash the apples
   3) Peel the apples
   4) Cut each apple into four pieces

(King, 1968, p. 11)
CTES Vocabulary

24. Sprang away
   1) brake
   2) walked
   3) jumped
   4) stayed

30. Neglect your duty
   1) disregard
   2) perform
   3) outline
   4) assign

(King, 1968, p. 4)

Metropolitan Achievement Tests - Concepts

10. 608 equals
   a) 60 hundreds and 8 ones
   b) 60 tens and 80 ones
   c) 6 hundreds and 8 ones
   d) 6 tens and 8 ones

32. At 2 P.M. the temperature was 20° above zero.
By 2 A.M. the temperature had dropped 30°. What was the
   temperature at 2 A.M.?
   a) 10° above zero
   b) 10° below zero
   c) 0°
   d) 30° below zero

(Durost et al, 1971, p. 18, 20)
5. The five girls on our basketball team scored a total of 30 points in a game. If each girl scored the same number of points, how many did each score?
   a) 20
   b) 5
   c) 25
   d) NG

17. On a 530-mile trip, Mr. Taylor traveled 140 miles one day and 230 miles the next day. How many miles did he have to travel the third day?
   a) 260
   b) 370
   c) 160
   d) NG

(Durost et al., 1971, p. 20, 21)

Metropolitan Achievement Tests - Computation

5. $3 \times 26 =$
   a) 68
   b) 87
   c) 78
   d) NG

38. What is the average of 63, 22, 45, 56, and 79?
   a) 53
   b) 45
   c) 265
   d) NG

(Durost et al., 1971, p. 16, 17)
Lorge-Thorndike Intelligence Test

10. boy $\rightarrow$ girl : brother $\rightarrow$
   f) child
   g) son
   h) father
   j) sister
   k) daughter

11. 

(Lorge et al, 1966, p. 21, 27)
APPENDIX C

THE OHIO STATE UNIVERSITY CRITICAL READING TEST
SAMPLE QUESTIONS

DIRECTIONS

Read each story and question carefully. Select the best answer to each question.

1. Jane catches a cold easily when she is around another person who has a cold. Jane walked past John and began to sneeze. She told her mother that night, "John gave me a cold."

   What was Jane's mistake?
   1. She shouldn't have walked past John.
   2. She may not have caught the cold from John.
   3. She shouldn't have gone to school.
   4. She should have told the teacher.

2. A very old lady was standing on the sidewalk by a busy street. A boy in a boy scout uniform walked up to her and helped her across the street.

   What conclusion can you draw from this paragraph?
   1. One boy scout always helps ladies across streets.
   2. One boy scout helped a lady across a street.
PART I

DIRECTIONS

Each of the questions follows a short story. Read the story carefully, then choose what you think is the best answer to the question.

1. Scott O'Dell was born in Los Angeles. While he was still in grade school his family moved to the port town of San Pedro, California. There he grew up among the fishermen, sailors, and their rough-and-ready sons. He went to school in Long Beach, attended college in California and later worked in the motion picture industry. He knew California and its seacoast well; he loved to hear stories about the "early days." Several times during his life, he had heard a story of the lost woman of San Nicholas Islands. When he had time he carefully traced the story and collected all of the facts he could. Finally, when he began to write The Island of the Blue Dolphins, he told the story so realistically that the reader is magically transported to the "Island of the Blue Dolphin."

Why do you think Scott O'Dell was able to write about the islands off the coast of California and the sea about them?

1. Because he had spent most of his life living along the California seacoast.
2. Because he studied geography and oceanography in college.
3. Because he had unusual writing ability.
4. Because he was a good story teller.

2. Refrigerator freight cars, refrigerated trucks and airplanes transport quantities of fruits and fresh vegetables. In winter, produce from gardens on the West Coast and in the South appears in our markets. All year around, we can have a diet which is high in health-giving fruits and vegetables.

This story shows how transportation promotes:

1. Travel
2. Safety
3. Sales
4. Health
3. Your teacher tells you that a special program about football will be on television this week. Where would you most quickly find information about the correct channel and time of the program?

1. Sports Illustrated
2. Your local newspaper
3. Last week's T.V. Guide
4. Football Today

4. Mary exclaimed, "I have gotten A's in all of my subjects so far this year." She knocked on wood so she would continue to receive A's. Mary received straight A's for the rest of the year. She decided to continue knocking on wood so that she would always receive straight A's.

Was Mary correct in her decision?

1. No, some school subjects are more difficult than others.
2. Yes, knocking on wood always means good luck.
3. No, the wood had nothing to do with her grades.
4. Yes, Mary was a very good student.

5. Mike and Dennis were watching television. "Here comes a man in a white hat," said Mike. "He'll save the pioneers." Dennis asked, "How do you know the man in the white hat is good?" Mike answered, "This man will be good because he is wearing a white hat. A man is either all good or all bad."

What should Dennis answer?

1. "Mike, you're wrong. A man is good sometimes and bad at other times."
2. "You're right, Mike. That man is all good and that white hat is there to show it."
3. "Mike, you're wrong. All men are good and it doesn't matter what color hat they wear."
4. "You're right, Mike, a man is either all good or all bad."
6. The principal of State Street Elementary decided that the Tiger Club would have to disband. "It is not a good club," he said. "The club is not fair in selecting its members." John and Bill were members of the Tiger Club, so many children decided that John and Bill were unfair.

Were the children correct?

1. No, John and Bill were probably nice boys who were forced to join the club.
2. No, just because the club as a whole was unfair doesn't mean each member was.
3. Yes, John and Bill wouldn't have been in the club if they were not unfair.
4. Yes, if the club was unfair, then all its members must have been unfair.

Taken from a newspaper editorial

7. The ministers who are urging all movie theaters to be closed on Sunday are a dedicated group of men. These honest, unselfish servants of God and man have the best interests of our children at heart. They want all children to be in church instead of in a movie every Sunday.

What is the writer doing in this paragraph?

1. He is describing the ministers who want the movie theaters closed with the best descriptive words possible.
2. He is describing all ministers with words that readers like to hear.
3. He is describing the ministers who want movie theaters closed on Sunday with words that suggest something good to the reader.
4. He is describing some ministers with words that suggest something bad to the reader.

8. A well-known proverb says, "If you open an umbrella in a house, someone there will get sick." John's mother believed this saying and often warned him never to open his umbrella in the house. One day he forgot, and opened his umbrella in the house. The next day his sister Susie became sick.
How was Susie's illness related to John's raising the umbrella?

1. Susie's illness was caused by John's raising the umbrella.
2. Susie's illness was not caused by John's raising the umbrella but by germs.
3. Susie's illness was caused by some disease and by John's raising the umbrella.
4. Susie's illness was not caused by John's raising the umbrella.

9. Mr. Clark said that all women are bad drivers. However, Mrs. Clark said "Official records show that men have twice as many accidents as women do. So women drivers are really twice as safe as men."

What must you know before you could agree with Mrs. Clark?

1. How many women have taken driving lessons.
2. How many drivers are men and how many are women.
3. Do men drive faster than women?
4. How many bad drivers have stopped driving.

The following is an excerpt from a political speech:

10. Now, folks, I'm not going to try and fool you. I know I can't change the whole government when I get elected, but there's some durn good things I can do. I can talk and I intend to talk plenty. I mean to tell them fancy lawyers that they can't pull the wool over our eyes. No siree, us folks have a right to be heard.

What is the candidate trying to do in his speech?

1. He is trying to tell the voters that politicians fool the people.
2. He is trying to tell the voters that lawyers are bad.
3. He is trying to tell the voters he is just like them and that he will take care of their rights.
4. He is trying to tell the voters that he can't change the government.
11. Some people who study language believe that all language is based upon particular sounds of animals; such as the bow-wow of the dog and the meow of the cat.

What is the best way to describe this statement?

1. It is a theory.
2. It is a fact.
3. It can be proved.
4. It is incorrect.

12. Even in a democracy where a free society is defined by its people, there comes a time when absolute freedom is impossible.

As used in the sentence, the underlined word means:

1. All
2. Most
3. Some
4. Complete

13. Hawaii's warm weather allows people of all ages to enjoy water sports all year round. The long stretches of beach on the islands are convenient to everybody. The most exciting water sport is surf-riding. Many Hawaiians have practiced surf-riding since they were children. They are so skillful that they make this difficult sport seem easy. I took surf-riding lessons and found it was not as easy as it looks.

Which of the following statements is opinion?

1. The most exciting water sport is surf-riding.
2. Hawaii has warm weather.
3. Many Hawaiians are skillful at surf-riding.
4. Many Hawaiians have practiced surf-riding since they were children.
14. He had an unhappy childhood and little formal education. His ambition to become an artist was bitterly opposed by his father. Although self-educated, he became the author of a book, the sales of which in his country ranked next to those of the Bible. Obstacles did not discourage him. People would say, "Why, you can't do that," but he hurdled one barrier after another. He placed a great deal of emphasis upon improving the health of young people, and he was known throughout the world as a good speaker. One of his closest associates said of him: "He accomplishes great deeds out of the greatness of his heart, the passion of his will, and the goodness of his soul."

The man: Adolf Hitler.

What conclusion could you draw from this paragraph which would be true?

1. That one of Hitler's close associates thought he was a great man.
2. That all of Hitler's close associates thought he was a great man.
3. That people all over the world thought Hitler was a great man.
4. That Hitler was the greatest speaker and the greatest man of all time.

15. Bob came to Grand Avenue School in December and started playing on the Room 101 basketball team. In January his team lost only one game. In February they won every game.

Which among the following best explains the success of Room 101's basketball team?

1. The team members practiced more in January and February.
2. Bob was a good player and helped the team win.
3. It is difficult to tell from the paragraph.
4. Room 101 must have had many tall boys.

16. A person is like a lovely flower. If he is given proper nourishment and sunshine he will become a beautiful human being.
Is this a good comparison?

1. Yes, people and flowers need the same things.
2. Yes, people are as lovely as flowers.
3. No, people are not as lovely as flowers.
4. No, people and flowers are different in many ways.

17. A candidate for public office had his picture taken to be used in his campaign. When he posed for the picture he wanted the American flag hanging in the background.

What was the candidate trying to achieve by having the American flag in the background of his picture?

1. He wanted to show a picture of the American flag at every opportunity.
2. He wanted voters to transfer their respect for the flag to him.
3. He wanted the flag because other candidates used it in their pictures.
4. He wanted to have an attractive background for his picture.

18. Jack cannot decide what to do. All of his friends are going to the movies Saturday afternoon, and they want Jack to go along. Jack doesn't want to go because he has seen the movie and didn't like it. However, he doesn't want to stay home alone Saturday because he would be bored.

What has Jack not considered?

1. Whether all of his friends are really going to the movie.
2. Whether he would like the movie if he saw it again.
3. Whether he should consider doing something else.
4. Whether his friends want him along.

19. Once a little boy who was out walking with his collie wandered away from home and fell into a well. His collie went for help, and led the boy's father to the well. Another time a collie helped a lost boy find his way back to his home.
What conclusion can be drawn from these statements?

1. Collies are the best pets children can have.
2. Collies are helpful in saving all children.
3. Collies are good pets because they always bring people to help you.
4. Collies were helpful in saving two children.

20. Jackie is Joan's older sister. Their mother gave Jackie a beautiful blue sweater for her birthday. Jackie liked it so much that her mother decided to get one for Joan's birthday, too.

Is this a good decision?

1. No, their mother should buy a different color for Joan.
2. Yes, Joan could never wear Jackie's sweater.
3. No, Joan might not like the same things as Jackie.
4. Yes, a sweater is a very nice gift.

21. Recently, Negro citizens in a southern city rioted because they were not allowed to register to vote. The event was reported in one newspaper as follows: Integrationists defy authority. White and Negro citizens who are protesting unfair practices invaded official offices in a pre-planned attempt to clog the machinery of the city's business.

Why did the reporter choose words such as "defy," "invaded," and "clog the machinery?"

1. Because these words are the most descriptive.
2. Because these words are the most accurate.
3. Because these words suggest desirable action.
4. Because these words suggest undesirable action.

22. John received an A in Science. He must be smart.

If these statements are true, what is taken for granted?

1. All children who get A's in science must be smart.
2. Some children who get A's in science must be smart.
3. A child receiving an A in any subject must be smart.
4. Other children in the class may not be smart.
23. My purpose in this campaign is not to seek profit for myself by getting a political office. It is to keep wild rabble rousers out of our government. Every office that we can fill with an honest, peace-loving man prevents the radicals from gaining power in our country.

What is the speaker doing in this paragraph?

1. He is using the best words possible to describe his opponents.
2. He is describing some office seekers with words which suggest something bad to the reader.
3. He is telling the truth in the best way it can be told.
4. He is describing all office seekers with words which suggest something good to the reader.

24. In October, Bill found two magazine articles which forecast the players for the season's "All American Team." One article was written by John Blake, the chief sports writer for International News Service. The other one was written by Ray Randall, who was a television star and knew many football players through guest appearances on his program.

In making a report to class about the "All American Team," what should Bill use?

1. He should give information from the person who knew the players personally.
2. He should give only the information from the sports writer.
3. He should give information from both articles but tell who wrote them.
4. He should give information from the magazine article which gave the better forecast.

25. Anyone who has the interest of the United States at heart will fight against Communism. Senator Smith has the interest of the United States at heart.
If the above statements are true, what conclusion must be drawn?

1. Anyone in the United States might fight against Communism.
2. Anyone in the United States will fight against Communism.
3. Senator Smith might fight against Communism.
4. Senator Smith will fight against Communism.

26. Mike says that musicians are sad people.

What is the correct way to describe this sentence?

1. Some musicians are sad.
2. All musicians are sad.
3. Some musicians are not sad.
4. Many musicians are not sad.

27. John said, "Patty's father is rich."

What is the meaning of rich in this sentence?

1. The meaning is unclear.
2. Patty's father must be a banker or an oilman.
3. Patty's father is a millionaire.
4. Patty's father will give many things to Patty.
PART II

DIRECTIONS

This section consists of a number of short reading passages. Each passage is followed by a few questions. Read each passage carefully, then select what you think is the best answer. Refer again to the passages as often as you find it necessary in answering the questions.

The Bat Poet

Once upon a time there was a little light brown bat, the color of coffee with cream in it. He looked like a furry mouse with wings. When I'd go in and out my front door, in the daytime, I'd look up over my head and see him hanging upside down from the roof of the porch. He and the others hung there in a bunch all snuggled together with their wings folded, fast asleep. One little brown bat said, "Don't go away. I'll be homesick."

Winter-Sleeping Wildlife

One of North America's hibernating mammals is most unusual. This unique hibernator, a bat, is the only mammal of the world's 2,000 mammals that can fly. North America has many of the world's known and named bats. One type is called the little brown bat. Usually the little brown bat selects a cave in which to pass the winter. He hangs upside down by one foot, then another, or perhaps all four to sleep during the day.

28. In what way are the stories alike?

1. They both tell that bats hibernate.
2. They both describe bats that talk.
3. They both tell how the bats sleep.
4. They both say that bats are mammals.

29. If you wanted to know to what class of animals a bat belongs, which sentence would you select?

1. The unique hibernator is a bat.
2. One of North America's hibernators is a bat.
3. He looked like a furry mouse with wings.
4. The bat is the only mammal that can fly.
30. Both of the stories are about bats. What sources would you use if you were making a report to a science class?

1. The second story.
2. The first story and part of the second.
3. Both of the stories.
4. Parts of each story.

The Autobiography of Benjamin Franklin

"I was put in grammar school at eight years of age, my father intending to devote me...to the service of the church. My early readiness in learning to read (which must have been very early as I do not remember when I could not read), and the opinion of his friends, that I should make a good scholar, encouraged him in this purpose....I continued at the grammar school not quite a year, though I had risen gradually from the middle of the class of that year to the head of it....But my father, in the meantime, thinking of the expense of a college education, which having so large a family he could not well afford...took me from the grammar school and sent me to a school for writing and arithmetic....I acquired fair writing pretty soon; but failed in the arithmetic. At ten years old I was taken home to assist in my father's business, which was that of tallow candle maker and soap-boiler."

Benjamin Franklin

"When Benjamin was eight years old, his father sent him to grammar school. He rose to the head of his class in reading and writing, and he read every book he could lay his hands on. But he was poor in arithmetic. His father began to think that perhaps Benjamin should be a trademan like his brothers. So, when Benjamin was ten years old, he was taken out of school to learn the trade of candlemaking."

31. How are the two stories different?

1. The second story gives more information about Franklin than the first story.
2. The second story is a second-hand report, the first story is a first-hand report.
3. The second story is more accurate than the first one.
4. The second story is better than the first one because it was written by a more experienced novelist.
32. How do the two stories describe the reasons for Ben's removal from grammar school?

1. In the first story his father wanted Ben to be a writer; in the second story he wanted him to be a tradesman like his brothers.
2. The first story and the second story both say that his father removed Ben from grammar school because he was poor in arithmetic.
3. The first story says that his father wanted Ben to work at soap boiling; the second story says he wanted Ben to be a candle-maker.
4. The first one says that Ben's education was too expensive and the second says his father wanted Ben to be a tradesman.

33. Which of the following sources would you choose if you wanted the best account of Franklin's thinking?

1. An encyclopedia
2. The second story
3. The first story
4. A history book

The following paragraph was found in John's fifth grade geography book:

The Pilgrim leaders said, 'Why don't we go to America? There we can worship as we please.' It was not easy to get the farm tools, furniture, chickens, hogs, and other supplies needed to start a colony. It wasn't easy to pay for a ship to carry people across the sea. But after three long years, the 102 Pilgrims set sail on the Mayflower. After nine weeks they saw land.

A diary written by one of the Pilgrim leaders describes the journey as follows:

"...the fifty Pilgrims left the goodly and pleasant city of Leyden, which had been their resting place for nearly two years....In England they were joined by the rest of the company: thirteen families and seven single men. Some of the newcomers were Pilgrims, like themselves, but others such as John Billington, who was eventually hanged for murder, were bad actors and troublesome citizens. The Pilgrims called these people the strangers."
34. In what way are the two stories alike?

1. They both tell why the Pilgrims left England.
2. They both tell about troublesome citizens.
3. They both tell how long the journey took.
4. They both tell how many Pilgrims sailed for America.

35. Which of the following sentences about the number of Pilgrims sailing for America is most accurate?

1. 102 Pilgrims came to America.
2. Between fifty to 100 Pilgrims sailed for America.
3. Thirteen families and seven single men came to America.
4. Fifty Pilgrims sailed for America.

36. Which of the following sources should have the most accurate information about the Pilgrims?

1. The diary written by a Pilgrim leader.
3. The Pilgrims' Progress.

---

Charlie and the Chocolate Factory

"I am very proud of my square candies that look round. Let's take a peek," Mr. Wonka said.

Everybody stopped and crowded to the door. The top half of the door was made of glass. Grandpa Joe lifted Charlie up so that he could get a better view, and looking in, Charlie saw a long table, and on the table there were rows and rows of small white square-shaped candies. The candies looked very much like square sugar lumps—except that each of them had a funny little pink face painted on one side. At the end of the table, a number of Oompa-Loompas were busily painting more faces on more candies.

"There you are!" cried Mr. Wonka. "Square candies that look round!"

"They don't look round to me," said Mike Teavee. "They look square," said Mr. Wonka. "I never said they weren't.

"You said they were round!" said Veruca Salt. "I never said anything of the sort," said Mr. Wonka. "I said they looked round."

"But they don't look round!" said Veruca Salt. "They look square!"

"They look round," insisted Mr. Wonka. "They most certainly do not look round!" cried Veruca Salt.

"Veruca, darling," said Mrs. Salt, "pay no attention to Mr. Wonka! He's lying to you!"
"My dear old fish," said Mr. Wonka, "go and boil your head!"

"How dare you speak to me like that!" shouted Mrs. Salt.

"Oh, do shut up," said Mr. Wonka. "Now watch this!" He took a key from his pocket, and unlocked the door, and flung it open... and suddenly... at the sound of the door opening, all the rows and rows of little square candies looked quickly round to see who was coming in. The tiny faces actually turned toward the door and stared at Mr. Wonka.

"There you are!" he cried triumphantly. "They're looking round! There's no argument about it! They are square candies that look round!"

"By golly, he's right!" said Grandpa Joe.

37. What kind of a person do you think Mr. Wonka is?

1. An honest man.
2. A loud, disagreeable man.
3. A serious-minded person.

38. How did the author describe Mr. Wonka to you?

1. By what Mr. Wonka said,
2. By what other people said to Mr. Wonka.
3. By telling what Mr. Wonka did.
4. By telling what Mr. Wonka was thinking.

39. What kind of story is this?

1. Sarcastic humor
2. Ironical
3. Biographical fiction
4. Legendary

40. What is the main idea of the story?

1. That some candies can appear to be both square and round.
2. That the same words can be used to describe the same things.
3. That the same words can mean different things to different people.
4. That honesty is the best policy.
"The Dog in the Manger"

A Dog jumped into the manger of an Ox to take an afternoon nap. It lay sleeping on the straw when the Ox returned from its work. The Ox came up to the manger and wanted to eat some of the straw.

The Dog was in a rage at being wakened from its nap. It stood up and barked at the Ox. Whenever the Ox came near, the Dog tried to bite it.

At last the Ox gave up hope of getting the straw.

41. What kind of story is this?

1. A folk tale
2. A fable
3. A fairy tale
4. A myth

42. What could the moral of this story be?

1. Be kind to one another.
2. Let a sleeping dog lie.
3. Some do not want others to have what they themselves cannot enjoy.
4. Don't bite the hand that feeds you.

The Cabin Faced West

Ann Hamilton swept the last of the day's dust out of the door into the sunset. Even the cabin faced west, Ann thought as she jerked the broom across the flat path the daylight made as it fell through the open door-way. It was the only place the daylight had a chance to come in. The cabin was solid logs all the way around without another opening anywhere. Its back was turned squarely against the East just as her father had turned his back. Just as her brothers David and Daniel had. "We've cast our lot with the West," her father had said as he stood in the doorway the day the cabin was completed. "And we won't look back."

Ann sighed as she leaned the broom against the wall near the hearth where her mother was rocking the baby.

"Ann," Mrs. Hamilton looked up with a little frown between her eyes. "Ann, there's no more work for you today. I can finish alone. You run along, if you've a mind to."

Ann went over and gave her mother a quick hug before she started for the door. "I'm going down to the road," she said.
Of all the places on her father's hill, Ann liked the road best. She had a feeling about the road. Sometimes her mother said she had a "feeling in her bones." She couldn't explain it; it was just there. That was the way Ann was about the road.

As she stood now, looking down where the road dropped over the hill and melted away under the great trees and tangled grapevines, Ann felt the usual excitement. It was silly to feel that way, she told herself. Nothing ever happened at this end of the road; everything exciting was at the other end--the Gettysburg end. Certainly there was nothing exciting about the road itself. Ann shuddered when she remembered the long, weary miles the road took up each of those dreadful mountains and the slipping, sliding miles down the other side, as they crossed Pennsylvania. Yet when Ann was alone, she usually came right here. It was almost as if the road held some kind of special promise for her.

43. Which of the following words describes Ann Hamilton?

1. Lazy
2. Indifferent
3. Ungrateful
4. Lonely

44. Which of the following statements best describes the time and setting of this story?

1. A family living in a log cabin on a hill during the colonial period.
2. A pioneer family living high in the Rocky Mountains.
3. A modern family camping out in a national park.
4. A family of early settlers on the western plains.

45. Building the cabin to face west held a special meaning for Ann's father. Which of the following statements best describes that meaning?

1. He wanted a better view of the road.
2. He wanted to face the sunset.
3. He was looking to the west for his future.
4. He wanted to face Gettysburg.

46. The last paragraph of this story suggests that the road holds a "special promise" for Ann. What do you think it might be?
1. The end of the road offers new experiences for her.
2. A return home to visit her friends in the East.
3. A frightening but tempting visit to the West.
4. A chance to travel down the road.

47. Which group of phrases best describes the order of events in the preceding paragraphs?

1. Introduction to an understanding mother
   Sweeping the cabin
   Time to play
   Wishful thinking

2. Ann's household duties
   The cabin faced west
   Playing on the hill
   Return to Gettysburg

3. The Western Frontier
   Ann's baby sister
   Her father and brothers
   A place to play

4. The characters and setting of the story
   An understanding mother
   Ann's favorite place
   Future promise

---

**Strawberry Girl**

After the rains stopped, the strawberries didn't do so well. The plants began to dry up in the sun's terrific heat. Birdie carried water in a bucket and dipped it on them with a gourd dipper. She went out early every morning. But they continued to dry up, and more of them died.

"The strawberries don't make!" she wailed bitterly. "They're jest fixin' to die!"

One morning she saw a horse lying in the middle of the strawberry field. At first she thought it was dead. Beneath its shaggy coat, it was very lean and bony. She approached it warily. Suddenly the animal raised its head and looked at her. Then it began to roll. Over and over it went, its four feet pawing the air in awkward movements.

By the time it scrambled to its feet, Birdie had found a stick and she gave chase. She flayed it with all her strength. The horse tore about aimlessly, trampling on rows where it had not wallowed.

"Mean little ole pony!" shouted Birdie. "You git outen here!" Buzz and Mrs. Boyer came. They ran the horse off through the woods.
"Cowhorse!" cried Birdie in disgust. "That was Shoestring's cowhorse. He rounds up their cows with it."

When she went back to the strawberry field and saw the damage, she cried. Pa put his arm around her and said he would buy new plants to replace the others.

"We belong to build us a fence, Pa!" said Birdie.

"Strawberries won't never make in an open field."

48. What is the main idea of the story?

1. You can expect trouble if you ask for it.
2. You shouldn't worry about small things.
3. You can grow strawberries with careful planning.
4. You can keep trying to overcome misfortune.

49. What kind of story is this?

1. Biography
2. Fable
3. Realistic fiction
4. Animal fantasy

50. What do the words "Strawberries won't never make in an open field" mean?

1. It means the strawberries should be planted near the farm.
2. It means the strawberries won't grow big and get ripe.
3. It means the strawberries won't make an open field.
4. It means the strawberries are always ruined by horses.

51. What kinds of feelings does Birdie show?

1. Despair
2. Fear
3. Hate
4. Happiness

Hallowe'en

52. Tonight is the night
When dead leaves fly
Like witches on switches
Across the sky,
When elf and sprite
Flit through the night
On a moony sheen.
How does the author describe leaves?

1. He says they are living things.
2. He says they have a mooney sheen.
3. He compares them to witches on switches.
4. He compares them to an elf and a sprite.

53. Morning is
   a new sheet of paper
   for you to write on.

   Whatever you want to say,
   all day,
   until night
   folds it up
   and files it away.

   The bright words and the dark words
   are gone
   until dawn
   and a new day
   to write on.

How does the author describe a day?

1. As dawn and night.
2. As a period of time.
3. As time to write.
4. As a sheet of paper.

54. There is a star that runs very fast,
   That goes pulling the moon
   Through the top of the poplars.
   It is all in silver,
   The tall star:
   The moon rolls goldenly along out of breath.
   Mr. Moon, does he make you hurry?

How is the author describing the moon and star?

1. As silver objects.
2. As living things.
3. As tall poplars.
4. As a rolling wagon.
APPENDIX D

ADDITIONAL ANALYSIS
Categorization of the questions in the Ohio State University Critical Reading Test made possible the analysis of the data in terms of "logic", "literature" and "general" skills: Tables XVIII to XXXII present the analysis of variance for computation, concepts, problem solving, vocabulary, and comprehension scores classified by sex and three levels of ability in each of the areas of critical reading.

**TABLE XVIII**

ANALYSIS OF VARIANCE FOR COMPUTATION SCORES CLASSIFIED BY SEX AND ABILITY IN "GENERAL" CRITICAL READING SKILLS

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**TABLE XIX**

ANALYSIS OF VARIANCE FOR CONCEPTS SCORES CLASSIFIED BY SEX AND ABILITY IN "GENERAL" CRITICAL READING SKILLS

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### Table XX

**ANALYSIS OF VARIANCE FOR PROBLEM SOLVING SCORES CLASSIFIED BY SEX AND ABILITY IN "GENERAL" CRITICAL READING SKILLS**

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### Table XXI

**ANALYSIS OF VARIANCE FOR VOCABULARY SCORES CLASSIFIED BY SEX AND ABILITY IN "GENERAL" CRITICAL READING SKILLS**

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### Table XXII

**ANALYSIS OF VARIANCE FOR COMPREHENSION SCORES CLASSIFIED BY SEX AND ABILITY IN "GENERAL" CRITICAL READING SKILLS**

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TABLE XXIII
ANALYSIS OF VARIANCE FOR COMPUTATION SCORES CLASSIFIED BY SEX AND ABILITY IN "LITERATURE" SKILLS IN CRITICAL READING

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TABLE XXIV
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### TABLE XXVII

ANALYSIS OF VARIANCE FOR COMPREHENSION SCORES CLASSIFIED BY SEX AND ABILITY IN "LITERATURE" SKILLS IN CRITICAL READING

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<td>28.757</td>
<td>&lt; .01</td>
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<td>1.584</td>
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TABLE XXXII

ANALYSIS OF VARIANCE FOR COMPREHENSION SCORES CLASSIFIED BY SEX AND ABILITY IN "LOGIC" SKILLS IN CRITICAL READING

<table>
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<td>29.481</td>
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In all sub-ability groups, a trichotomizing of ability differentiated scores in computation, concepts, problem solving, vocabulary and comprehension. Sex differences, favoring the boys, occurred in the area of vocabulary for literary and general skills as well as in computation for logic skills. In computation, the girls were superior to the boys. Thus, no basic differences in the pattern of relationships among the variables are indicated by this approach to the problem.