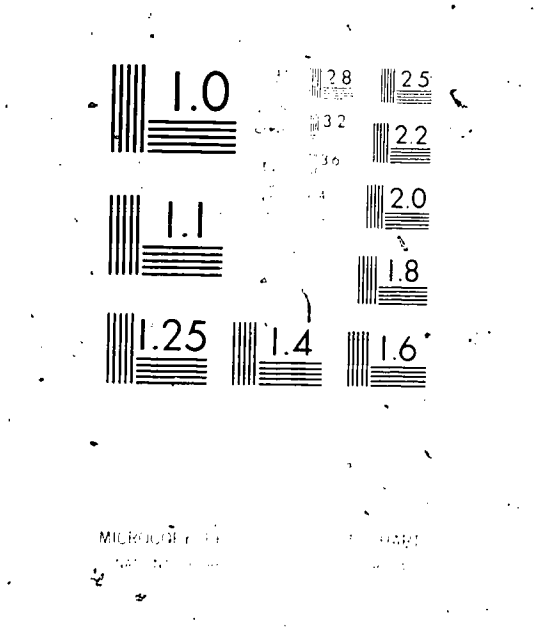
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ABSTRACT

The effect of mastery of three prereading skills (letter order, letter orientation, and word detail) on first-grade reading achievement was investigated in a study of 1068 students from 42 randomly selected classrooms; 687 students completed all instruments and could be included in analyses of results. Systematic instruction was given to 16 classrooms for geometric shapes/outline figures and to 11 classrooms for letter/word stimuli; the remaining classrooms served as a control group. Preceding the period of systematic skill instruction, tests of prereading skills and of reading readiness were administered. Immediately following instruction and again 18 weeks later, the test of prereading skills was readministered together with a test of reading achievement. Analyses indicated significant differences between reading achievement scores of students who began first grade with a mastery of skills and students who did not and between children who attained mastery by November and those who did not. The number of children who changed from nonmastery to mastery was significantly greater in both treatment groups than in the control group. (Author/AA)

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Technical Report No. 392

EFFECT OF SELECTED PREREADING SKILLS ON SUBSEQUENT READING ACHIEVEMENT

by

Cathy Stallard

Report from the Project on
Conditions of School Learning and
Instructional Strategies

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ABSTRACT

This study was designed to investigate the effect of mastery of three prereading skills, letter order, letter orientation and word detail, on subsequent first-grade reading achievement. Prior to this study, the skills investigated had been shown to be 1) reasonably independent, measurable and teachable, 2) among the best predictors of first-grade reading achievement, and 3) a part of the repertoire of superior first grade readers. There was a need, however, to look more closely at 1) the relationship of these three skills to subsequent first-grade reading achievement, 2) the effect of mastery on the reading achievement of students who gain mastery before first grade, 3) the effect of gaining mastery at different times during the first grade, 4) the degree to which mastery effects the reading achievement of children from high, middle and low socioeconomic levels and 5) the efficiency of different types of systematic instruction in moving children from non-mastery to mastery of the three skills.

The study included 1,068 students from 42 randomly selected classrooms in 20 elementary schools in Fort Worth, Texas. Treatments were randomly assigned to intact classrooms with 16 classroom groups receiving systematic skill instruction involving geometric shapes/outline figures stimuli, 11 classroom groups receiving systematic skill instruction involving letter/word stimuli and 15 classroom groups receiving no systematic skill instruction. Each of the 35 twenty minute skill lessons were administered on a daily bases by individual classroom teachers from September 29 - November 17, 1975. Preceeding the period of systematic skill instruction the PRS Prereading Skills Test (1975) and the Metropolitan Reading Readiness Test (1969) were

administered to all students in the 42 classrooms. Immediately following and 18 weeks subsequent to the termination of skill instruction, the PRS Prereading Skills Test was readministered and the Gates-MacGinitie Reading Achievement Tests, Primary A, Forms 1 and 2 (1965) were given.

To examine the effect of mastery and non-mastery of the skills on subsequent first-grade reading achievement, two-tailed t-tests of significance were computed for differences in reading achievement of groups of children demonstrating mastery of the selected skills and groups of children not demonstrating mastery. One-hundred and seventy-four comparisons were made with one-hundred and fifty-two of the comparisons being between students of comparable socioeconomic level, ethnic background and age.

Results indicated that a statistically significant difference existed 1) between the reading achievement scores of students who began first grade with a mastery of the skills and students who did not and 2) between children who attained mastery by November and students who did not. Children who first demonstrated performances of mastery in March outperformed students who never demonstrated mastery but differences in the performances between the groups were not statistically significant. While the number of students in Treatment groups who changed from non-mastery to mastery was significantly greater than the number of students who changed in Control groups, training using geometric forms/outline figures or letter/word stimuli did

not differ in impact on mastery of the skills. On the basis of the results of this study, it was concluded that mastery of the three selected skills positively affect first-grade reading achievement and that instruction in these skills appears to be worthwhile.

CHAPTER I

RATIONALE

Introduction

The purpose of this study is to examine the effect of mastery and non-mastery of three prereading skills on subsequent first-grade reading achievement. To achieve this purpose, the reading achievement scores of groups of first-grade children demonstrating mastery of the selected skills were compared to the reading achievement scores of groups of first-grade children not demonstrating mastery.

Scores used as measures of reading achievement were the raw performance scores on the Vocabulary and Comprehension Subtests of a November and a March administration of the Gates Reading Achievement Test, Primary A, Form 1 or 2 (1965), total scores on both of these tests and the sum of total scores on both of these tests. Mastery of the three prereading skills was demonstrated by a score of 87.5% correct on each of the three visual subtests of the criterion-referenced PRS Prereading Skills Test (1975).

The three prereading skills in this study, letter order, letter orientation and word detail, as defined on page 4, have been shown to be reasonably independent, measureable and teachable skills (Calfee,

Chapman and Venezky, 1972). Taken together these skills have also been shown to be among the best predictors of first-grade reading achievement. The skills appear to have been mastered by superior first-grade readers. Additionally, there is evidence that the ability to move from non-mastery to mastery of these skills occurs best through a program of systematic instruction (Venezky, Leslie and Green, 1975; Ramm, Zajano, Hubbard and Pittelman, 1973). There is a continuing need, however, to look more closely at 1) the relationship of these three skills to subsequent first-grade reading achievement, 2) the effect of mastery on the reading achievement of students who gain mastery before first grade, 3) the effect of gaining mastery at different times during the first grade, 4) the degree to which mastery effects the reading achievement of children from high, middle and low socioeconomic levels and 5) the efficiency of different types of systematic instruction in moving children from non-mastery to mastery of the three skills.

This study was designed to provide insights for examining such unanswered questions as these:

1. Will the level of first-grade reading achievement of students who master the skills be higher than the level of first-grade reading achievement of non-masters?

2. Is mastery of the skills simply a concomitant of superior reading ability or does mastery of the skills contribute to reading ability?

3. Is the time at which mastery occurs related to the effect of

mastery on reading achievement?

4. Do children from different socioeconomic levels differ in the extent to which they benefit from mastery?

5. Does training which emphasizes geometric shapes/outline figures or letter/word stimuli differ in its impact on mastery of the selected skills?

Implicit in the design of the study is the assumption that children who attain mastery of the three selected prereading skills will attain a significantly higher level of first-grade reading achievement than children who do not attain mastery. Many educators assume that mastery of the three selected skills positively affect first-grade reading achievement but whether the assumption is valid remains to be determined. If children who attain mastery of the selected prereading skills do attain a higher level of first-grade reading achievement, then work to increase children's ability in these three skills will have more substantial support.

Definition of Terms

The relationship of visual skills to reading achievement has received much attention in reading research and, as a consequence, certain terms have been used to describe a wide variety of tasks. Take, for example, tasks which purport to measure letter orientation. "Letter orientation" tasks might focus on a student's ability to attend to, or apply himself to, a variety of tasks like discriminating between objects or letters of similar visual configuration by

copying, matching, recalling, writing or naming letters or objects either in isolation or in word contexts. Because there is similar variance in the tasks commonly used to measure the skills in this study the specific task used to measure mastery of each skill is given in the definitions that follow:

1. Letter order--the ability to attend to the order of letters and letter strings of 2 or 3 letters, i.e., ability to distinguish the difference between "ha" and "ah," as demonstrated by mastering a task requiring one to circle a letter or letter string that matches a standard to the left of the possible response choices.

2. Letter orientation--the ability to attend to the orientation of the distinct features of letters, i.e., ability to discriminate between "n" and "u," as demonstrated by mastery of a task requiring one to circle a letter that matches a standard to the left of the possible response choices.

3. Word detail--the ability to attend to all details of a word, i.e., ability to distinguish the difference between "war" and "was" as demonstrated by mastery of a task requiring one to circle the word that matches a standard to the left of the possible response choices.

Rationale for the Study

The discussion that follows has two parts: review of literature and statement of the hypotheses. In the review of the literature, findings from four groups of investigations are presented to support the need and to provide a background for the issues investigated in this study. The review is limited to 1) studies of the relationship of first grade reading achievement and the ability to attend to the skills in this study; 2) comparisons of the abilities of high achieving first grade students to the abilities of low achieving first grade students; 3) comparisons of the effects of systematic

instruction in the selected prereading skills to the effects of incidental skill instruction; and 4) studies of the relationship of sex, age, ethnic background and socioeconomic level to first-grade reading achievement.

Review of Literature

The findings from the following four groups of studies support the contention that ascertaining the effect of mastery of the selected skills on subsequent first-grade reading achievement warrants investigation.

Correlational studies of visual skills and first-grade reading achievement. Of the studies reported in the annual reviews of reading research, studies designed to look closely at various aspects of initial reading acquisitions are by far the most numerous. Many of these studies are correlational, and they represent attempts to identify the best measures of reading readiness and the best predictors of subsequent reading achievement. The majority of such correlational studies yield correlation coefficients as measures of visual discrimination skills and reading achievement.

Following a review of correlational studies of visual discrimination, only thirteen studies were selected for review in this chapter. These studies were selected because the reported correlations of scores on visual discrimination tests and scores on measures of reading achievement were based on tasks identical to tasks indicative of skill mastery as defined on page four of this chapter. Additionally, scores

used in the correlational analyses were derived from tests identical in format to the PRS Prereading Skills Test (1975) used in this study. Correlational studies of visual discrimination eliminated from this review reported either (a) results from test tasks measuring the visual discrimination of letters and words by means other than matching stimuli to response, i.e. oral identification, written reproduction or mental recollection, or (b) results from testing formats requiring the location of a response to stimuli when stimuli and responses were not presented simultaneously.

Taken collectively, the results of the thirteen selected studies demonstrate that the ability to recognize letters, with respect to the order and orientation of the letter/letters, and the ability to discriminate between words with similar visual configuration are two of the best predictors of first-grade reading achievement. Before looking more specifically at the results from each of these studies it is important to note that Barrett (1966), on the basis of a comprehensive review of literature, concluded "reading letters and numbers, matching words and copying geometric patterns appear to be the best predictive measures of first-grade reading achievement." (1966, p. 70). The work of Smith (1928), Potter (1949), Silvaroli (1963) and Lee, Clark and Lee (1967) demonstrate the high predictive validity of the ability to attend to the order and orientation of letters; the work of Gates (Gates, 1926; Gates, Bond and Russell, 1939; Gates, 1939; and Gates, 1940), Wilson (Wilson and Burke, 1937; Wilson and Flemming, 1940; Wilson,

1942), Deputy (1936) and Weiner and Feldman (1963) demonstrate the high predictive validity of the ability to attend to the detail of words.

One of the first investigators to examine the relationship of specific prereading skill mastery to subsequent reading achievement was Smith (1928). In this study, the Stanford-Binet Intelligence Test (1916) was administered to all children in 12 first grade classrooms. On the basis of the scores made, teachers in the classrooms selected three children from their rooms of superior intelligence, four children of average intelligence and three children of below average intelligence. These ten children from each classroom became the subjects of the study.

During the first week of school subjects were asked to match lower case letters of the alphabet. Twelve weeks later these children were given the Detroit Word Recognition Test (1916). The coefficient of correlation between the letter matching test and the Detroit Word Recognition Test was .87. Smith interpreted this coefficient as valid evidence that the ability to attend to the orientation of letters shares a close relationship with the ability to read words in isolation and to attend successfully to activities in initial reading instruction.

Additional evidence for the relationship of ability to attend to letter orientation and ability to achieve in initial reading activities was reported by Lee, Clark and Lee (1967). These authors constructed a readiness test composed of three subtests which involved the discrimination of letters and a fourth which measured the ability to differentiate between words. These subtests were given to 164 children in the

Los Angeles School District at the beginning of the first grade year. The children then received either the Lee-Clark Reading Test Primer (1962) or the Gates Silent Reading Tests, Types 1, 2 and 3 (1965) near the end of their first and/or second semester of first grade. The composite score of the readiness subtests correlated with the Lee-Clark Reading Test Primer (1962) at .49. When the composite score was correlated with scores on the Gates test, a correlation coefficient of .54 resulted. As a final comparison, Lee, Clark and Lee totaled the scores of children who had Kindergarten experience, correlated this total to the Lee-Clark Reading Test Primer (1962) scores and reported a correlation coefficient of .68.

A third study (Silvaroli, 1963) was designed to determine if a combination of readiness factors would be more highly correlated to first-grade reading achievement than any single factor. Factors considered were mental age, auditory discrimination, visual discrimination, letter identification, social class status and maternal need-achievement as determined by a picture story task given to mothers of subjects tested. The specific test for letter identification was the Durrell Informal Test of Upper and Lower Case Letter Identification (date of publication unknown) and the test for reading achievement was the McClelland Reading Achievement Test (date of publication unknown). Relevant to the present discussion was the finding that only when all six factors were combined did a higher correlation result than the solitary factor, letter identification. Score on the letter identification subtest correlated at a .65 level

with the score on the McClelland Reading Achievement Test. A t-test revealed no significance difference between the coefficient of the combined factors to reading achievement and the coefficient of the solitary factor letter identification to reading achievement was computed. Difference between the coefficients was not significant. On the basis of this test, Silvaroli concluded that "a measure of letter identification, upper and lower case letters, can be used to predict probable success in first grade reading. It appears to be of no value to add the factors of mental age, auditory and visual discrimination, social class status and maternal nee-achievement scores for first grade boys and girls" (Silvaroli, 1963, p. 297).

Before concluding the discussion of correlational studies related to letter orientation and letter order, attention should also be given to the results obtained by Potter (1958). Potter reported correlations coefficients of the test scores of 600 first grade children in 12 schools in Bloomfield, New Jersey. Combined scores from Part 1 and Part 2 of the Lee-Clark Primer Readiness Test (1955) were correlated to scores on the measure of first-grade reading achievement, total score on the Gates Primary Reading Tests. The correlation coefficient of this comparison was .44. In the same study, Part 3 of the Lee-Clark test, composed of 20 word matching items, was correlated to the Gates test. The correlation coefficient of this comparison was .36. The results reported in this study have special significance to the unanswered question of differing impacts of geometric shapes/outline figures or letter/word stimuli upon mastery of the selected skills. Potter correlated tasks of geometric shapes/outline figures

to reading achievement. Such tasks demonstrated to have relatively high correlation to reading achievement.

A study of the relationship of first grade reading achievement and measures of the ability to attend not only to letter orientation and order but also to word detail, was conducted by Deputy (1930). This study involved 103 of the 165 children who entered first grade in public school #210 in Brooklyn, New York in 1929. The total number of students enrolled was not used because complete data concerning test scores were not available for 62 of the children. The test of readiness was composed of four subtests. One of the four subtests, Test of Word Selection, measured the ability to attend to the orientation and order of letters and to the detail of words. The test was composed of 48 items, each consisting of selection of a response that was identical to the given stimulus word or letter. Stimulus was to the left, separated from the 5-12 response choices by a vertical line. The scores on this test were correlated to the composite score of three measures of reading achievement, two tests constructed by the investigator and the Detroit Word Recognition Test. The correlation coefficient reported between the Test of Word Selection and the composite score on the three achievement tests was .49.

The works of Gates and his colleagues are the most extensive attempt to examine the relationship of the prereading skill of attending to detail of words with subsequent reading achievement (Gates, 1926; Gates, Bond and Russell, 1939; Gates, 1939; Gates, 1940). These carefully executed studies have produced results of high reliability. That is, when tests of the prereading skills and reading achievement were administered to the separate populations of each study, the coefficients of correlation produced were extremely similar.

One of Gates' first works (Gates, 1926) involved a population of 310 school children in Grades 1 through 7. In this study, Gates administered six separate tests measuring visual perception, one test of auditory-visual association, and one test of visual-visual association at the beginning of the school year. Scores of each test were correlated to scores on the Stanford Binet Intelligence Test (1916), scores on three tests of overall reading ability and scores on two tests of spelling ability administered at the end of the same year. One of the visual perception subtests (Test 5) measures word detail. The correlation coefficient between the mean of scores on Test 5 and the mean of scores on the [redacted] tests measuring overall reading ability was .59, second only in rank of correlation to Test 3, the ability to attend to the similarities and dissimilarities between pairs of identical and non-identical words, to the mean of scores on the same three tests of overall reading ability.

Scores on Subtest 5, measuring word detail skill, was also correlated to the Courtis Silent Reading Test, No. 2, measuring the comprehension of paragraphs of easy and difficult readability. The correlation was computed for the third and fourth grade population and the fifth through seventh grade population. The correlation coefficients were .72 and .56, respectively. Such results may lead one to conclude that the ability to attend to the details of words is closely related to success in overall reading ability, having highest relationship in early stages of reading acquisition. Such was the conclusion drawn by Gates.

Another of Gates' most cited and comprehensive studies, conducted as a joint venture with Bond and Russell (Gates, Bond and Russell,1939), involved 97 of the 158 students in four classes of the New York City School District. Although the study was conducted over 35 years ago, the population (mean IQ, 102; mean chronological age 6.2) was comparable to today's school aged population, making the reported results relevant and comparable to studies of today.

In preparation for the study, Gates, Bond and Russell evaluated more than 100 separate types of readiness and achievement tests. Following this evaluation, seven measures of the visual perception of words and letters, five measures of the visual perception of pictures and shapes, and tests of phonetic abilities, immediate memory, saying letters, letter recognition, social adjustment, quality of home experiences, quality of previous reading instruction, speech defects and ability to complete a story were selected as the most probable predictors of initial reading achievement. These readiness measures, along with the Stanford-Binet Test of Intelligence, seven hand and eye dominance measures and five reading achievement measures were administered shortly after school began in the fall of 1933. The battery of tests was readministered at mid-year, year end, and in the case of two classes, at the beginning of second grade. More than 1,000 separate correlations of these test scores indicated that the perception of words--the perception of word endings, beginnings, nonsensical words with same initial sound, rhyming words, word discrimination

of pairs or groups--was most highly correlated with subsequent reading achievement. The correlations of this ability with overall reading achievement ranged from .43 - .62. The highest correlate to reading achievement was the Stone-Grover Reading Readiness Test (date of publication unknown). This test was composed of 24 items with the stimulus word printed at the left of four response choices, a test identical to the PRS Word Detail Visual Subtest (1975). The correlation coefficient for scores on the Stone-Grover Reading Readiness Test and scores on measures of reading achievement was .62. Scores on digit/geometric form tasks indicated that ability to discriminate digits and geometric forms were less related to initial reading achievement scores than tasks involving word and letter discrimination. While ability to discriminate word forms proved to have highest correlation to initial reading achievment, nonsense words were second highest, followed by letter perception tasks.

While two of Gates' later studies were primarily designed to determine the predictive validity of some of the subtests above, correlation coefficients between the mean of each readiness subtest scores and the mean of the reading achievement scores (Gates, 1939, 1940) were computed and add credence to the present discussion. The Gates study of 1939 involved 156 pupils in seven first grade classrooms; the second study (Gates, 1940) involved 133 pupils in seven

classes. The tests for reading achievement in the 1939 study were a special word recognition test, a special sentence reading test and the Gates Primary Reading Tests-Word Recognition and Sentence Reading (1926). Only the Gates Primary Reading Tests-Word Recognition and Sentence Reading (1926) were used in the second study. Again, Test 5, Word Matching, as previously described, correlated at a high level with overall reading ability in both studies -- .58 and .45. The correlation coefficient of Test 5 with overall reading achievement was the highest correlation coefficient in the first study and, in the second study, second in rank.[1] Barrett (1965) interpreted these fingings as follows:

> Although tests of significance were not computed for any of the differences between correlation coefficients, it appears that tests requiring visual discrimination of words are slightly better predictors of reading achievement than are tests requiring visual discrimination of letters or pictures [p. 68].

Most of the results of a second series of studies, conducted by Wilson (Wilson and Burke, 1937; Wilson and Flemming, 1940; Wilson, 1942) are not relevant to this discussion as scores from separate prereading skill subtests were not correlated with reading achievement scores. The

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[1]The end result of the studies by Gates was the Gates Reading Readiness Test (1926) composed of seven subtests: (1) Picture Directions, (2) Word Matching, (3) Word Card Matching, (4) Letter Matching, (5) Letter and Number Naming, (6) Rhyming, and (7) Blending, assumed best predictors of reading achievement. Of the four visual discrimination tasks included in this test, three require the ability to identify differences and minimal contrasts in words and letters. The Gates Reading Readiness Test was used in subsequent studies reviewed in this chapter.

high correlation of the total score on the entire test battery (Wilson-Flemming Symbols Test, 1940) with the Metropolitan Achievement Test in Reading (1922) however, led the authors of both studies to conclude that the ability to recognize letters, with respect to the order and orientation of such letters, is one of the best predictors of first grade reading achievement. One of the analyses in the 1942 study correlated scores on the Gates Reading Readiness Test (1926) with scores on the Metropolitan Achievement Test in Reading (1931). Scores on Subtest 3 of the Gates test (testing ability to attend to minimal contrasts in pairs of words, as described on page 11) had the highest correlation with scores on measures of reading achievement. The correlation coefficient for a population of 20 Kindergarten children in a college lab school was .46 and for a population of 23 Kindergarten children from a New York City public school, located in an underpriviledged section of the city, was .67. The total Gates battery produced lower correlation coefficient with first grade reading achievement than Subtest 3 and Subtest 5. This fact led Wilson to hypothesize that Subtest 1 of the Gates Reading Readiness Test, Picture Directions, and Subtest 6, Rhyming Words, may have little relationship to subsequent reading achievement. This hypothesis has further support in the study conducted by Barrett (1965), over 25 years later. In the Barrett study six multiple regression analyses were computed between scores on measures of readiness and scores on measures of first grade reading achievement. Scores on the Gates Picture Direction subtest were not retained as a factor in any regression analyses. Such results indicate that the sub-

test is of limited value, when used in combination with other measures of reading readiness, for predicting scores on a subsequent measure of reading achievement.

In the multiple regressions computed, scores on the Gates Reading Readiness Test: Subtest 7: Letters and Numbers Naming (1958) made the highest contribution to prediction of scores made on first grade reading achievement measures; scores on the Gates Word Matching Test (1958) ranked as third highest contributor to such prediction, following scores on the Goins Pattern Copying Test (1958).

The last and most recent of correlational studies reviewed in this chapter was conducted by Weiner and Feldman (1963). The purpose of the Weiner and Feldman study was to construct a Reading Prognosis Test to predict future reading ability. The authors felt such a test was needed as the skills and knowledge of children from different socio-economic status levels was not being adequately measured by existing prognostic instruments. The test has three divisions with a total of eight subtests. Two of the subtests, Visual Similarities and Visual Dissimilarities, are composed of tasks comparable to the PRS Prereading Word Detail Subtest (1975), used in the present study. Visual Similarities measured the ability to match three to four letter words; Visual Dissimilarities measured the ability to recognize non-identical letters in a pair of words. In the Weiner and Feldman study, the scores on these two subtests were correlated with scores on the Gates Primary Paragraph Reading Test (1958) and scores on the Gates Sentence Readi

Test (1958) The correlation coefficient between scores on the Visual Similarities and Visual Dissimilarities Subtests and the Gates Paragraph Test for the low socioeconomic group was .61. The correlation coefficient of the same two scores for the average socioeconomic group was .68. The correlation coefficient between scores on the Visual Similarities and Visual Dissimilarities Subtests and the Gates Sentence Test for the low socioeconomic group was .55. The correlation coefficient of the same two scores for the average socioeconomic group was .63. These findings attest to the close relationship of first grade reading achievement and the ability to discriminate visual forms. The findings also indicate that the relationship varies according to the socioeconomic status of the child who performs the tasks.

A summary of findings from the studies discussed appears in Table 1. The range of correlation coefficients between subtest scores on tests of the ability to attend to the orientation and order of letters and the scores on measures of reading ability is .30 - .87; the range of correlation coefficients between the ability to attend to the detail of words and the ability to read is .36 - .84. While these ranges suggest that the skills of this study and first grade reading achievement share a close relationship, no assumption can be made on the basis of these ranges alone that one ability (ability to attend to the order and orientation of letters and to the detail of words) leads to an increase in the second ability (ability to attain a substantial level of success in reading). Similarily, while

Table 1

Correlational Studies of Ability to Attend to the Prereading Skills of Letter Order, Letter Orientation and Word Detail and Scores on Measures of First-Grade Reading Achievement

Study	Number of Subjects	Skill Correlated	Measure of Letter Orientation Letter Order or Word Detail	Measure of First Grade Reading Achievement	Correlation Coefficient
Smith (1928)	120	Letter Orientation	Author constructed lower case letter cards to match	2 special silent reading tests and Detroit Word Recognition Test	.87
		Letter Order			
Potter (1949)	176	Letter Orientation	Part 1 of Lee-Clark Readiness Test (12 lower case letters in 1 vertical line. Task: draw line from each letter to same letter in a second vertical line, printed parallel to the first line, but letter order is rearranged)	Gates Primary Reading Test, Sentence Reading and Paragraph Reading Subtests Only	.30
		Word Detail	Lee-Clark Readiness Test, Part III (20 word-matching items with stimulus to left of a row of four response choices)		.36
Silvaroli (1963)	87	Letter Orientation	Sheldon Reading Test: Pre-Reading	Durrell Informal Test of Upper and Lower Case Letter Identification and Gates Primary Reading Test, Total Score	.65
		Letter Order			
Deputy (1930)	103	Letter Order	Author constructed word selection subtest	Detroit Word-Recognition Test	.49
		Word Detail			

Study	Number of Subjects	Skill Correlated	Measure of Letter Orientation Letter Order or Word Detail	Measure of First Grade Reading Achievement	Correlation Coefficient
Gates (1926)	310	Word Detail	Gates Subtest 5-Word Matching		.49
			Gates Subtest 10-Word Similarities (3rd - 4th grades)		.48
			Word Similarities (5th - 7th grades)		
			Gates Subtest 11-Word Dissimilarities (3rd - 4th grades)		.84
			Word Dissimilarities (5th - 7th grades)		.41
			Test 12 (3rd - 4th grades)		.72
			Test 12 (5th - 7th grades)		.56
Gates, Bond and Russell (1939)	97	Word Detail	1-Stone-Grover Total Score (Part I and II--as described in Deputy study above	Gates Primary Readiness Test, Total Score	.62
			2-Perception of Pairs of Words--1 page of pairs of words; underlines pairs that are different		.62
			3-Visual Perception, Subtest 4--43 items; underline word same as stimulus word		
			4-Ability to recognize word seen--Gates Reading Diagnostic Tests, Part VIII, Section 2--20 lines of 6 words; 5 second displayed stimulus		Does not meet the definition of word detail--non-simultaneously presented stimuli and responses
			5-Part I, Stone Grover Test (as previously described)		.62
			6-Part II, Stone Grover Test (as previously described)		.62

Study	Number of Subjects	Skill Correlated	Measure of Letter Orientation Letter Order or Word Detail	Measure of First Grade Reading Achievement	Correlation Coefficient
			7-Van Wagenen Test V, Word Discrimination		.62
			8-Correlation of errors in #3 and #4 above and the ability to recognize nonsense words seen on a 43 item test of 4 responses to 1 stimulus. Errors analyzed were the selection of word having same ending but different beginning		-.56
			9-Correlation of errors in #4 and ability to recognize nonsense words as described in #8. Errors were the selection of words with different letters but similar configurations or profiles		-.53
			10-Ability to recognize nonsense words (as described in #8)		.49
			11-Correlation of reversal errors on #3 and #4 and the ability to recognize nonsense words. Errors were the selection of word composed of the letters in the stimulus word but letters were in reverse order		-.38
Gates (1939)	156	Word Detail	Gates Subtest 1-Word Matching (as previously described)	Gates Primary Reading Test, Word Recognition and Sentence Reading Subtests	.58

Study	Number of Subjects	Skill Correlated	Measure of Letter Orientation Letter Order or Word Detail	Measure of First Grade Reading Achievement	Correlation Coefficient
Gates (1940)	133	Word Detail	Gates Subtest 1-Word Matching	Gates Primary Reading Test-Word Recognition and Sentence Reading Subtests	.45
Wilson (1942)	63	Word Detail	Gates Subtest 1-Word Matching	Metropolitan Reading Achievement Test	.56
Lee, Clark and Lee (1967)	164	Letter Order Word Detail	Lee-Clark Reading Readiness Test	Lee-Clark Primer Test	.49
				Gates Reading Test, Total Score	.54
				Gates Reading Test, Total Score of children having had Kindergarten experience	.68
Weiner and Feldman (1963)	40 1st Validation Study	Word Detail	Reading Prognosis Test, Visual Perceptual Subtests	Gates Primary Reading Test, Sentence Reading (Low socio-economic group)	.61
				(Medium socio-economic group)	.51
				(Total SES group)	.61
				Gates Primary Reading Test, Paragraph Reading (Low socio-economic group)	.62
				(Medium socio-economic group)	.68
				(Total SES group)	.69

Study	Number of Subjects	Skill Correlated	Measure of Letter Orientation Letter Order or Word Detail	Measure of First Grade Reading Achievement	Correlation Coefficient
	138 2nd Validation Study	Word Detail		Gates Primary Reading Test, Sentence Reading	
				(Low socio-economic group)	.50
				(Medium socio-economic group)	.46
				(Total SES group)	.55
				Gates Primary Reading Test, Paragraph Reading	
				(Low socio-economic group)	.55
				(Medium socio-economic group)	.61
				(Total SES group)	.63

Range of correlation coefficients for Letter Order and Letter Orientation is .30 - .87.

Range of correlation coefficients for Word Detail is .36 - .84.

these ranges substantiate the claim that the scores on measures of these prereading skills are fairly reliable predictors of scores on subsequent first grade reading achievement measures, the correlations do not demonstrate that increases in the ability to read can be attributed to increases in the ability to attend to letter orientation, letter order and word detail, as demonstrated by a change from non-mastery to mastery on a criterion referenced test. As a last caution, one should not assume that correlation coefficients from the thirteen studies reviewed demonstrate that children without mastery of these three skills will experience less success in first grade reading activities than children of comparable ability who demonstrate mastery of these skills. Making such assumptions would ignore the possibility that the relationship may exist simply because both abilities share a close relationship to still another causal factor.

To cite two examples, there is a possibility that the high correlations between scores on measures of readiness and scores on subsequent measures of achievement are due to the mediating effects of either general intelligence or background experience. While the findings of Gates (1926) appear to deny the possibility that general intelligence is such a mediating factor[2], substantial evidence to

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[2]Gates reported correlations between scores on perception tests and scores on reading achievement tests with the influence of intelligence removed through procedures of partial correlation. Silent reading and word perception correlated .69. This partial correlation was higher than the raw correlation of intelligence and reading, which was .50. "These figures imply that the perceptive factor, irrespective of intelligence, is more closely associated with reading . . . than all of the functions embraced in 'intelligence' as measured" (Gates, 1926, p.442.) The IQ test Gates used included practically no reading.

justifiably eliminate intelligence as a mediating factor does not exist. Secondly, the ability to read and the ability to attend to the orientation and order of letters and to the detail of words may correlate at a high level because both abilities may result from an enriched preschool environment. It is possible that had the previously cited studies correlated the number of preschool letter/word experiences in a "highly enriched preschool background" to the measure of first grade reading achievement, the range of correlation coefficients produced may not have been significantly different from the range of coefficients of the measures of the prereading skills of letter orientation, letter order and word detail with measures of first grade reading achievement.

Therefore, before a cause and effect relationship between the skills in this study and the ability to read can be inferred, the effects of possible mediating factors must be examined. Likewise, before increases in reading ability can be attributed to mastery of the three prereading skills, it should be demonstrated that mastery of attending to the order and orientation of letters and to the detail of words either (1) reliably precedes an increase in subsequent first grade reading achievement, or (2) accounts for differences between achievement scores of groups of children who differ only in mastery or non-mastery of the three skills, i.e., groups are equal on the basis of socio-economic background, preschool environmental experiences, chronological and mental age, sex and initial reading ability.

To sum up this section of the review of literature, results from thirteen correlational studies were cited as evidence that the ability to attend to the skills in this study and first grade reading achieve-

ment share a close relationship. The results indicate that determining if this relationship is one in which attending to the visual prereading skills leads to an increase in first-grade reading achievement warrants further investigation. Children who master these skills obtain high scores on first grade reading achievement measures. Future investigations to ascertain the relation between word-perception skills and reading achievement are likely to be fruitful. In the words of Arthur Gates: "We need especially to discover the varieties of word-perception; the characteristic of effective and ineffective types; whether these various forms are primarily due to native aptitude or to acquired attitudes or skills; whether they may be readily changed and improved; how they are or may be influenced by various types of training" (1926, p. 445). Although written 50 years ago, the absence of definitive knowledge concerning word-perception make the words above as relevant to the direction for future research today as they were when Gates first wrote them.

Studies comparing groups of high achieving readers to groups of poorer readers. Studies comparing groups of high-achieving readers to groups of poorer readers suggest that children experiencing difficulty in first grade reading activities exhibit errors in attending to letter order and letter orientation more frequently than other types of errors and more consistently than peers who do not have difficulty in learning to read. Conversely, the findings of these studies illustrate that a high percentage of children who attain a substantial level of reading achievement appear to possess a mastery of the skills of attending to the order and orientation of letters and to the detail of words.

Such comparisons have been made on the bases of the type and number of errors both groups make.

Four major studies have been designed to analyze the type and frequency of letter orientation errors made in early stages of learning. (Hildreth (1932), Davidson (1934), Calfee, Chapman and Venezky (1972) and Gibson, Gibson, Pick and Osser (1962). The analyses of errors in each of these studies were made by comparing four to five year olds who had no or limited formal reading instruction to six to eight year olds who had considerable formal reading instruction. The flaw in the studies is that analyses of errors were not made by comparing students of similar mental or chronological age but different levels of reading achievement. Therefore, while it may be safe to assume that children of six to eight years of age are "good readers" when compared to children of four to five years of age, it would be unwise to interpret the comparisons of letter orientation errors made between these two groups as evidence that poor readers make a certain type of errors and good readers do not. Thus, when taken collectively, the results of these four studies only indicate that many children entering first grade at six years of age are making a high percentage of letter orientation errors while children entering second and third grade are making significantly less letter orientation errors. The results indicate only that maturation and incidental skill instruction can increase children's ability to recognize the orientation of letters. The results do not show, however, whether earlier mastery would have been associated with increased achievement. In other words,

work of Hildreth (1932), Davidson (1934), Calfee, Chapman and Venezky (1972) and Gibson, Gibson, Pick and Osser (1962) demonstrate that most children will come to a realization of the significance of orientation in letter symbols as they progress through school. The works of these investigators do not attempt to answer the question: Would children gaining mastery of this skill before the end of Kindergarten and the beginning of first grade have a significantly higher level of reading achievement than children attaining mastery later in their school career?

Hildreth (1932) analyzed the letter orientation errors of four groups of children with superior intelligence. These children were given a test of number and letter construction constructed by Hildreth. The test was given at three different times, at intervals of approximately nine months. While the analysis of errors made in the construction of letters does not have relevance to the discussion of letter orientation as defined in this study, the observations of the children's perception of the letters are important to note. Hildreth reported that "children (having superior intelligence) were frequently puzzled by the lateral direction of letters and numbers (they were asked to construct) and often asked, 'Which way shall I make it" . . . On receiving no help the children commented, 'I'll just make it any old way' and in a great number of such instances a reversal of the symbol was made" (1932, pp. 5-6). Hildreth went on to report that the tendency to make letter orientation errors in letter construction was practically universal in the four to six year olds.

In a study two years subsequent and using the same aged population as Hildreth, Davidson (1934) analyzed the errors of children of average intelligence on tasks requiring letter matching ability only. Davidson's experiment involved 50 preschool and 120 first grade children. The children's intelligence quotients ranged from 57 to 142 (mean 100.53, as measured by the Stanford Binet Test; 1926). Davidson described the investigator-constructed task as the circling of each response identical to a single letter stimulus where response choices included 5 letters identical to stimulus, 5 mirror images of stimulus and 30 additional letters. The analysis of errors of children performing this task revealed that preschool children read letters backwards and recognized forms without reference to the form's orientation in space. Specifically, 82.6% of the kindergarten pupils selected one or more reversed letters, with only 4.9% of the Kindergarten pupils selecting no letter or geometric form reversals. A higher percentage (29.5%) of the first grade pupils selected no letter or geometric form reversals. Additionally, letter orientation errors averaged 70.5% of all errors for Kindergarten children and 43.0% of all errors for first grade children. As Davidson points out, this error rate is strikingly large when one notes that had such errors ocurred by chance, only 25% of the errors should have been allocated to reversal forms of the stimulus letter, as the reversed letter was only one of four incorrect response choices.

In a more recent study, similar findings were reported (Calfee, Chapman and Venezky, 1972). Tasks almost identical to Davidson's test tasks were given to a population of 43 Kindgertan children. Eighty-five percent of the errors these children made were selection of reverse alternatives. Had the selection of incorrect response choices occurred through random guessing, only 33% of the errors should have been reversal errors.

To discuss more specifically the contention that letter orientation errors are maturationally related, an additional finding of Davidson (1934) and the work by Gibson, et al. (1962) should be mentioned. Davidson stated, "At a chronological age of seven and one-half years 50 percent of the pupils . . .were able to select d, q, and b without error . . . One cannot but conclude that growth in ability to distinguish between the letters of the alphabet is closely allied with increasing mental age . . . Increase in ability to differentiate comes with increasing mental maturity and experience" (p. 457). The number of word reversal errors of the 50 Kindergartners and 120 first grade children in Davidson's study decreased distinctly at mental age five and one-half years and at six and one-half years, but errors did not consistently decrease with either mental age or chronological age. Therefore, these results do not support the contention that maturation alone improves ability to attend to the orientation of letters. It is a fact, however, that the average number of reversal errors for the Kindergarten children was 3.3, while it was only .08 for the first grade children.

Gibson, Gibson, Pick and Osser (1962) concluded, following an extensive analysis of the qualitative and quantitative letter orientation errors, that ability to attend to the orientation of letters increases through maturation. The errors analyzed were those made by 167 children of four to eight years of age. The letter orientation errors made by the youngest group were extremely numerous but the error rate declined to almost zero for the eight year olds. When t-tests of differences between the mean drop in letter orientation error rate were made, the results were significantly different from zero at the .01 level for each of the five age levels (four, five, six, seven and eight year olds). Explanation for the significant declines in error rate were attributed to the maturation of retinal processes and to the higher chronological age of children exposed to letter-like forms. Gibson, et al, concluded that both of these maturation factors make the discrimination of letters possible. Again, while these works by Davidson (1934) and Gibson, Gibson, Pick and Osser (1962) show that increased mental and chronological development are associated with a realization that the orientation of letter symbols have significance in reading, the findings do not demonstrate that promoting this realization earlier in a child's mental or chronological development would positively or adversely affect reading achievement.

Turning attention to the significance of attending to letter order as a discriminator between good and poor readers, many researchers have reported that a high percentage of letter order errors are made

by pre-school pupils (Gates, Bond and Russell, 1939; Wilson and Flemming, 1938; Robinson and Higgins, 1967; Rudel and Teuber, 1963; and Calfee, Chapman and Venezky, 1972). As a matter of fact, the two studies by Robinson and Higgins (1964, 1967) and the study by Rudel and Teuber (1963) indicated that approximately 69% of Kindergarten and first grade pupils and 36% of second and third grade children make one or more letter order errors in tests requiring the matching of similar letter pairs.

Gates, Bond and Russell (1939), Wilson and Flemming (1938) and Calfee, Chapman and Venezky (1972) grouped children by reading achievement levels to compare frequency of letter order errors. The results of these comparisons are discussed below.

Gates, Bond and Russell (1939) compared many attributes of the seven pupils who had made noticeably slow progress in reading (scoring 0 on the reading achievement measures given at mid-year) to the attributes of the 90 pupils scoring above 0 on these reading tests. Mean scores of the poorest readers differed little from the mean scores of the whole groups in chronological age, IQ, or ratings on quality of the completion of a story.[3] The mean scores of the seven poorest readers were lower, however, on the several tests of word perception and ability to read letters. The poorer readers made

[3] The ability to complete a story was the second highest correlate to initial reading success in the 1939 study. The ability to perceive letters and words was the highest correlate to initial reading success.

slightly more letter order errors and were less likely than the entire group to note the beginnings of words (as evidenced by the number of errors accruing from identifying a word having the same ending but different initial letters to a stimulus). Six of the seven poorest readers fell below the mean on subtest measures requiring attending to letter order in words of three to five letters each. Gates, Bond and Russell (1939) also noted that children knowing the most letter forms and sounds tended to be the first to learn how to read. Conversely, the children who were ignorant of, or much confused about letter forms and sounds, tended very definitely to be the poor readers.

Within the same time period Wilson and Flenning (1938) analyzed the letter order errors exhibited in the visual matching performances of 123 four and five year old kindergarten children, 110 first grade children, 108 second grade children and 57 third grade children. The average number of reversals for the entire groups of children was 18.2 of 83 possibilities, with the per child range of errors being 6 to 38. Only the capital letter subtest for the third grade sample resulted in zero letter order errors.

The most definitive conclusions Wilson and Flemming drew, following the numerous analyses computed, were:

1. Many reversals made by the Grade 1 children had already become habit responses.

2. Data from the three Kindergarten groups add evidence that inability to attend to letter order begins long before first grade.

3. Letter order errors seem to vary depending upon the letters combined, with some errors persisting into the third grade for certain letter combinations.

4. Reversal responses seem to be specific learnings rather than general tendencies.

5. Many reversals were due to confusion or inadequacy in remembering--resulting, perhaps, from carelessness or incompleteness of observation.

Unfortunately, Wilson and Flemming did not report findings of the relationship of letter order errors to reading ability.

The most recent study of letter order errors in young children was conducted by Calfee, Chapman and Venezky (1972). The basic purpose of their three-year investigation was to identify basic cognitive skills related to the acquisition of reading and to design an objective measure of skills identified. The end product was a Basic Skills Test Package (1972), an in-depth test of the skills found to be basic prerequisites to the acquisition of reading: matching of visual forms, auditory-phonetic identification letter-sound association, vocabulary knowledge and general achievement. Results from the Basic Skills Package have particular relevance to the discussion of letter order errors in young children. Errors were tabulated following the administration of the Basic Skills Test Package to 21 Kindergarten children in Madison, Wisconsin and 22 Kindergarten children in Beloit, Wisconsin (November 1968 to January 1969); 70% of the Madison group error and 65% of the Beloit group error was error in attending to the order of the stimulus pair (e.g., CQ-QO QC CQ CO). The authors also noted that had the errors occurred by chance, only 33% of the errors (as compared to the obtained 70% and 65%) should have been letter order errors.

A major study investigating the persistence of word detail errors in early readers was conducted by Hill in 1936. Hill administered a series of tests measuring the prereading skills of letter orientation, letter order and word detail. The tests were given to three groups of children (average age was 84.2 months). Twenty-eight children came from a first grade university elementary school, 35 came from a Junior Primary (Kindergarten) school, and 87 came from the Kindergarten classes of an orphanage. The test for word discrimination was composed of three parts, each part increased in difficulty from the use of only two words to the use of five word response choices. No child, even following a period of training in attention to the detail of words, made a perfect score on the measures of attending to the detail of words. The analyses of errors showed that most errors were made:

1. when the identity between the words was great, i.e. when a large number of letters in two words were the same and when the configurations were identical or extremely similar. Children in the sample appeared to be unable to attend to the middle section of a word or to the minimal contrasting features of the words.

2. when the letters and the configuration of two words remained the same, but order of letters was reversed. Children appeared to be unable to attend to the letter order.

3. when reversible letters were present in a word. The letters b, d, p and q caused more difficulty than either those same letters appearing in isolation or the disorientation of a word without these letters.

To summarize the results of studies discussed in this section of Chapter 1, the data indicate that 1) most preschool children do not attend to the significance of the orientation and order of letters

or to the significance of the detail of words; 2) first grade children who make slow progress in reading have lower mean scores on several tests of word and letter perception than first grade children making acceptable and rapid progress in reading; 3) inability to attend to middle section and minimal contrasts between words accounts for the majority of errors in visual perception of words;and 4) ability to attend to the significance of the orientation and order of letters and to the detail of words may occur through maturation and incidental skill instruction.

Data have not been obtained to ascertain:

a) if the effect of increased time for mastery of these skills, through maturation, on first, second or third grade reading achievement is adverse, negligible, or positive; or

b) if children entering first, second or third grade have difficulty in learning to read until mastery of the skills is attained.

Studies investigating the value of systematic instruction in the skills of attending to letter orientation, letter order and word detail. As previously discussed, it is apparent from the literature that the skills in this study share a close relationship to initial reading achievement and that errors in attending to these skills are made by children in Kindergarten, first, second and third grade. When educators examine the results of past studies, additional questions arise:

1. Since ability to attend to the orientation and order of letters evolves without exposure to daily systematic instruction in the skill, of what value is a program of systematic instruction to develop these skills?

2. If the value of a program of systematic instruction is to reduce the amount of time needed to attain mastery of the skill, does systematic instruction reduce the amount of time needed to gain an understanding of the significance of letter orientation, letter order and word detail in reading from the amount of time needed either through maturation or incidental skill instruction?

3. Will promoting mastery of the skills earlier in a child's chronological development positively or adversely affect reading achievement?

The answer to question 1, regarding the value of systematic skill instruction, rests mainly in the opinions and hypotheses of reading researchers. Empirical tests of the effectiveness of various visual discrimination programs have been contradictory. Contradiction in results of comparative studies may have arisen from two causes. First, comparisons were made on the basis of comparisons between first grade students exposed to experimental skill instruction treatment and students in control groups. Such a comparison rests on the false assumption that all students in the treatment group benefited from treatment, i.e., all students in treatment are considered to have benefited from treatment and/or to have mastered the skills being investigated. Similarly, all students in control groups are assumed to have an absence of the skills investigated.

A second plausible cause of contradiction might be the use of reading achievement scores as the basis of measuring change. The more valid measure of experimental and control comparisons might better be the use of a criterion measure that reflects the efficiency of the experimental treatment in increasing mastery of specific skills. Such a measure would establish the success by which the treatment increased the student's proficiency in the skills included. Comparing achievement test scores does not measure the success of the program in meeting its objectives, which is a different issue from determining whether skill mastery leads to increased achievement.

To assess the latter issue, comparisons of reading achievement scores should be made but groups compared should not be those exposed or not exposed to treatment but rather groups of students demonstrating mastery on a reliable and valid criterion measure of skill mastery and students not demonstrating mastery of the skills.

Turning attention away from research as a source for answering question one, opinions concerning the value of systematic instruction in attending to the orientation of letters have been expressed. In Brian Fellow's book, The Discrimination Process and Development, Chapter 17, "Learning and the Perception of Orientation" (1968, pp. 130-145) include a very comprehensive discussion of such opinions. Fellows summarized the review by stating: " . . . it may be said that the research reviewed in this chapter clearly indicates that letter

orientation discrimination in children is not solely a function of maturation; it is in fact a skill quite sensitive to training. . ."

Two studies most often cited in support of this statement are the recent works of Hendrickson and Muehl (1962) and Jeffreys (1958). The work of Hendrickson and Muehl indicates that preschoolers can learn the significance of the orientation of letters through a program of systematic instruction. Jeffrey's data (1958) indicated that children incapable of performing the discrimination of letter orientation at a given time can be taught it very quickly, even as early as four years of age, if the concept of same and different are adequately interpreted by the child and responses to stimuli are within the child's verbal and motor capacities. Unfortunately, past studies have not been designed to examine the effects on the subsequent reading achievement, leaving the question of the value of letter orientation training unanswered and open to opinion and speculation.

As Wilson and Flemming state:

> The data in the study (Wilson, Flemming, 1940) give no clues as to what causes children to make reversal responses [letter order errors] when they begin to learn symbols . . . .
>
> It is probable that most teachers far underestimate the long and difficult processes involved in mastering these symbols. There are over 52 printed letter symbols, all varied by printed and especially by written styles. To learn all these forms, with their names and sounds, is so difficult that it should rarely be left to chance, incidental or concomitant learning. That difficulty in learning them is real was attested to by observation of kindergarten and Grade 1 children during the tests. The examiners were impressed with the intense effort put forth by most of the children in trying to name or write letters. The effort was often painful to observe--alternating squirming and tension, sustained frowning, panting, grunting, whispering and muttering, even weeping.
>
> The practical conclusions indicated by the findings of the study seem to be that children need careful guidance in learning letter and number symbols, and that for most children like the Horace Mann groups studied, need for this guidance begins long before Grade 1, and for some children probably continues for a considerable time after Grade 1. (pp. 30-31, 1940).

Gibson, et al. (1962) oppose this position and state that, "teachers apparently give a good deal of concentrated and highly verbal attention to letter orientation (and letter order) errors but there is no evidence that such attention is needed." (p. 905). The authors point out that skills in attention to letter orientation and letter order may be skills similar to attention to the distinctive features of letters, and that attending to phonemic differences has not often been taught, but nevertheless learned. Gibson, et al, also contend that the significance of varying dimensions of letters has been effectively learned solely through experiential exposure to the repeated processing of graphemic symbols.

These authors state, however, that helping children to pay attention to orientation of letters "can hardly hurt . . . (although) such help or instruction has not been shown to transfer to reading ability. . . . but if the typical matching tasks of readiness actually used variables which are significant for letter discrimination (instead of pictures of objects) there would certainly be greater potential transfer value" (Gibson, et al., 1962, p. 905).

In answer to question 2, regarding the value of a program of systematic instruction in reducing the amount of time needed to attain mastery of the skills, there is evidence that a greater number of children changed from non-mastery to mastery of the skills at the end of Kindergarten in classes where instruction in the three skills was given than in classes where instruction was not given (Kamm, Zajano, Hubbard and Pittelman, 1973).

As reported in the 1971-1972 field test of the Prereading Skills program, involving twenty-three Kindergarten classrooms and 545 pupils fewer than 30 percent of the field test pupils mastered the five pre-reading skills prior to instruction. Post-instructional testing of Letter Order and Letter Orientation showed mastery by up to 78 percent of the pupils tested. (Kamm, et al., 1973, p.xi).

In a second study, a small-scale field test of the revised Pre-reading Skills Program (1974) conducted during the 1972-1973 school year, the number of students changing from non-mastery to mastery of the prereading skills in classes receiving systematic skill instruction was over and above the number of students demonstrating such a change in classes where systematic skill instruction was not given (Venezky, Leslie and Green, 1975). The small-scale field test included schools that had used the program during the 1971-72 school year, as well as several schools using the program only during the 1972-73 school year (Venezky, Green and Leslie, 1975). Forty-six classes--22 Kindergarten classes and 10 first grade classrooms, composed of 627 Kindergarten children and 257 first grade children--participated in this study

In partial answer to question 3, regarding whether a reduction in the time needed before mastery of the skills occurs will lead to a significant increase in subsequent reading achievement, Venezky states:

> While the evidence that direct instruction in these skills produces mastery appears to outweigh the evidence that maturation alone produces mastery, ascertaining the necessity of each skill for learning to read is a far more complex matter. None of the three skills has been shown to be absolute prerequisites to learning to read, but the child who comes to initial reading instruction with a mastery of these skills should have less difficulty in learning to read as demonstrated on periodic reading achievement measures than children who do not possess these skills. (1974, p.13).

Due to the limitations imposed through design, assessment of the effect of systematic instruction in these skills on overall reading achievement was not attempted in the study just cited. That is, since the study was not designed to examine such an effect, data were not available to determine if mastery of the skills occurred through instruction received in Kindergarten, previous to the period of systematic instruction; if mastery accrued through maturity alone; or if mastery occurred through the effects of systematic instruction of these three skills. While the effects of the three prereading skills on overall reading achievement as demonstrated by scores on a formal, standardized measure of first-grade reading achievement has not been demonstrated, the effects of the three skills have been detected in a standardized instrument for reading readiness, the Clymer-Barrett Reading Readiness Test (1969). Students having mastery of the three skills scored significantly higher than students without mastery of the skills ($p < .05$) on the letter recognition subtests of the Clymer-Barrett Reading Readiness Test (1969).

As a final note, there appears to be a need to investigate the difference in effectiveness of visual skill instruction when letters and words are used as instructional stimuli, as opposed to geometric forms and outline figures. Such need rests in the fact that numerous readiness lessons require visual discrimination of geometric forms and outline figures as well as letters and words, despite the low

coefficients of correlation between ability to discriminate geometric forms and reading achievement. If training in geometric forms and outline figures or letter and word shapes provides less transfer to reading related tasks, such findings would be valuable to the development of new beginning reading programs.

Studies of the effect of sex, age, ethnic background and socio-economic status on first-grade reading achievement. Factors that might serve as plausible causes for differences between groups are socioeconomic status, race, age and sex. The most substantial indication of the relationship between sex and reading achievement in the American educational system is the significantly larger number of boys than girls in remedial reading classes (Monroe, 1932) and the inclination of our culture to feminize reading activities. Johnson (1966), Silverberg (1972) and Farnham-Diggory (1972) present additional evidence that supports the contention that such differences may be innate. Girls learn letters and letter-like forms more rapidly than boys.

The relationship of age to reading achievement has been well documented. The effect of maturation on the skills selected for this study is discussed in the second section of this review of literature.

To consider all of the research regarding the effects of differences in ethnic background would be tangential to the central issue of this paper. It is important to note, however, that Black, Mexican-American

and American Indian populations have been shown to have certain deprivations of cultural or linguistic nature that detrimentally affect reading achievement. These deprivations appear to be over and above the cultural or linguistic deprivations experienced by Anglo-Saxon children.

It has been established that Mexican-American students benefit from early school instruction to develop an awareness of English language complexities and that American Indian students tend to use configuration, sound clues and idiomatic expressions inappropriately (Phillion and Galloway, 1969). Many Black children are handicapped in initial reading performances by dialect, poverty of vocabulary, dearth of adult models, lack of early stimulation to engage in reading related activities, a cultural deemphasis of the value of standard speech, and a failure to consistently use complex English language structures.

Socioeconomic factors undoubtedly affect a child's level of reading achievement as well as his/her purposes for and uses of reading. These factors also determine the quality and quantity of reading materials available to the child, which in turn, in and of themselves, influence the reading behaviors of the child. The research during the 1960's placed a heavy emphasis on the socioeconomic influences of a child's environment upon the child's reading behavior. Studies have tended to reveal that most adverse socioeconomic influences upon reading are found in children from low socioeconomic

communities. Such environments produce a dearth of adult models (Almy, 1967 and Goldstein, 1963), little early stimulation (Deutsch, 1960), lower family educational and occupational levels (Calloway, 1973) and less emphasis upon the value of learning (Bloom, Davis and Hess, 1965). As a matter of fact, Barton and Wilder concluded (following a national survey of elementary school teachers) that socioeconomic level of a child's environment is the single most important factor in rate of reading progress. The results of their work revealed that by fourth grade about one-half of the children in lower socioeconomic communities were below grade level in reading achievement. Thorndike (1973) has found this phenomenon in other countries of the world.

In the countries he considered -- France, Germany, India, Israel, Japan, U.S.A., U.S.S.R., Denmark, Finland, Sweden, Norway, Hong Kong and Great Britain -- the evidence suggests that differences in comprehension ability are not due to innate characteristics but rather to economic status of the home. In each country, parent's socioeconomic status positively correlated to reading achievement. This factor, as a motivational force for the child, appeared to be equal to or greater than considerations of writing systems, orthography and methods of instruction as influences on success in initial reading. This finding was present both within and between countries.

To sum up, past studies support the contention that an examination of the effect of mastery of the three prereading skills, attending to letter orientation, letter order and word detail, on subsequent reading achievement is warranted. Such a study would be significant.

to the field of reading as it has not been ascertained:

1. if the relationship between letter orientation, letter order and word detail and reading achievement is one in which mastery of the skills leads to an increase in subsequent first grade reading achievement;

2 if children changing from non-mastery to mastery of these skills by November or March of their first grade year exhibit increases in scores on a standardized instrument measuring first grade reading achievement;

3. if the effect of mastery of the 3 skills of reading achievement is the same for children from high, middle and low socio-economic communities.

4. if systematic instruction in the skills is a more efficient and effective method for eliminating skill deficiencies than non-systematic or incidental instruction in the skills; and

5. if a program of systematic instruction is designed to use letter/word instructional stimuli, will this program prove to produce better mastery of the three prereading skills than a program designed to use geometric form/outline figure stimuli.

The fact that a relationship exists between the prereading skills in this study and reading achievement is well documented. Whether the relationship between these skills and subsequent reading achievement is one in which mastery of the three selected prereading skills leads to an increase in subsequent reading achievement remains to be demonstrated.

Hypotheses

Seven hypotheses were tested in this study. To test each hypothesis, reading achievement scores of first grade students were

compared. Comparisons were made between groups who demonstrated a performance of mastery or non-mastery of the skills of attending to letter order, letter orientation and word detail.

The hypotheses tested in this study were:

1. Mastery of letter order, letter orientation and word detail[3] will significantly increase[4] subsequent first grade reading achievement when students who begin first grade with a mastery of letter order, letter orientation and word detail are compared to students who begin first grade without a mastery of the selected prereading skills.[5]

2. Mastery of letter order, letter orientation and word detail will significantly increase subsequent first grade reading achievement when students who entered first grade without mastery of the selected skills but who attained mastery by November are compared to students who began first grade without mastery of the selected prereading skills and who did not attain mastery by November.

3. Mastery of letter order, letter orientation and word detail

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[3]Mastery was defined as ability to answer correctly 14 of 16 items (87.5% correct) of Letter Order, Letter Orientation and Word Detail on each subtest of the Prereading Skills Test (1975). The term mastery in the following hypotheses refers to this demonstrated performance.

[4]The desired level of significance is $p < .05$.

[5]The group mean of the scores on the Gates-MacGinitie Reading Achievement Test (1965), administration in November and March and the sum of the total test scores were used as the indices of reading achievement.

will significantly increase subsequent first grade reading achievement when students who entered first grade without mastery of the selected skills and who did not attain mastery of the skills until March are compared to students who begin first grade without mastery of the skills and who do not attain mastery by March.

4. Students who do not consistently demonstrate mastery of all three skills at all testing periods (September, November and March) but who do demonstrate mastery at one or two of the testing times will perform more like masters than non-masters on measures of reading achievement.

5. The relationship of scores on the three visual subtests of the PRS Prereading Skills Test (1975) and scores on the Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965) will be the same for children of low, middle and high socio-economic communities.

6. The number of students exposed to systematic skill instruction who change from non-mastery to mastery or who maintain mastery will be significantly greater than the number of students in control groups who change from non-mastery to mastery.

7. The number of students exposed to systematic instruction using letter/word stimuli who change from non-mastery to mastery or who maintain mastery will be significantly greater than the number of students exposed to systematic instruction using geometric shapes/outline figures as stimuli who change from non-mastery to mastery or who maintain mastery.

CHAPTER II

METHOD

As stated in Chapter I, the purpose of this study was to examine the effect of mastery of three prereading skills on subsequent first grade reading achievement. The methods of the study are discussed in the five subdivisions of this chapter: Design of Study, Subjects, Materials, Procedures and Data Analysis.

Design of Study

The design used in this study most closely corresponds to Design 10 as discussed in Experimental and Quasi-Experimental Designs for Research (Campbell and Stanley, 1963, pp. 40, 47-50). The principles of this design involve administration of pre- and post-tests to experimental and control groups in which "control and experimental groups do not have pre-experimental sampling equivalence. . ." (p.47). The groups were naturally assembled classrooms and assignment of treatment to groups was random and under experimenter's control. The study involved experimental and control groups, given

a pretest and two subsequent posttests on skills of letter order, letter orientation and word detail as well as a pretest of initial reading ability and two subsequent posttests of reading achievement. Treatments were randomly assigned to 42 intact classrooms, selected through random sampling.

Subjects

Forty-two first grade classrooms from the Fort Worth Independent School District, Fort Worth, Texas were included in the study. Classrooms were selected by stratified random sampling, with classroom teacher qualities and socio-economic level of the community served by the elementary school as criteria for stratification. Classrooms were selected from a list where the teacher had volunteered to participate, had received a Bachelor of Arts/Science Degree in Education, including at least three hours of course credit in reading methodology and had taught first grade for more than one year previous to September 1, 1975. The number of classrooms selected from the 16 elementary schools which serve high socio-economic communities and the 32 elementary schools which serve middle socio-economic communities, as nearly as possible, equalled the number of classrooms selected from the 30 elementary schools which serve low socio-economic communities. As shown in Table 2, 12 classrooms in the study represented elementary schools which serve high socio-economic communities, 15 classrooms represented elementary schools which serve middle socio-economic communities and 15 classrooms represented elementary schools which

Table 2

Schools Participating in the Study

School	SES Level of Community Served	Number of Teachers/ Classrooms Involved	Number of Pupils Enrolled September 1975	Number of Subjects Involved In Study	Experimental Group Designation	
Westcreek	High	4/4	119	80		4 C*
Wycliff	High	2/2	43	30	2 TG	
Bruce Shulkey	High	1/1	25	19	1 TG	
J. T. Stevens	High	2/2	58	37	2 TL	
Bluebonnet	High	1/1	23	18	1 TL	
M. L. Phillips	High	2/2	51	39	2 TL	
Oaklawn	Middle	2/2	37	26	1 TL	1 C
B. H. Carroll	Middle	2/2	57	37	1 TG	1 C
Theodore Willis	Middle	2/2	53	32		2 C
Greenbriar	Middle	2/2	46	30	1 TG	1 C
M. M. Walton	Middle	1/1	20	0[1]	1 TG	
Brooklyn Heights	Middle	2/1	31	17	1 TG	
W. M. Green	Middle	3/3	86	35[2]	3 TL	
Burton Hill	Middle	2/2	58	40	2 TL	
Carver-Hamilton	Low	3/3	66	16	1 TG	2 C
H. V. Helbing	Low	2/2	48	41	1 TG	1 C
Carroll Peak	Low	4/4	103	71	2 TL	2 C
South Ft. Worth	Low	2/2	55	47	1 TG	1 C
Diamond Hill	Low	1/1	21	17	1 TG	
Sam Rosen	Low	3/3	68	51	3 TL	
TOTAL 20	12H, 15M, 15L	43/42	1,068	687	16TL, 11TG, 15C	

70

71

* C denotes control group
TG denotes systematic skill instruction using geometric shapes and outline figures as stimuli
TL denotes systematic skill instruction using letters and words as stimuli

[1] Data from the children in this classroom were not used in the study. The teacher incurred an extended illness and did not complete the training program.

[2] Te[illegible]e improperly administered in one of these classrooms. Data from the children in this classroom were not used in the study.

serve low socio-economic communities.[1]

Socio-economic rank for each elementary school was determined by an analysis of 1970 census data, as reported in "Fort Worth Area Census Tract and Market Fact Book," a pamphlet prepared by Dr. Robert H. Talbert of Texas Christian University. The composite score from rating the occupation, education, housing and income of each inhabitant of the community tracts in the Fort Worth Standard Metropolitan Statistical Area was used to determine an average composite socio-economic rating for each elementary school. The mean (99.38) and standard deviation (44.68) was used to rank the socio-economic rating of each school. That is, schools one quartile above and below the mean (range 69-129) were ranked middle socio-economic; schools in the first quartile (below 69) were ranked low socio-economic, and schools in the fourth quartile (above 129) were ranked high socio-economic schools.

Of the 1,068 children enrolled in the 42 classrooms at the beginning of the study, 321 children did not complete all testing instruments, 63 children moved at some time during the study, and 6 had incomplete data concerning age, sex and/or physical description. As complete data concerning each child's ability to attend to the three reading skills and records of the children's overall reading ability were

[1]Only 12 classrooms, representing high socio-economic communities, met the criteria for selection, causing unequal representation of classrooms serving high socio-economic communities.

not available, scores from the tests of these 390 children were not included in the analyses of data.

To determine if the absence of test scores from these children might result in a set of scores unrepresentative of the original population, a t-test between scores on the PRS Prereading Skills Tests of the 687 subjects in the study were compared to scores on the same test of the 1,068 children initially enrolled in the selected classrooms. As shown in Table 3, differences in mean score of original population and subject sample were non-significant ($p = .59$ for difference in means of the Letter Order Subtest, $p = .40$ of difference in means on Letter Orientation Subtest and $p = .70$ for difference in means of the Word Detail Subtest). There was no significant difference between original population and subject sample in age, ethnic background, socioeconomic level or sexual composition. This suggests that the scores on testing instruments of subjects in this study adequately represented the scores on testing instruments which might have been made by the students eliminated from the study. It was concluded that use of scores from the 687 subjects could be interpreted as representative of data from 1,068 students in the original population. Elimination of the 390 children described above would not act as a confounding factor in the interpretation of results of the study.

Subjects for the study were the 687 first-grade children enrolled in the 42 selected classrooms, who were present for and completed all testing instruments. Approximately one-half of the subjects were boys (N=342) and one-half were girls (N=345). The number of subjects attending schools which serve high socioeconomic community tracts was 223, the number of subjects attending schools which serve middle socioeconomic community tracts was 271, and the number attending

Table 3

Comparisons Between the Sex, Race, Age Readiness Score and Prereading Skills Visual Subtest Scores of Students in Original Population and Subjects in Study

Measure of Comparison	Original Population (N = 1,068)		Subjects in Study (N = 687)		P Value of t-test between means
	Mean	S.D.	Mean	S.D.	
Sex: Female coded 1 Male coded 2	1.53	.50	1.49	.71	.27
Race: Anglo coded 1 Black coded 2 Mexican-American coded 3 Other ethnic minority groups coded 4	1.53	.90	1.53	.77	.96
Age:	6.87	6.34	6.92	6.70	.89
Metropolitan:	64.33	19.1	64.24	17.4	.92
Prereading Skills Test, Visual Subtest Letter Order:	14.05	3.43	14.15	3.31	.59
Prereading Skills Test, Visual Subtest Letter Orientation:	14.12	3.50	14.27	3.35	.40
Prereading Skills Test, Visual Subtest Word Detail:	13.95	4.35	14.02	3.10	.70

schools which serve low socio-economic community tracts was 193. The number of subjects from Anglo ethnic background was 431 (63% of total subject population); 133 subjects were from Black ethnic groups (19%); 116 were from Mexican American ethnic groups (17%) and 4 were from Oriental, American Indian or other minority ethnic groups (1%).

Materials

Instructional Materials

Two sets of instructional materials were used in the study. One set included 35 selected activities from the PRS Prereading Skills Program (1974), designed to use letters and words as instructional stimuli. Ten of the 35 activities were designed to teach the skill of attending to letter order, 12 were designed to teach the skill of attending to letter orientation, and 13 were designed to teach the skill of attending to the detail of words. The activities were used in the 16 randomly assigned experimental classrooms designated as TL (Treatment with Letter/Word Stimuli).

The second set of instructional materials included 35 activities designed to use geometric shapes and outline figures as instructional stimuli. Twenty-two of the activities in the set were selected from the PRS Prereading Skills Program (1974) and 13 were constructed by the investigator. Objectives of the 35 activities in this set of instructional materials were the same as the objectives for the first set of materials. The activities were used in the 11 randomly assigned

experimental classrooms designated as TG (Treatment with Geometric Shape/Outline Figure). A list of both sets of activities is found in Appendix A. Samples of investigator-constructed activities are also included in Appendix A.

Testing Instruments

The group administered form of the Prereading Skills Test, Visual Component (1975) was used as the measure of mastery of the skills in the study. The test has a visual and sound component, composed of items in the individually administered Prereading Skills Test (1975). The Visual Component is composed of three subtests (Letter Order, Letter Orientation and Word Detail), 16 items each and three sample items. A copy of the test can be found in Appendix B.

Mastery of the skills in the study was indicated by a score at or above 14 of 16 items correct on all three subtests in the Visual Component (87.5% correct). Children not scoring at least 87.5% correct on all three visual subtests were designated non-masters of the skills investigated.

Prior to use in this study, the group administered form of the Prereading Skills Test (1975) had been administered to approximately 250 kindergarten and first grade children attending Hawthorne, Midvale and Hoyt Elementary Schools in Madison, Wisconsin.[2]

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[2]The investogator would like to express gratitude to Mrs. Russert, Mrs. Marty, Mrs. Swinson, Mrs. McClure and their children for volunteering to participate in the test-try-out.

Results of the test try-out verified that the test met criteria which had proved useful in other group administered tests for young children.

The PRS Prereading Test (1975) was judged to be a valid measure of mastery of the skills in this study because 1) test items were identical in format to the task used as an index of skill mastery in this study, as defined on page 4, Chapter I; 2) items were selected by a rational, empirical process; and 3) items adequately represent the total population of possible items. Hoyte reliabilities of the PRS Prereading Test were .84 for Letter Order, .86 for Letter Orientation, and .84 for Word Detail (unpublished WRDC Memorandum, 1975).

Overall reading achievement was measured by (1) raw scores on the November and March administrations of the Vocabulary and Comprehension subtests of the Gates-MacGinitie Reading Test, Primary A, Forms 1 and 2 (1965), (2) total Vocabulary and Comprehension subtests, and (3) sum of the total raw scores on the Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965). Scores from the Metropolitan Reading Readiness Test were used as indices of reading readiness.

The Gates-MacGinitie Reading Test, Primary A, Form 1 and Form 2 (1965) were judged to be valid and reliable measures of overall reading ability as the testing tasks accurately reflected the objective of this study--sampling the child's ability to attend to the skills of this study in performances of overall reading ability.

The Vocabulary Subtest was composed of 48 items. The child was to circle one of four response choices that corresponded to a picture illustrating the meaning of one of these words. The response choices in beginning items were only slightly similar or confusing. Response choices became more similar in details and general appearances in concluding exercises.

The Comprehension Subtest sampled the child's ability to read and understand whole sentences and paragraphs. It contained 34 passages. The child was to mark one of four pictures that best illustrated the meaning of the Passage.

Alternate form reliabilities between Forms 1 and 2 of the test are .86 for the Vocabulary subtest and .83 for the Comprehension subtest while split-half reliabilities for the two subtests are .89 and .94 (Gates-MacGinitie, 1972, p.9).

Procedures

Implementation of this study involved the following dates and activities.

September 17 and September 24, 1975 - Inservice training sessions for the 15 reading specialists who volunteered to administer the PRS Prereading Skills Test (1975) and the Gates-MacGinitie Reading Test, Primary A, Forms 1 and 2 (1965) were given by the investigator. The purpose of the sessions was to present the objectives of the study as well as the relationship of the testing program to the objectives.

The schedule and procedures in administering both tests and questions concerning the role each specialist played for the duration of the study were also discussed.

On and between the dates of September 22 and September 30, 1975 the PRS Prereading Skills Test (1975) was administered to all children enrolled in the 42 selected classrooms. All tests were given by the investigator and 15 reading specialists. All testers had completed work for a Master's Degree with emphasis in reading methodology and had at least three years of prior teaching experience. The scores from these tests were used as measures of September prereading skill mastery.

September 25, 1975 - An inservice training session was conducted for teachers, reading specialists and principals involved in the study. Forty-three teachers, sixteen specialists and three principals attended. The inservice session was conducted by the investigator and was designed to: 1) explain the purpose of the study, 2) describe and distribute materials used in the study, 3) outline the responsibilities of teachers and specialists in the implementation of the study. Potential benefits of the study for children in participating classrooms were presented and questions concerning the study were raised. A Schedule for Teaching the Activities in the Experiment sheet was given to each teacher. On these sheets, teachers were to check each activity as it was completed and note any problems encountered during the instruction of that activity. Such notations served as aids in monitoring the period of systematic skill instruction. Additional monitoring was not attempted although correspondence between investigator and teacher was encouraged. During the instructional period,

six telephone calls and 22 individual or group letters to and from teachers and specialists were made and written. Eight letters were mailed to teachers and specialists following the period of systematic skill instruction.

Prior to September 29th, experimental and control treatments had been randomly assigned to the 42 classrooms. As shown in Table 2, Participating Teachers, Pupils, Subjects and Designated Socio-economic Level and Assignment of Each School Selected for the Study, four classrooms representing high, five classrooms representing middle and six classrooms representing low socio-economic communities were designated control classrooms. Five classrooms representing high socio-economic communities, six representing middle socio-economic communities and five representing low socio-economic communities were designated Treatment with Letter and Word Stimuli (TL). Three classrooms representing high socio-economic communities, four representing middle socioeconomic communities and four representing low socioeconomic communities were designated Treatment with Geometric Shapes and Outline Figures (TG).

Beginning September 29, 1975 and continuing until November 17, 1975 students in the 27 experimental classrooms received daily skill lessons, in addition to the activities of the regular reading program. The skill lessons were approximately 20 minutes in length. During the time used for systematic skill lessons in the experimental classes, reading orally to pupils in control classrooms was to have been done. Regular classroom activities were taken from

Lippincott, Houghton-Mifflin, Follett or Macmillian basal series.

November 18-24, 1975 - the Gates-MacGinitie Reading Test, Primary A, Form 1 or 2 (1965) was administered to all children in the study.

November 19-26, 1975 - The PRS Prereading Skills Test (1975) was readministered to all children in the 42 selected classrooms. The scores from this test were used as the measure of November prereading skill mastery.

On December 1, 1975 all teachers in experimental classrooms were to return the Schedule for Teaching the Activities in the Experiment Sheet. Twenty-one of the 27 teachers in experimental classrooms returned completed sheets. As seen in the example in Appendix C, teachers checked each completed activity and noted problems encountered during instruction. The six teachers who did not return the monitoring instrument were contacted and five reported to have completed all 35 activities as scheduled, one teacher did not and data from her class was eliminated from the study.

March 15-30, 1976 -- The PRS Prereading Skills Test (1975) was readministered to all children in the 42 selected classrooms. The scores from these tests were used as the measure of March prereading skill mastery. The Gates-MacGinitie Reading Test, Primary A, Form 1 or 2 (1965) was also readministered at this time.

At the end of each testing period tests were mailed to the investigator. Tests were hand-scored; raw scores and descriptive data were recorded on data sheets. Data on these sheets were transfered to keypunch coding sheets by Judy Suchman of the Wisconsin Research and Development Center for Cognitive Learning coding pool, a trained keypunch coder. Two professional keypunchers at the Wisconsin Research and Development Center for Cognitive Learning transposed the coded sheets to key punch cards. All cards were then verified for accuracy of transcription by a key punch verifier.

Data Analysis

To measure the effect of mastery on the reading achievement of children who do and do not master the prereading skills of letter order, letter orientation and word detail, two-tailed t-tests of differences between mean reading achievement scores of master and non-master groups were performed. Two-tailed t-tests were also done to examine differences between the mean ages of the master and non-master groups. When the difference between groups exceeded four weeks, an analysis of covariance was performed with age as the covariate on achievement. Comparisons and t-tests of differences in mean achievement were also made when the intervening variables of socio-economic level and ethnic background of master, and non-master, groups were equalized.

To determine if subjects in master, and non-master, groups were significantly different in relation to the intervening variables of

sex, ethnic background, age and socio-economic status, data concerning each of these factors were collected for each subject. To utilize this demographic data in more than a descriptive manner, data from each student were assigned the following interval rankings:

a) Sex - 1 = Male
2 = Female

b) Socio-economic level - 1 = Low
2 = Middle
3 = High

c) Ethnic background - 1 = Anglo
2 = Black
3 = Mexican-American
4 = Other

Means of the data were then computed and compared for significance of difference between master and non-master groups through a t-test of mean rankings.

Dependent measures for all analyses were the Vocabulary and Comprehension Subtests of the Gates-MacGinitie Reading Achievement Tests, Primary A, Forms 1 and 2 (1965) administered in November and March, total test scores on both of these tests, sum of Total scores on the November and March tests and the Metropolitan Reading Readiness Test (1969). The independent measure was a score at or above the criterion for mastery on the PRS Prereading Skills Test (1975).

To test Hypothesis 1, group means of the scores on dependent measures of reading achievement from all September masters and non-masters were compared. Two-tailed t-tests of differences of means were run. The

following seven comparisons between achievement scores of master and non-master subgroups were also made:

1) Anglo masters and non-masters from high socio-economic communities,

2) Black masters and non-masters from high socio-economic communities,

3) Anglo masters and non-masters from middle socio-economic communities,

4) Mexican Americans from middle socio-economic communities

5) Black masters and non-masters from low socio-economic communities

6) Anglo masters and non-masters from low socio-economic communities, and

7) Mexican Americans from low socio-economic communities.

To test Hypothesis 2, group means on the dependent measures of reading achievement from all September non-masters who became masters of the skills in November were compared to the September non-masters who did not master the skills in November. In addition to the comparison between the entire group of masters and non-masters, group achievement means of Anglo masters and non-masters from high SES communities, Anglo masters and non-masters from middle SES, Black masters and non-masters from middle SES, Mexican Americans from middle SES communities, Anglos from low SES communities, Black

students from low SES communities, Mexican American students from low SES communities were compared. Two-tailed t-tests of differences between achievement means of each of the eight sub-groups of November masters and non-masters were performed.

To test hypothesis 3, four comparisons of mean reading achievement scores were made. Scores from students who did not demonstrate mastery of the skills in September or November but did demonstrate mastery in March were compared to the scores from students who did not master the skills in September, November or March.

The four comparisons were between

1) all students who had not mastered the skills of this study until March and all students who never mastered the skills.

2) Anglo students from high SES communities who had not mastered the skills until March and Anglo students from high SES who never mastered the skills.

3) Anglo students from low SES communities who did not master the skills until March and Anglo students from low SES who never mastered the skills.

4) Black students from low SES communities who did not master the skills until March and Black students from low SES communities who never mastered the skills.

If the difference in mean age between masters and non-masters was greater than four weeks, an analysis of covariance was computed between achievement means of masters and non-masters with age as the

covariate. Differences in slopes between the masters and non-masters groups were computed to examine the homogeneity of the reading achievement scores of the two groups. Correlation coefficients between age and achievement and two-tailed t-tests were computed to determine the effect of mastery on reading achievement when age differences between masters and non-masters groups were eliminated.

To determine if the performance of students who do not consistently demonstrate mastery of the skills at all testing periods was more like the performance of masters or non-masters on measures of reading achievement, a statistical test of Hypothesis 4 was performed. The test statistic was a two-tailed t-test of a second difference of group means as described in the following formula:

$$\frac{(m_2 - m_3) - (m_1 - m_2)}{\frac{4}{n_2} \cdot s_2^2 + \frac{1}{n_1} \cdot s_1^2 + \frac{1}{n_3} \cdot s_3^2}$$

when m_1 = achievement scores of masters groups

m_2 = achievement scores of inconsistent masters and non-masters

m_3 = achievement scores of non-masters

n_1 = number of subjects who mastered at all testing times

n_2 = number of subjects who mastered at one or more testing times

n_3 = number of subjects who never mastered

S_1^2 = variance between achievement scores of masters groups

S_2^2 = variance between achievement scores of inconsistent masters

S_3^2 = variance between achievement scores of non-masters

To determine if the relationship between mastery of the three selected skills in this study and subsequent reading achievement is the same for children of low, middle and high socio-economic communities (Hypothesis 5), an analysis of covariance of raw scores on the PRS Prereading Skills Test and total scores from the November and March administration of the Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965) and sum of total scores of these two tests was performed. Coefficients of correlation between PRS Prereading Test score and Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 were computed and level of significance of the resulting r was determined.

To test Hypothesis 6, a test for stratified equality of proportions was performed. The equality of proportions test assessed whether the number of students exposed to systematic skill instruction from non-mastery to mastery or who maintained mastery was significantly greater than the number of students in control groups who changed from non-mastery to mastery or who maintained mastery. Probability of chance occurence as explanation for differences in proportions of subjects compared was assessed by a z-test of difference between the two proportions.

The statistic used to test Hypothesis 7 was identical to the statistic used in the test of Hypothesis 6, except that the students compared were those demonstrating change or maintenance of mastery following systematic instruction with letter/word as opposed to instruction with geometric shape/outline figure instructional stimuli.

Computer programs used for analysis were Minitab Welsh t-tests, Minitab Regression Analysis, and Fortran ISX Analysis of Covariance. The programs are available through the Madison Academic Computer Center, University of Wisconsin-Madison.

In the next chapter results from the discussion of the data of these analyses are given. Also contained in Chapter III is a presentation of the limitations in making inferences from the data. Concluding ChapterIII is a discussion of assumptions needed before generalizations of results to other populations can be made.

Summary, conclusions and implications of this study are presented in Chapter IV.

CHAPTER III

DISCUSSION OF RESULTS AND PRESENTATION OF LIMITATIONS OF STUDY

The purpose of this chapter is to present and discuss the results of tests of each hypothesis and to comment upon the limitations in statistical inference and generalizability of results of the these tests. Results are given in the following manner: restatement of hypothesis, notation of data used to test the hypothesis, discussion of the results of the tests and presentation of the limitations on statistical inferences from results. Limitations of generalizability of the results of this study to other populations or samples will be given as a separate and concluding subheading of this chapter.

Discussion of Results

Hypothesis 1: Mastery of letter order, letter orientation and word detail will significantly increase subsequent first-grade reading achievement when students who begin first grade with a mastery of letter order, letter orientation and word detail are compared to students who begin first grade without a mastery of the selected prereading skills.

Test of Hypothesis. The complexities of human learning prohibit placing credence in a one-variable cause-effect relationship. The multiple interrelationships and interactions in the learning process

place responsibility upon the researcher to examine the degree to which intervening factors affect any investigated relationship of one independent and one dependent variable. For this reason, investigations of differences between reading achievement of masters and non-masters were preceded by an examination of differences between groups in socioeconomic status, age, sex and ethnic background. If significant differences in any of these factors existed, the factors' effect was statistically controlled in investigations of the single effect of mastery and non-mastery on reading achievement.

As shown in Table 4, when subjects are grouped by time of mastery, socioeconomic level and ethnic background, 27 master and non-master groups are formed. Ideally, one should compare the master and non-masters in each of these 27 groups to determine the effect of mastery on achievement, controlling for the effect of socioeconomic level and ethnic background differences between master and non-master groups. Unfortunately only 18 comparisons were possible with ten of these compraisons involving very small sample sizes. Nine comparisons were not attempted:

1) Mexican-American masters and non-masters from high socioeconomic communities, exhibiting mastery or non-mastery in September;

2) Black masters and non-masters from high socioeconomic communities who exhibited mastery or non-mastery in September;

3) Mexican-American September non-masters, coming from high

Table 4

Classification of Subjects by Socio-economic Level of Community in Which They Live, by Ethnic Background, and by Time that Mastery of Letter Order, Letter Orientation and Word Detail Was Attained

		Anglo	Black	Mexican-American and Other	Total
September Masters and Non-Masters					
High SES:	M[1]	182	2	15	199
	NM	19	3	0	22
Middle SES:	M	106	18	20	144
	NM	43	14	13	70
Low SES:	M	49	25	38	112
	NM	25	66	29	120
September Non-Masters to November Masters and Non-Masters					
High SES:	M	14	2	0	16
	NM	5	1	0	6
Middle SES:	M	36	8	10	54
	NM	7	6	3	16
Low SES:	M	19	28	25	72
	NM	6	38	4	48
December Non-Masters to March Masters or Non-Masters					
High SES:	M	3	1	0	4
	NM	2	0	0	2
Middle SES:	M	7	5	2	14
	NM	0	1	1	2
Low SES:	M	3	14	3	20
	NM	3	24	1	28

[1] M denotes number of masters; NM denotes number of non-masters.

socioeconomic communities, who either did or did not master the skills in December

4) Black students from high socioeconomic communities who first demonstrated mastery in March and Black students from the same community who never demonstrated mastery;

5) Black students from middle socioeconomic communities who first demonstrated mastery in March and Black students from the same community who never demonstrated mastery;

6) Mexican-American students from high socioeconomic communities who first demonstrated mastery in March and Mexican-American students from the same community who never demonstrated mastery;

7) Anglo students from middle socioeconomic communities who first demonstrated mastery in March and Anglo students who never demonstrated mastery;

8) Mexican-American students from middle socioeconomic communities who first demonstrated [illegible] in March and Mexican-American students from the same community who never demonstrated mastery; and

9) Mexican-American students from low socioeconomic communities who first demonstrated mastery in March and Mexican-American students who never demonstrated mastery.

Data in Table 5 are the mean achievement scores of all September masters and September non-masters of letter order, letter orientation

TABLE 5

COMPARISONS BETWEEN ALL SUBJECTS WHO DID AND DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF THEIR FIRST GRADE YEAR ON MEASURES OF READING ACHIEVEMENT, SEX, RACE, AGE AND SOCIOECONOMIC LEVEL[1]

	Attained Mastery of Letter Order, Letter Orientation and Word Detail by Sept. (N = 457)		Did Not Attain Mastery of Letter Order, Letter Orientation and Word Detail by Sept. (N = 218)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.	25.02	11.0	14.25	6.72	15.63	.00001
Nov. Comp.	11.34	7.11	7.34	4.76	8.63	.00001
Nov. Total	36.35	16.7	21.46	9.47	14.72	.00001
March Voc.	36.48	10.2	22.77	10.1	16.44	.00001
March Comp.	19.96	8.95	10.75	6.49	15.15	.00001
March Total	56.43	17.8	33.45	15.4	17.21	.00001
M & M Sum	94.80	52.4	54.86	22.4	13.85	.00001
Metropolitan Reading Readiness Test	75.36	14.2	55.73	22.7	11.73	.00001
Intervening Variables						
Sex: M=1; F=2	1.51	.50	1.46	.50	1.30	.1957
Race: A=1; B=2; MA=3; O=4	1.43	.78	1.78	.75	-5.56	.00001
Age	6.50	.42	6.39	.37	3.52	.0005
SES: L=1; M=2; H=3	2.19	.80	1.54	.70	10.93	.00001

[1] Means for Sex, Race, Age and Socioeconomic Level were derived by ranking the descriptive data arbitrarily, as follows:
Males=1; Anglo Ethnic Groups=1; Mexican American Ethnic Groups=3;
Females=2; Black Ethnic Groups=2; Other Minority Ethnic Groups=4;
Low Socioeconomic=1; Middle Socioeconomic=2; High Socioeconomic=3.

and word detail. Scores were obtained from the November Vocabulary Subtest, November Comprehension Subtest, November Total test score, March Vocabulary, March Comprehension, March Total test score, sum of total November and March test scores and scores from the Metropolitan Reading Readiness Test (1969). Two-tailed t-tests between mean scores of masters and non-masters groups revealed that the difference between the achievement of the two groups was significant ($p < .00001$). September masters and non-masters differed significantly in age, socioeconomic status and ethnic background. To [illegible]te the effect of these variables, additional tests were made. Comparisons were between achievement of September masters and non-masters of comparable age, socioeconomic status and ethnic background.

As reported in Table 6, Anglo subjects in high socioeconomic communities who mastered the skills of this study by September of first grade scored significantly higher on all measures of reading achievement (N = 182 masters and 20 non-masters).

Since data in Table 7 is based on an N equal to 5, results should be interpreted with extreme caution. Results reveal that the two students mastering the prereading skills scored higher on all measures of reading achievement but the difference between the achievement of these two students and the achievement scores of the three non-masters was not statistically significant.

TABLE 6

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN HIGH SOCIOECONOMIC COMMUNITIES WHO MASTERED AND WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF THEIR FIRST GRADE YEAR[1]

	Sept. Masters (N = 182)		Sept. Non-Masters (N = 20)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	29.61	10.8	18.60	8.3	5.47	.00001
Nov. Comp.[2]	13.92	8.2	8.80	5.8	3.57	.0014
Nov. Total	43.53	18.0	27.40	12.1	5.34	.00001
March Voc.[2]	41.65	6.57	32.65	9.53	4.12	.0005
March Comp.[2]	23.42	9.28	18.75	9.26	2.14	.043
March Total	65.01	14.0	50.90	17.6	3.47	.0023
N & M Sum	113.55	70.8	78.30	26.6	4.44	.0001
Metropolitan[3] Reading Readiness Test	77.70	10.4	68.80	13.3	2.88	.009

[1] Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.40; Non-masters group mean age was 6.33. Masters on the average were 3.6 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3] Total raw score on Metropolitan Reading Readiness Test (1969).

TABLE 7

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF BLACK STUDENTS IN HIGH SOCIOECONOMIC COMMUNITIES WHO MASTERED AND WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF THEIR FIRST GRADE YEAR[1]

	Sept. Masters (N = 2)		Sept. Non-Masters (N = 3)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	29.50	10.6	18.67	5.13	1.34	.3113
Nov. Comp.[2]	16.00	7.0	9.67	5.86	1.05	.3712
Nov. Total	48.50	17.7	28.33	11.0	1.23	.3452
March Voc.[2]	42.50	.70	36.33	16.8	.636	.5899
March Comp.[2]	19.50	13.4	16.33	12.2	.268	.8063
March Total	62.00	14.1	52.67	28.7	.482	.6628
N & M Sum	107.50	31.8	81.00	39.7	.825	.4698
Metropolitan[3] Reading Readiness Test	77.5	10.6	65.67	15.5	1.01	.3855

[1]Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.30; Non-masters group mean age was 6.26. Masters on the average were 2 weeks older than non-masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

Because the mean age of the 106 Anglo students from middle socioeconomic communities who mastered the prereading skills in September was six weeks above the mean age of the 43 non-masters, it was deemed necessary to control for the plausible effect of age difference on differences in reading achievement. To adjust means to account for differences in ages between groups, an analysis of covariance was run. This analysis followed the two-tailed tests of differences between reading achievement scores of the two groups. As reported in Table 8, the results of the analysis reveal that Anglo students from middle socioeconomic communities who mastered letter order, letter orientation and word detail by September of first grade scored significantly higher than Anglo non-masters on all measures of reading achievement ($p < .001$).

While master and non-master groups in the next two comparisons are almost equal in number, sample sizes are small. Differences in reading achievement in these two comparisons may not reflect normal population variations. Differences might reflect idiosyncracies in individual student performances. For this reason, differences between the reading achievement, as reported in Tables 9 and 10, should be interpreted cautiously.

In the first comparison (Table 9), 18 Black students from middle socioeconomic communities who mastered the skills in September outperformed 14 Black students of the same socioeconomic level who had not mastered the skills at that time. Scores were statistically significant

TABLE 8

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN MIDDLE SOCIOECONOMIC COMMUNITIES WHO DID AND DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF FIRST GRADE YEAR[1]

Dependent Measure	Masters of LOLOWD in September (N=106) Mean(Y_1)	S.D.	Non-Masters of LOLOWD in September (N=43) Mean(Y_2)	S.D.	Adjusted SS Y_1	Adjusted SS Y_2	df/145 F Ratio for Diff. of Slopes	Correlation Coefficients Bet. Age and Ach. Masters/N-M		P Value for r Bet. Age and Ach. Masters/N-M		T for Unadj. Y_1-Y_2	P Value for Unadj. Y_1-Y_2 $\alpha \leq .05$	df/146 F Ratio for Adj. Y_1-Y_2	P Value for Adj. Y_1-Y_2 $\alpha \leq .05$
Nov. Voc.[2]	21.22	9.84	16.00	7.81	10160	2564	.089	.03	-.02	NS	NS	6.690	.0000	35.64	.001
Nov. Comp.[2]	10.62	6.49	7.51	4.93	4419	1021	.448	-.001	.15	NS	NS	3.17	.002	7.51	.01
Nov. Total	36.82	14.5	23.51	11.5	22090	5562	.009	.02	.04	NS	NS	5.91	.0000	27.65	.001
March Voc.[2]	36.35	9.68	24.47	10.6	27844	10146	.213	-.09	-.007	NS	NS	6.34	.0000	49.32	.001
March Comp.[2]	20.55	7.60	12.16	5.89	6070	1458	.013	-.05	-.10	NS	NS	7.21	.0000	42.48	.001
March Total	56.93	16.3	36.63	15.5	27845	10146	.213	-.09	-.001	NS	NS	7.13	.0000	49.32	.001
N & M Sum	93.58	28.8	60.14	25.0	87154	26179	.02	-.04	.02	NS	NS	7.08	.0000	43.79	.001
Metropolitan[3] Reading Readiness Test	75.80	13.4	62.26	20.0	18821	16738	2.63	.08	.28	NS	.01	4.092	.0001	20.86	.001
Age	6.56	.395	6.44	.399											

[1] An analysis of covariance was run to adjust means for differences in ages between masters and non-masters groups. Masters on the average were 6 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1969).

[3] Total raw score on Metropolitan Reading Readiness Test (1965).

TABLE 9

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF BLACK STUDENTS IN MIDDLE SOCIOECONOMIC COMMUNITIES WHO MASTERED OR WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF THEIR FIRST GRADE YEAR[1]

	Sept. Masters (N = 18)		Sept. Non-Masters (N = 14)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	18.44	5.35	11.93	4.62	3.69	.001
Nov. Comp.[2]	9.39	5.94	4.86	5.08	2.32	.029
Nov. Total	27.83	5.80	16.79	8.29	4.25	.0004
March Voc.[2]	31.11	9.90	24.07	8.95	2.11	.045
March Comp.[2]	12.67	5.46	11.14	4.99	.823	.4186
March Total	43.78	14.2	35.21	12.5	1.81	.081
N & M Sum	71.61	16.5	52.00	16.3	3.45	.002
Metropolitan[3] Reading Readiness Test	63.78	8.78	50.79	12.8	3.26	.004

[1] Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.56; Non-masters group mean age was 6.49. Masters on the average were 3.6 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3] Total raw score on Metropolitan Reading Readiness Test (1969).

on all measures except for scores on the March Comprehension Sub-test (p=.4186) and March Total test scores (p=.08). In the second comparison (Table 10), 20 Mexican-American students from middle socioeconomic communities, mastering the skills in September outperformed 13 non-masters on all measures of reading achievement except on the November Comprehension Sub-test (mean of masters = 7.35; mean of non-masters - 9.77). The difference in achievement between masters and non-masters in the comparison was significant on the March Vocabulary Sub-test (p = .0198), March Comprehension Sub-test (p - .007), March Total test score (p - .007) and November and March sum of Total test scores (p = .019).

Adequate sample sizes were available for all three comparisons of low socioeconomic groups. In each of these three comparisons, masters were more than one month older than non-masters. For this reason, following a t-test of differences between reading achievement means, unadjusted for differences in ages, an analysis of covariance between groups was run. Age was the covariate on achievement scores. As shown in Table 11, 49 Anglo students from low socioeconomic communities who mastered the prereading skills in September outperformed 25 Anglo students who had not mastered at that time on all measures of reading achievement except for scores on the November Comprehension Sub-test (unadjusted means 8.94 and 8.08) and on the Metropolitan Reading Readiness Test (unadjusted means 80.69 and 65.08). Difference between

TABLE 10

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF MEXICAN AMERICAN STUDENTS IN MIDDLE SOCIOECONOMIC COMMUNITIES WHO MASTERED OR WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL BY SEPTEMBER OF THEIR FIRST GRADE YEAR[1]

	Sept. Masters (N = 20)		Sept. Non-Masters (N = 13)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	18.15	7.75	15.23	6.64	1.15	.26
Nov. Comp.[2]	7.35	4.43	9.77	7.77	-1.02	.32
Nov. Total	25.50	9.73	22.85	10.2	.744	.47
March Voc.[2]	29.05	11.1	21.15	7.0	2.51	.0198
March Comp.[2]	16.70	7.51	9.92	5.51	2.99	.007
March Total	45.75	17.7	30.85	11.2	2.96	.007
N & M Sum	72.2	22.6	53.69	19.3	2.51	.019
Metropolitan[3] Reading Readiness Test	61.50	12.5	51.23	14.8	2.06	.052

[1]Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.46; Non-masters group mean age was 6.50. Non-masters on the average were 2 weeks older than masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw scores on Metropolitan Reading Readiness Test (1969).

TABLE 11

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO DID AND DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF FIRST GRADE YEAR[1]

Dependent Measure	Masters of LOLOWD In September (N=49) Mean(Y_1)	S.D.	Non-Masters of LOLOWD In September (N=25) Mean(Y_2)	S.D.	Adjusted SS Y_1	Adjusted SS Y_2	df/67 F Ratio for Diff. of Slopes	Correlation Coefficients Bet. Age and Ach. (N=49) Masters/N-M	(N=22)	F Value for r Bet. Age and Ach. Masters/N-M		t for Unadj. Y -Y 1 2	P Value for Unadj. Y_1-Y_2 α = .05	df/68 F Ratio for Adj. Y-Y 1 2	P Value for Adj. Y -Y 1 2 α = .05
Nov. Voc.[2]	22.41	8.83	14.96	8.16	3749	1539	1.629	.14	.42	NS	.01	3.61	.0008	8.48	.005
Nov. Comp.[2]	8.94	5.26	8.08	3.24	1329	215	.381	.02	.21	NS	NS	.865	.39	.057	NS
Nov. Total	31.41	13.2	23.04	10.0	8408	2358	1.26	.08	.40	NS	.01	3.04	.004	5.10	.05
March Voc.[2]	34.31	10.1	23.32	10.5	4348	2453	3.93	.01	.47	NS	.01	4.32	.0001	13.470	.001
March Comp.[2]	18.77	8.34	11.48	4.65	3338	670	.385	.04	.25	NS	.05	4.13	.0001	7.89	.01
March Total	52.55	17.6	34.8	14.5	14892	4030	3.92	.02	.59	NS	.01	4.62	.0000	11.104	.005
N & M Sum	84.12	28.7	56.92	19.6	39579	7972	2.670	.06	.06	NS	.01	4.80	.0000	11.23	.025
Metropolitan[3] Reading Readiness Test	80.67	15.3	65.08	22.8	11269	8129	.429	.24	-.004	.05	NS	3.03	.004	3.65	.056
Age	6.67	.394	6.57	.327								1.12	.27		

[1] An analysis of covariance was run to adjust means for differences in ages between masters and non-masters groups. Masters on the average were 5 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary B, Forms 1 and 2 (1969).

[3] Total raw score on Metropolitan Reading Readiness Test (1965).

mean scores of non-masters and masters on these two measures was not significant ($p = .39$ and $.056$).

As shown in Table 12, 25 Black students from low socioeconomic communities who mastered the prereading skills by September outperformed 66 non-masters on all reading achievement measures. The differences in performances of the groups was statistically significant on November Total test scores ($p = .05$), on the March Comprehension test scores ($p = .001$), March Total test scores ($p = .001$) and on the Metropolitan Reading Readiness Test ($p < .001$).

Similarly, as shown in Table 13, the 38 Mexican-American students from low socioeconomic communities who mastered the skills by September outperformed the 29 non-masters on all measures of reading achievement. The difference between the scores of the masters and non-masters groups was statistically significant on the March Vocabulary test scores ($p = .001$), March Comprehension test scores ($p = .01$), March Total test scores ($p = .01$), sum of November and March Total test scores ($p = .01$) and the Metropolitan Reading Readiness Test scores ($p = .025$).

Discussion of Hypothesis 1. Results of the 64 t-tests of difference between achievement scores of September masters and September non-masters reveal that masters significantly outperformed non-masters on all but 20 of the tests. Of the 20 t-tests resulting in non-significance, two resulted in p values of .052 and .056. The only instances where non-masters scored higher than masters were

TABLE 17

COMPARISONS OF MEAN READING ACHIEVEMENT SCORES OF BLACK STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO DID AND DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF FIRST GRADE YEAR[1]

Subtest & Measure	Masters of LOLOSD in September (N=75) Mean(Y_1)	S.D.	Non-Masters of LOLOWD in September (N=69) Mean(Y_2)	S.D.	Adjusted SS Y_1	Adjusted SS Y_2	df/87 F Ratio for Diff. of Slopes	Correlation Coefficients Bet. Age and A-h. Master	Non-M	P Value for r Bet. Age and A-h. Master	Non-M	T for Unadj. Y_1-Y_2	P Value for Unadj. Y_1-Y_2 <.05	df/88 F Ratio for Adj. Y_1-Y_2	P Value for Adj. Y_1-Y_2 <.05
Nov. Voc.[2]	15.12	7.67	11.55	7.45	1413	3604	9.09	-.08	.75	NS	.01	.993	.32	.535	NS
Nov. Comp.[2]	8.08	4.73	6.82	4.50	536	1314	.117	.03	.27	NS	.05	1.15	.25	1.198	NS
Nov. Total	23.40	10.7	19.41	6.91	2746	3108	.001	-.03	-.05	NS	NS	1.73	.09	4.40	.05
March Voc.[2]	24.44	10.7	19.53	9.71	2746	3232	.032	-.02	-.16	NS	NS	2.03	.04	3.82	.10
March Comp.[2]	12.68	6.34	7.82	5.28	936	1814	.445	.15	.56	NS	.01	2.71	.008	8.738	.001
March Total	36.12	16.4	26.39	12.0	39059	9348	1.31	.20	.008	NS	NS	2.706	.008	9.34	.001
N & M Sum	59.52	26.2	49.96	35.7	16498	82865	10.45	.12	.86	NS	.01	1.40	.17	1.24	NS
Metropolitan[3] Reading Readiness Test	64.92	16.5	42.15	20.0	6525841	26126481	1.357	.19	-.15	NS	NS	5.77	.0000	28.451	.001
Age	6.43	.49	[illegible]	.86								.811	.42		

[1] An analysis of covariance was run to adjust means for differences in ages between masters and non-masters groups. Masters on the average were 6 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1969).

[3] Total raw score on Metropolitan Reading Readiness Test (1965).

TABLE 13

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF MEXICAN-AMERICAN STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO DID AND DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER OF FIRST GRADE YEAR[1]

Dependent Measure	Masters of LOLOWD in September (N=38) Mean(Y_1)	S.D.	Non-Masters of LOLOWD in September (N=29) Mean(Y_2)	S.D.	Adjusted SS Y_1	Adjusted SS Y_2	df/63 F Ratio for Diff. of Slopes	Correlation Coefficients Bet. Age and Ach. Masters/N-M		P Value for r Bet. Age and Ach. Masters/N-M		T for Unadj. Y_1-Y_2	P Value for Unadj. Y_1-Y_2 α .05	df/64 F Ratio for Adj. Y_1-Y_2	P Value for Adj. Y_1-Y_2 α .05
Nov. Voc.[2]	14.55	7.72	11.83	5.78	2205	936	1.28	.17	.10	NS	NS	1.65	.10	1.69	NS
Nov. Comp.[2]	8.18	3.58	7.24	2.85	474	287	.970	.42	.21	.01	NS	1.20	.24	.309	NS
Nov. Total	22.74	9.63	19.07	6.16	3433	1062	.467	.29	.19	.05	NS	1.89	.06	1.76	NS
March Voc.[2]	27.16	10.2	19.62	8.98	2852	1502	.637	.47	.34	.01	.01	3.20	.002	12.24	.001
March Comp.[2]	13.52	5.95	9.90	4.62	1308	597	.064	.09	.03	NS	NS	3.04	.004	7.44	.01
March Total	41.24	15.5	29.52	12.7	8929	4545	.073	.08	-.008	NS	NS	3.39	.001	9.803	.01
N & M Sum	63.97	23.0	48.57	17.3	19555	8367	.207	.16	.06	NS	NS	3.13	.003	7.37	.01
Metropolitan[3] Reading Readiness Test	75.21	22.4	60.24	31.0	18526	26827	.542	-.08	-.20	NS	NS	2.20	.03	6.13	.025
Age	6.64	.382	6.42	.33								1.82	.07		

[1] An analysis of covariance was run to adjust means for differences in ages between masters and non-masters groups. Masters on the average were 8 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1969).

[3] Total raw score on Metropolitan Reading Readiness Test (1965).

in comparisons of achievement of the two masters and three non-masters reported on Table 7. On the basis of the tests of Hypothesis 1, Hypothesis 1 is not rejected.

Limitations of Inference. The following limitation applies equally to Hypotheses 2, 3, 4 and 5. Random Sampling is usually a necessary prerequisite for drawing valid inferences from a two-tailed t-test. Subjects were not randomly assigned to comparison groups in which this statistic was used. Rather assignment to comparison groups was made on the basis of ability to perform visual discrimination tasks to a criterion level designated mastery. Such an ability, in the most abstract sense of the term, might be considered to be randomly assigned. That is, it might be argued that the ability to master the visual discrimination tasks of this study has been "randomly" assigned to some individual subjects. Since placement in a comparison group is made on the bases of the presence or absence of this particular "randomly" assigned ability, it might be argued that subjects themselves have been randomly assigned to comparison groups. Whether this abstract conceptualization of random assignment establishes a legitimate "random population" or not was not established. The abstract argument does not, however, alleviate the fact that placement of subjects in comparison groups was not made through a procedure of literal random assignment. Because such assignment was not made sample selection bias may be relected in the results of this study.

Two conditions of the study reduce the possiblity that sample bias significantly affected results obtained. Subjects in this study adequately represented the original population of 1,068 first grade students from which the subjects came. Secondly, when interpretations of the data were made, results involving less than 30 subjects were interpreted cautiously.

Realizing that non-randomization violates one of the assumptions needed for selection of a two-tailed t-test as a statistical measure, support for such a selection may be needed. First, the t-test is the statistic most applicable for determining rejection or non-rejection of an hypothesis involving differences in two sets of data from the same population, as was the condition of the Hypotheses in this study. Secondly, the necessary assumption that population distribution on the dependent variable is normal was met by the scores on the Gates Reading Achievement Test (1965). Data of this study met a third assumption for use of t-test statistic: examination of the standard deviations of the comparison groups, as well as the non-significant p values on differences between slopes of the eight sets of data compared in the analysis of covariance, made it reasonably safe to assume that the variances for the populations compared were equal. Lastly, while use of the non-parametric Mann-Whitney U-Test was a viable alternative to the t-test, most sample sizes exceed the limit of n = 20, whereby the U-Test converts to a z-test, automatically utilizing the normal curve table. Since sample sizes were large, the difference in strength between the U and t-tests

made the t-test a more desirable measure, realizing in this selection that literal non-randomization is a condition of this study.

Hypothesis 2: Mastery of letter order, letter orientation and word detail will significantly increase subsequent first-grade reading achievement when students who entered first grade without mastery of the selected skills but who attained mastery by November are compared to students who began first grade without a mastery of the selected prereading skills and who do not attain mastery by November.

Test of Hypothesis 2. Data in Table 14 are the mean reading achievement scores of all subjects who did not attain mastery of letter order, letter orientation and word detail by September and who either attained or did not attain mastery in November of their first grade year. The t-test between means on the dependent measures revealed that difference between the means was significant at $p \leq .00001$. The t-test of difference of the November Vocabulary Sub-test scores produced a p value of .001. No significant difference exists between masters and non-masters on measures of sexual, racial or socioeconomic composition of groups. There was a significant difference between groups in mean age ($p = .0028$).

To block for the effect of age on the group means, further tests of Hypothesis 2 were made and are reported in Tables 15, 16, 17, 18, 19 20 and 21. In all seven of these tests, students compared

TABLE 14

COMPARISONS BETWEEN ALL SUBJECTS WHO DID NOT ATTAIN MASTERY OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL BY SEPTEMBER AND WHO EITHER ATTAINED OR DID NOT ATTAIN MASTERY IN NOVEMBER OF THEIR FIRST GRADE YEAR ON MEASURES OF READING ACHIEVEMENT, SEX, RACE, AGE AND SOCIOECONOMIC LEVEL[1]

	Attained Mastery of Letter Order, Letter Orientation and Word Detail in Nov. (N = 145)		Did Not Attain Mastery of Letter Order, Letter Orientation and Word Detail in Nov. (N = 73)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.	15.15	7.51	12.47	4.29	3.35	.001
Nov. Comp.	8.33	4.78	5.37	4.06	4.78	.00001
Nov. Total	23.29	10.1	17.84	6.80	4.72	.00001
March Voc.	25.131	10.2	18.07	7.94	5.61	.00001
March Comp.	12.43	6.45	7.41	5.16	6.22	.00001
March Total	37.47	15.3	25.48	12.2	6.28	.00001
N & M Sum	60.69	22.7	43.27	16.5	6.48	.00001
Metropolitan Reading Readiness Test	62.32	22.3	42.64	17.1	7.22	*.00001
Intervening Variables						
Sex: M=1; F=2	1.48	.50	1.41	.50	1.00	.316
Race: A=1; B=2; MA=3; O=4	1.75	.87	1.84	.60	-.87	.393
Age	6.44	.37	6.29	.34	3.05	.0028
SES: L=1, M=2; H=3	1.60	.69	1.42	.64	1.85	.0663

*Both groups were non-masters at time scores were obtained.

[1]Means for Sex, Race, Age and Socioeconomic Level were derived by ranking the descriptive data arbitrarily, as follows:
Males=1; Anglo Ethnic Groups=1; Mexican American Ethnic Groups=3;
Females=2; Black Ethnic Groups=2; Other Minority Ethnic Groups=4;
Low Socioeconomic=1; Middle Socioeconomic=2; High Socioeconomic=3.

were from similar ethnic and socioeconomic backgrounds. The first five of these comparisons were made between groups that included fewer than ten subjects. For this reason, results of the comparisons should be interpreted cautiously.

As shown in Table 15, 14 Anglo students from high socioeconomic communities who were non-masters of the selected skills in September but who mastered the skills by November of their first grade year made significantly higher scores on six of the eight achievement measures than did the five non-masters. The scores obtained from the masters group on the Metropolitan Readiness Test (1969) were not significantly higher than the November non-masters group, but at the time scores were obtained both groups were non-masters.

As shown in Table 16, Anglo masters outperformed Anglo non-masters on all measures of reading achievement with the difference between master and non-master groups being significant on the November Comprehension Sub-test ($p = .03$) and November Total test scores ($p = .04$). Data in Table 17, based on an N of eight and six, respectively, for masters and non-masters, indicate that non-masters from middle socioeconomic communities outperformed the eight Black masters from middle socioeconomic communities on all measures of achievement, except on the Metropolitan Reading Readiness Test (1969), which was taken at a time when all subjects were non-masters. The higher performance of non-master students was significantly higher on the

TABLE 15

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN HIGH SOCIOECONOMIC COMMUNITIES WHO WERE NON-MASTERS OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS BY NOVEMBER OF THEIR FIRST GRADE YEAR[1]

	Nov. Masters (N = 14)		Nov. Non-Masters (N = 5)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	19.57	9.25	15.00	4.58	1.42	.19
Nov. Comp.[2]	10.71	5.72	5.20	2.39	2.96	.02
Nov. Total	30.29	13.3	20.20	5.40	2.35	.0509
March Voc.[2]	36.36	6.95	20.40	4.10	6.12	.0005
March Comp.[2]	22.86	7.38	8.20	5.17	4.82	.0019
March Total	59.21	12.9	28.6	7.30	6.44	.0004
N & M Sum	89.5	22.7	48.8	11.3	5.14	.0013
Metropolitan[3] Reading Readiness Test	69.43	11.5	61	10.4	1.50	*.18

[1] Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.32; Non-masters group mean age was 6.38. Non-masters on the average were 3 weeks older than masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3] Total raw score on Metropolitan Reading Readiness Test (1969).

*Both groups were non-masters at time scores were obtained.

TABLE 16

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN MIDDLE SOCIOECONOMIC COMMUNITIES WHO HAD NOT MASTERED LETTER, ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO DID OR DID NOT MASTER THESE SKILLS BY NOVEMBER OF THEIR FIRST GRADE YEAR[1]

	Sept. Masters (N = 36)		Sept. Non-Masters (N = 7)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	16.78	7.99	12	5.69	1.89	.08
Nov. Comp.[2]	8.22	4.82	3.86	3.98	2.56	.03
Nov. Total	25	11.5	15.86	8.93	2.36	.04
March Voc.[2]	25.27	10.4	20.27	11.8	1.05	.33
March Comp.[2]	12.58	5.6	10	7.3	.89	.40
March Total	37.86	14.8	30.29	18.8	1.00	.35
N & M Sum	62.86	24.2	46.14	26.1	1.57	.16
Metropolitan[3] Reading Readiness Test	64.25	19.5	52	20.7	1.44	*.19

[1]Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.45; Non-masters group mean age was 6.40. Masters on the average were 2 weeks older than non-masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

*Both groups were non-masters at time scores were obtained.

TABLE 17

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF BLACK STUDENTS IN MIDDLE SOCIOECONOMIC COMMUNITIES WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO DID OR DID NOT MASTER THESE SKILLS IN NOVEMBER OF THEIR FIRST GRADE YEAR[1]

	Nov. Masters (N = 8)		Nov. Non-Masters (N = 6)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	9.6	3.70	15.0	4.05	-2.54	.03
Nov. Comp.[2]	3.4	4.81	6.8	5.1	-1.28	.23
Nov. Total	13.0	6.37	21.8	8.3	-2.17	.06
March Voc.[2]	23.6	8.07	24.6	10.8	-.199	.85
March Comp.[2]	9.3	4.8	13.6	4.32	-1.80	.11
March Total	32.9	11.2	38.3	14.4	-.770	.46
N & M Sum	45.9	14.9	60.2	15.5	-1.74	.12
Metropolitan[3] Reading Readiness Test	52.3	8.71	48.8	17.9	.435	*.68

*Both groups were non-masters at time scores were obtained.

[1]Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.52; Non-masters group mean age was 6.45. Masters on the average were 3.6 weeks older than non-masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

November Vocabulary Test (p = .03).

Based on a total sample of 13 with ten masters and 3 non-masters, results reported in Table 18 reveal that the Mexican-American subjects from middle socioeconomic communities outperformed non-masters on all measures of reading achievement with the scores on the sum of November and March Total test scores and the scores on the Metropolitan Reading Readiness Test (1969) being statistically significant at p = .048 and p = .025, respectively. Both groups were non-masters at the time the Metropolitan Reading Readiness Test was given.

As previously stated, the four comparisons just reported and the following comparison were not based on large sample sizes. Definitive statements concerning the representativeness of the results for the populations from which the sample was taken should not be made. Of the 25 Anglo students from low socioeconomic communities who had not mastered the prereading skills in September, 19 mastered in November and were compared to the six Anglo students who did not master in November. This comparison revealed that masters outperformed non-masters on all measures of reading achievement except for the November Vocabulary Sub-test (mean of non-masters was 15.0; mean of masters was 14.9). Results of all tests in this comparison are reported in Table 19.

Results reported in Table 20 are based upon a total sample of 66, with 28 subjects being masters and 38 being non-masters. Because the mean age of the 28 Black November masters was 20 weeks

TABLE 18

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF MEXICAN AMERICAN STUDENTS FROM MIDDLE SOCIOECONOMIC COMMUNITIES WHO WERE NON-MASTERS OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS BY NOVEMBER OF THEIR FIRST GRADE YEAR[1]

	Nov. Masters (N = 10)		Nov. Non-Masters (N = 3)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	17.4	5.6	8.00	4.6	2.95	.0599
Nov. Comp.[2]	11.7	7.7	3.3	4.2	2.45	.09
Nov. Total	26.3	8.1	11.3	8.4	2.73	.07
March Voc.[2]	22.4	7.5	17.0	2.7	1.91	.15
March Comp.[2]	11.4	4.6	5.0	6.2	1.64	.24
March Total	33.5	11.1	22.0	6.6	2.23	.11
N & M Sum	59.8	17.7	33.3	3.8	4.4	[illegible]
Metropolitan[3] Reading Readiness Test	56.2	13.0	34.6	5.51	4.15	[illegible]

[1] Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.51; Non-masters group mean age was 6.47. Masters on the average were 3.6 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3] Total raw score on Metropolitan Reading Readiness Test (1969).

*Both groups were non-masters at time scores were obtained.

TABLE 19

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO WERE NON-MASTERS OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS BY NOVEMBER OF THEIR FIRST GRADE YEAR[1]

	Nov. Masters (N = 19)		Nov. Non-Masters (N = 6)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	14.9	9.25	15.0	3.5	-.02	.98
Nov. Comp.[2]	8.2	3.45	7.8	2.7	.238	.82
Nov. Total	23.1	11.4	22.8	3.2	.09	.93
March Voc.[2]	24.5	10.7	19.5	9.8	1.07	.31
March Comp.[2]	12.1	6.2	9.5	2.7	1.45	.18
March Total	36.6	15.0	29.0	12.2	1.26	.24
N & M Sum	59.7	21.0	51.3	13.9	.99	.35
Metropolitan[3] Reading Readiness Test	71.1	21.3	46.0	17.3	2.93	*.02

[1]The mean ages of masters and non-masters groups were the same. Mean age was 6.5 years.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

*Both groups were non-masters at time scores were obtained.

TABLE 20

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF BLACK STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS IN NOVEMBER OF FIRST GRADE YEAR[1]

Dependent Measure	Masters of LOLOWD in November (N=23) Mean(Y_1)	S.D.	Non-Masters of LOLOWD in November (N=38) Mean(Y_2)	S.D.	Adjusted SS Y_1	Adjusted SS Y_2	df/62 F Ratio for Diff. of Slopes	Correlation Coefficients Bet. Age and Ach. Masters/N-M		P Value for r Bet. Age and Ach. Masters/N-M		T for Unadj. Y_1-Y_2	P Value for Unadj. Y_1-Y_2 $\alpha \leq .05$	df/63 F Ratio for Adj. Y_1-Y_2	P Value for Adj. Y_1-Y_2 $\alpha \leq .05$
Nov. Voc.[2]	15.50	10.7	12.1	3.07	3069	350	5.74	.80	.02	.01	NS	1.64	.11	.554	NS
Nov. Comp.[2]	9.11	3.53	5.13	4.42	3367	722	2.51	.23	.29	NS	.05	4.06	.0001	12.39	.001
Nov. Total	22.36	7.13	17.24	5.96	13724	13129	2.768	-.27	.22	.05	NS	3.09	.003	11.35	.005
March Voc.[2]	24.32	10.3	16.0	6.37	2852	1502	.637	.47	.34	.01	.01	3.78	.004	12.24	.001
March Comp.[2]	10.50	5.27	5.84	4.40	749	715	2.07	.65	.41	.01	.01	3.80	.003	11.24	.005
March Total	32.57	12.1	21.84	9.77	3959	3533	7.20	-.26	.41	.05	.01	3.85	.003	16.45	.001
N & M Sum	64.71	49.0	39.08	14.2	64812	7459	3.20	.90	.38	.01	.01	2.687	.01	7.83	.01
Metropolitan[3] Reading Readiness Test	47.60	23.7	38.13	16.0	15207	9472	.757	-.30	.07	.05	NS	1.83	.07*	5.34	.025*
Age	6.54	1.25	6.15	.298								1.593	.119		

*Both groups were non-masters at time test scores were obtained.

[1] An analysis of covariance was run to adjust means for differences in ages between masters and non-masters groups. Masters on the average were 20 weeks older than non-masters.

[2] Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1969).

[3] Total raw score on Metropolitan Reading Readiness Test (1965).

above the mean age of the 38 Black non-masters, an analysis of covariance was performed on the data to control for the effect of age differences between groups on reading achievement. When p values for the F-ratio of the age-adjusted means were computed, results revealed that mean scores from masters were significantly higher than scores from non-masters on all achievement measures except on scores from the November Vocabulary Sub-test ($p = .11$). Noting the standard deviation of scores in the masters group may explain the statistical non-significance of differences between masters and non-masters' scores on this sub-test.

As a final test of Hypothesis 2, 25 Mexican-American students from low socioeconomic communities who first mastered the skills of this study in November were compared to the four Mexican-American students who had not mastered the skills by November (Table 21). The mean score of the 25 masters was higher than the mean score of the non-masters on all achievement measures except the mean score of the November Vocabulary Sub-test (masters mean = 11.8; non-masters mean = 12.0). The difference between means on this sub-test was not statistically significant ($p = .97$).

Discussion of Hypothesis 2. In total, 56 two-tailed t-tests of differences between reading achievement means were made as tests of Hypothesis 2. Of the 56 tests, all but 14 were made between groups containing fewer than ten subjects. To base conclusions on such small samples is questionable. Sample sizes for tests of differences in reading achievement of the total group of November masters and

TABLE 21

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF MEXICAN AMERICAN STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO WERE NON-MASTERS OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS IN NOVEMBER OF THEIR FIRST GRADE YEAR[1]

	Nov. Masters (N = 25)		Nov. Non-Masters (N = 4)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	11.8	5.4	12.0	9.0	-.04	.97
Nov. Comp.[2]	7.4	3.0	6.3	1.9	1.02	.35
Nov. Total	19.2	5.9	18.3	8.8	.208	.85
March Voc.[2]	19.8	8.7	18.3	11.9	.257	.81
March Comp.[2]	10.0	4.6	9.0	5.6	.353	.75
March Total	29.8	12.3	27.3	17.2	.294	.79
N & M Sum	49.1	16.3	45.5	25.5	.272	.80
Metropolitan[3] Reading Readiness Test	63.7	30.9	38.5	24.0	1.87	*.13

[1]Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.47; Non-masters group mean age was 6.52. Non-masters on the average were 2.6 weeks older than masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

*Both groups were non-masters at time scores were obtained.

non-masters and the sub-group of Black masters and non-masters from low socioeconomic communities were above 27. Test of differences in reading achievement of the total groups of November masters and non-masters were statistically significant at or above a p value of $p < .001$. Similarly, tests of differences between Black masters and non-masters from low socioeconomic communities revealed that reading achievement of masters, in all but one of the tests, was significantly above the achievement of non-masters ($p < .01$). On the basis of the results of tests of Hypothesis 2, Hypothesis 2 is not rejected. However, recognizing the outcomes of tests summarized in Tables 15-19, this interpretation must be viewed with extreme caution.

Limitations of Inference. The most severe limitation of the tests of this Hypothesis results from the sample sizes. In all tests but the first and third, sample sizes were below the 30 member criterion of adequate sample size. Due to the small sample size, mean achievement scores of six comparisons should be viewed with caution. These results, as reported in Tables 15-19, may be based on unstable means, reflecting idiosyncracies in individuals sampled rather than averages of represented populations.

Hypothesis 3: Mastery of letter order, letter orientation and word detail will significantly increase subsequent first-grade reading achievement when students who entered first grade without mastery of the selected skills and who did not attain mastery of the skills until March are compared to students who begin first grade without mastery of the skills and who do not attain mastery by March.

Test of Hypothesis 3. Data in Table 22 are the mean achievement scores of all the 73 subjects who had not mastered the skills of letter order, letter orientation and word detail by November but who either did or did not master the skills by March of first grade. March masters outperformed non-masters on all measures of reading achievement taken in March. While difference between the groups approach significance on the March Vocabulary and March Comprehension Sub-tests ($p = .054$ and $p = .061$), only the difference between means of the March Total test scores was statistically significant ($p = .039$). The interpretation of data in this comparison must be prefaced with the fact that masters were significantly older than non-masters and that the difference in mean socioeconomic levels of the master and non-master groups was statistically significant.

To eliminate the effect of differences in age and socioeconomic level between comparison groups, additional test for Hypothesis 3 were made. Scores from three Anglo masters from high socioeconomic communities and two Anglo students of the same socioeconomic communities who were non-masters are reported in Table 23. Results from this comparison indicate that masters outperformed non-masters. Such results, again, must be viewed cautiously, as total sample size was only five.

While results from the 14 March masters who were Black students from low socioeconomic communities and the 24 March non-masters who were from the same socioeconomic level (Table 24) might more closely represent the universal set of results of the population from which

TABLE 22

COMPARISONS BETWEEN ALL STUDENTS WHO HAD NOT ATTAINED MASTERY OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL BY NOVEMBER AND WHO DID OR DID NOT MASTER THESE SKILLS BY MARCH OF FIRST GRADE ON MEASURES OF READING ACHIEVEMENT, SEX, RACE, AGE AND SOCIOECONOMIC LEVEL[1]

	Attained Mastery of Letter Order, Letter Orientation and Word Detail by March (N = 41)		Did Not Attain Mastery of Letter Order, Letter Orientation and Word Detail by March (N = 32)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.	12.27	4.96	12.72	3.29	-.47	*.644
Nov. Comp.	5.85	3.73	4.75	4.43	1.13	*.263
Nov. Total	18.12	7.47	17.47	5.92	.417	*.679
March Voc.	19.61	8.55	16.09	6.70	1.97	.054
March Comp.	8.39	5.38	6.16	4.64	1.90	.061
March Total	28.00	13.0	22.25	10.3	2.10	.039
N & M Sum	46.04	17.7	39.72	14.3	1.70	.096
Metropolitan Reading Readiness Test	44.98	16.1	39.66	18.0	1.309	*.1958
Intervening Variables						
Sex: M=1; F=2	1.44	.50	1.38	.49	.54	.587
Race: A=1; B=2; MA=3; O=4	1.78	.69	1.91	.47	**-.93	.357
Age	6.36	.34	6.19	.31	2.28	.026
SES: L=1; M=2; H=3	1.61	.67	1.19	.54	3.00	.004

*Both groups were non-masters at time scores were obtained.

**Mastery coded 1; Non-mastery coded 9.

[1]Means for Sex, Race, Age and Socioeconomic Level were derived by ranking the descriptive data arbitrarily, as follows:
Males=1; Anglo Ethnic Groups=1; Mexican American Ethnic Groups=3;
Females=2; Black Ethnic Groups=2; Other Minority Ethnic Groups=4;
Low Socioeconomic=1; Middle Socioeconomic=2; High Socioeconomic=3.

TABLE 23

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN HIGH SOCIOECONOMIC COMMUNITIES WHO HAD NOT MASTERED THE SKILLS OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL BY NOVEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS BY MARCH OF THEIR FIRST GRADE YEAR[1]

	March Masters (N = 3)		March Non-Masters (N = 2)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	15.33	6.43	14.5	.707	.222	*.86
Nov. Comp.[2]	4.33	2.52	6.5	2.12	-1.04	*.49
Nov. Total	19.67	7.51	21.0	1.41	-.30	*.82
March Voc.[2]	23.33	.577	16.0	1.41	6.95	.09
March Comp.[2]	8.67	7.23	7.50	.707	.277	.83
March Total	32.00	7.81	23.50	2.12	1.79	.32
N & M Sum	51.67	14.8	44.50	3.54	.803	*.57
Metropolitan[3] Reading Readiness Test	58.00	8.54	65.50	14.8	-.646	*.63

*Both groups were non-masters at time scores were obtained.

[1]While the mean ages between these two groups were above the 4 week criterion level, analysis of covariance between the groups to adjust the means to reflect differences in ages. Masters group mean age was 6.20; Non-masters group mean age was 6.65. Non-masters were on the average 23 weeks older than masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

TABLE 24

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF BLACK STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN SEPTEMBER AND NOVEMBER AND WHO DID OR DID NOT ATTAIN MASTERY BY MARCH OF THEIR FIRST GRADE YEAR[1]

	March Masters (N = 14)		March Non-Masters (N = 24)		T	P Value $\alpha \leq .05$
Dependent Measure	Mean	S.D.	Mean	S.D.		
Nov. Voc.[2]	11.86	2.51	12.25	3.40	-.41	*.69
Nov. Comp.[2]	6.64	3.23	4.25	4.83	1.83	*.07
Nov. Total	18.50	5.16	16.50	6.37	1.06	*.30
March Voc.[2]	17.43	6.42	15.17	6.33	1.05	.30
March Comp.[2]	6.43	4.01	5.50	4.65	.65	.52
March Total	23.86	9.65	20.67	9.85	.975	.33
N & M Sum	42.36	13.8	37.17	14.4	1.10	*.28
Metropolitan[3] Reading Readiness Test	38.8	13.1	37.8	17.7	.21	*.84

*Both groups were non-masters at time scores were obtained.

[1]Means are not adjusted to reflect differences in ages between groups. Masters group mean age was 6.18; Non-masters group mean age was 6.13. Masters on the average were 3 weeks older than non-masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965).

[3]Total raw score on Metropolitan Reading Readiness Test (1969).

the results were drawn, sample sizes in both the master and non-master groups fall below the 30 member criterion of adequate. Results of this comparison reveal that masters outscored non-masters on every March achievement measure but differences in scores were not significant.

Similarly, results of the comparison of scores of the three Anglo masters and three Anglo non-masters from low socioeconomic communities, as presented in Table 25, masters outperformed non-masters on all achievement measures, following adjustment of means to equate the groups in differences of age. Total sample size in this comparison was six.

Discussion of Hypothesis 3. Results of the 12 two-tailed t-tests of differences between March achievement scores of March masters and non-masters reveal that masters outscored non-masters on all measures of reading achievement, but differences between means were non-significant in most cases. Differences between the March Total test scores of the total March master and non-master groups (N = 41 and 32, respectively were statistically significant ($p = .039$). Analysis of the data used to test Hypothesis 3 indicated that 1) students who begin first grade without a mastery of the three prereading skills and who first attain mastery in March will outperform students who never attain mastery of the skills, 2) differences in performance of the groups will most probably not approach statistical significance and 3) differences in the socioeconomic level and age of the groups may be statistically significant.

TABLE 25

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF ANGLO STUDENTS IN LOW SOCIOECONOMIC COMMUNITIES WHO DID NOT MASTER LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL IN NOVEMBER AND WHO EITHER DID OR DID NOT MASTER THESE SKILLS IN MARCH OF FIRST GRADE YEAR[1]

Dependent Measure	Masters of LOLOWD In March (N=7) Mean(Y_1)	S.D.	Non-Masters of LOLOWD in March (N=3) Mean(Y_2)	S.D.	Adjusted SS Y_1	Adjusted SS Y_2	df/2 F Ratio for Diff. of Slopes	Correlation Coefficiences Bet. Age and Ach. Masters/N-M		P Value for r Bet. Age and Ach. Masters/N-M		T for Unadj. Y_1-Y_2	P Value for Unadj. Y_1-Y_2 $\alpha \leq .05$	df/3 F Ratio for Adj. Y_1-Y_2	P Value for Adj. Y_1-Y_2 $\alpha \leq .05$
Nov. Voc.[2]	14.33	3.79	15.67	3.79	28.7	26.7	2.09	-.20	.99	NS	.01	-.431	*.6685	.031	*NS
Nov. Comp.[2]	9.33	3.06	6.33	1.53	18.7	4.7	.191	-.87	-.76	.06	NS	1.52	*.27	11.04	*.05
Nov. Total	23.667	4.04	22.0	2.65	32.7	14.0	4.25	-.84	.98	.06	.01	.598	*.59	1.87	*NS
March Voc.[2]	17.00	9.64	22.00	11.3	186	254	2.92	.53	.99	NS	.01	-.584	.60	1.32	NS
March Comp.[2]	9.33	3.06	9.67	2.89	18.7	16.7	1.70	.000	.999	NS	.01	-.137	.90	.08	NS
March Total	26.33	12.3	31.67	14.2	305	401	2.56	.41	.999	NS	.01	-.492	.66	.88	NS
N & M Sum	49.00	13.5	53.67	16.7	366	551	2.85	.25	.99	NS	.01	-.376	.73	.457	NS
Metropolitan[3] Reading Readiness Test	50.67	19.4	41.3	17.4	755	605	1.35	.39	.98	NS	.01	.620	*.58	.330	NS
Age	6.9	.27	6.23	.06								4.26	.05		

*Both groups were non-masters at time scores were obtained.

[1]An analysis of covariance was run to adjust means for differences in ages between masters and non-masters groups. Masters on the average were 36 weeks older than non-masters.

[2]Subtests of Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1969).

[3]Total raw score on Metropolitan Reading Readiness Test (1965).

There is strong evidence that mastery of the skills effects the reading performances of the March masters. Results of comparisons of scores obtained on November reading achievement measures, taken at a time when the total group and the three sub-groups of March masters and non-masters were both non-masters, revealed that the March non-masters group scored higher than the March masters group in five of the 12 achievement comparisons. Following mastery of the skills by the March masters, March masters outscored the non-masters

However, due to the fact that differences between achievement scores of the March master and March non-master groups were statistically significant in only one comparison, Hypothesis 3 is rejected.

Limitations of Inference. Considering the previously stated limitation of non-randomization and the limitation of small sample size, inferences from results from Hypothesis 3 can be made. Sample size for the total March master and non-master group were adequate and were more equal in number than had been the case in tests of total samples for Hypotheses 1 and 2.

Hypothesis 4: Students who do not consistently master all three selected skills at all testing periods (September, November and March) but who demonstrate mastery at one or two testing times will perform more like masters than like non-masters on measures of reading achievement.

Test of Hypothesis 4. The difference between reading achievement mean scores of the 430 subjects who maintained mastery and the 214 subjects who gained or lost mastery at some time during the first grade

year and the 32 students who never attained mastery of the skills were computed. The difference between the means of the Masters and Gainers/Losers was greater than the difference between the means of the Gainers/Losers and non-masters group, as reported in Table 26. Two-tailed t-tests of differences between differences of means reveal that the difference of differences between means in the 2 X 2 comparisons was statistically significant on all measures of reading achievement except on the measure of November Comprehension ($t = .6715$).

Discussion of Hypothesis 4. On the basis of these results, Hypothesis 4 is rejected. Analysis of the data indicate that students who gain or lose mastery of the selected prereading skills of this study at some time during the first grade will perform more like students who never attain mastery than like students who begin with a mastery of the skills and maintain the mastery throughout the first grade year.

Limitations of Inference. Since the number of non-masters was so small in proportion to the number of subjects in the other two groups, the non-master achievement mean can not be as reliably accepted as a true reflection of the population of first-grade non-masters as can be the achievement means of the masters and gainers/losers groups. The N for the non-masters group was large enough, however, to be accepted as a valid "small" sample of the population ($N>30$). Considering the small sample size of the

TABLE 26

COMPARISONS BETWEEN READING ACHIEVEMENT SCORES OF STUDENTS WHO LOST OR GAINED MASTERY, MAINTAINED MASTERY AND NEVER ATTAINED MASTERY OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL DURING THE FIRST GRADE YEAR

Dependent Measure	Means of Subjects who maintained mastery (N = 430)	Means of Subjects who gain or loose mastery (N = 214)	Means of Subjects who never attain mastery (N = 32)	Difference Bet. Means of Masters & Gainers/Losers	Difference Bet. Means of Gainers/Losers & Non-masters	Difference of Difference Bet. Means	T-Test of Difference of Differences Bet. Means	P Value of T-Test
November Vocabulary	25.4	14.8	12.7	10.6	2.1	8.5	6.8092	<.01
November Comprehension	11.5	7.8	4.8	3.7	3.0	.7	.6715	NS
November Total	36.9	22.5	17.5	14.4	5.0	9.4	4.9830	<.01
March Vocabulary	37.0	24.1	16.0	13.1	8.1	5.0	2.6488	<.01
March Comprehension	20.3	11.6	6.2	8.7	5.7	3.0	2.3169	<.05
March Total	57.4	35.7	22.3	21.7	13.4	8.3	2.8317	<.01
November & March Sum	94.1	58.0	39.7	36.1	18.3	17.8	2.0395	<.05

[1]The differences between the means of the three groups compared was significant at p<.00001 for each of the eight achievement means.

non-master group and the non-random assignment of subjects, results of tests of Hypothesis 4 should be interpreted with relatively high reliability. That is, the negative aspect of sample size should not overshadow the strength of test gained from the large number of subjects present in the other comparison groups. The large number of subjects in these groups created a large variance in test scores, which in turn increased the standard error used to assess statistical significance of the tests. Significant differences between reading achievement performances of the groups were present even when within group variance was large.

Hypothesis 5: The relationship of scores on the three visual subtests of the PRS Prereading Skills Test (1975) and scores on the Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965) will be the same for children of low, middle and high socioeconomic communities.

Test for Hypothesis 5. Data in Table 27 were used to determine the degree to which the relationship of scores on the tasks used to measure letter order, letter orientation and word detail and scores on subsequent reading achievement of students from low, middle and high socioeconomic communities varied. The number of students from each socioeconomic level was almost equal. Total scores on the PRS PRereading Skills Test (1975) were computed for each student in each socioeconomic level. These scores ranged from 0 - 48. The scores were correlated to the total scores of the

TABLE 27

THE EFFECT OF MASTERY OF LETTER ORDER, LETTER ORIENTATION AND WORD DETAIL ON MEASURES OF FIRST GRADE READING ACHIEVEMENT OF STUDENTS FROM HIGH, MIDDLE AND LOW SOCIOECONOMIC COMMUNITIES

Mastery and Achievement Measures	High Socioeconomic (N = 206)						Middle Socioeconomic (N = 271)						Low Socioeconomic (N = 193)					
	Mean of PRS Score	S.D. of PRS Score	Mean of Ach. Score	S.D. of Ach. Score	Coefficient of Correlation	P for r of Coef.	Mean of PRS Score	S.D. of PRS Score	Mean of Ach. Score	S.D. of Ach. Score	Coefficient of Correlation	P for r of Coef.	Mean of PRS Score	S.D. of PRS Score	Mean of Ach. Score	S.D. of Ach. Score	Coefficient of Correlation	Coefficient of Correlation
September PRS score on Sum of November and March Gates Reading Achievement Test Scores	46.2	2.6	110.0	67.9	.14	<.05	43.6	7.2	76.6	30.2	.51	<.01	37.5	11.9	59.3	26.8	.51	<.01
November PRS Score on Total Test Score of November Gates Reading Achievement Test	47.0	1.5	41.9	18.0	.26	<.01	46.6	3.7	29.4	14.3	.26	<.01	43.9	7.6	23.4	10.8	.31	<.01
March PRS Score on Total Test Score of the March Gates Reading Achievement Test	47.4	1.1	63.7	14.9	.33	<.01	46.7	4.3	47.2	18.2	.27	<.01	44.9	6.4	35.9	17.8	.38	<.01
March PRS Score on Sum of November and March Gates Reading Achievement Test Scores	47.4	1.1	110.0	67.9	.16	<.05	46.7	4.3	76.6	30.2	.25	<.01	44.9	6.4	59.3	26.8	.38	<.01

November, March and to the sum of Total scores of the adminstrations of the Gates-MacGinitie Reading Achievement Test (1965). The correlation coefficients of the PRS Prereading Skills Test and the Gates-MacGinitie Reading Achievement Test (1965) were computed for each of the three socioeconomic levels and for all three testing times. All coefficients of correlation were significant at or below a p value of .05. As shown in Table 27, the correlation of the PRS Prereading Skills Test scores and achievement scores was stronger for children of low socioeconomic communities. The coefficients of correlation between September scores on the PRS Prereading Skills Test and total reading achievement (as reflected in the sum of the November and March achievement test scores) was moderately high (r = .51) for middle and low socioeconomic level groups. All other correlations would be classified as either moderate (r = .31 for November PRS Prereading Skills Test and November achievement scores of children from low socioeconomic communities; r = .33 and .38 for March PRS Prereading Skills Test and March achievement scores of children from high and low socioeconomic communities, respectively; r = .38 for March PRS Prereading Skills Test scores and sum of November and March Total test scores of children from low socioeconomic communities) or low (r ranging from .14 - .27).

Discussion of Hypothesis 5. Results of the correlation of scores on the PRS Prereading Skills Test and scores on the Gates-MacGinitie Reading Achievement Test reveal that the realtionship between scores is

stronger for students from low socioeconomic communities than for students from middle or high socioeconomic communities. Similarly, the relationship of these scores is stronger for children from middle socioeconomic communities than high socioeconomic communities.

Comparison of correlation coefficients obtained from each socioeconomic level reveals that the relationship of PRS Prereading Skills Test scores and Gates-MacGinitie Reading Achievement Test scores is not the same for students from high, middle and low socioeconomic communities. Hypothesis 5 is rejected.

Limitations of Inference. Most important, there is no support for an inference that children from low socioeconomic communities need or depend upon visual skills when performing reading activities to a greater degree than do children from middle or high socioeconomic communities. Nor would it be proper to infer that children in high socioeconomic communities rely less upon visual discrimination tasks than upon other "higher or lower" tasks than do children in lower socioeconomic levels. Such inferences are not justified by the data of this hypothesis. As a matter of fact, interpretation of all coefficients of correlation related to this hypothesis must be made in light of the influence of the standard deviation of scores on the PRS Prereading Skills Test (1975) on the correlation. That is, the number of students scoring 100% correct on the PRS Prereading Skills Test was so large

for all groups (especially the high socioeconomic group) that the variance in scores on the test was very small. Examination of the range and distribution of individual scores gives additional data for interpreting the results of tests for Hypothesis 5. The range and distribution of scores for each testing period and socioeconomic level follow.

1) Range of scores on the September test was 4 - 48 for low socioeconomic groups, with 22 scores below 20 and 47 scores below 40; range of scores on the September test was 0 - 48 for middle socioeconomic groups, with 4 scores below 20 and 33 scores below 40; range of scores on the September test was 29 - 48 for high socioeconomic groups, with no scores below 20 and 5 scores below 40.

2) Range of scores on the November test was 5 - 48 for low socioeconomic groups, with 2 scores below 20 and 23 scores below 40; range of scores on the November test for the middle socioeconomic was 0 - 48, with the single zero score being the only score below 20 and 5 scores below 40; range of scores on the November test was 38 - 48 for high socioeconomic groups, with no scores below 20 and only a score of 38 and a score of 39 being below 40.

3) Range of scores on the March test was 6 - 48 for low socioeconomic groups, with 5 scores below 20 and 12 scores below 40; range of scores on the March test was 0 - 48 for middle socioeconomic groups, with the single zero score being the only

score below 20 and 11 scores below 40; range of scores on the March test was 39-48 for high socioeconomic groups, with no scores below 20 and the single 39 score being the only score below 40.

One might suspect that a ranking of such a set of scores and a ranking of Gates-MacGinitie Reading Achievement Test (1965) scores (having potential for large variance between scores, equal to either 0 - 82 or 0 -164, dependent upon whether the two total test scores of November and March or the two sums of total tests scores are being considered) would have constricted potential for high correlation. Because of this, the investigator contends that the true relationship of scores on the three visual subtests and scores on the achievement measures is of greater magnitude than evidences by the results of tests of Hypothesis 5. Had the variance between highest and lowest scores in each socioeconomic level been greater, as might be evidenced in subsequent comparisons with other populations, interpretation of the coefficients obtained would have been viewed as more accurate measures of the relationship between PRS Prereading Skills Test and Gates-MacGinitie Reading Achievement Test scores than are the coefficients reported in this study.

Hypothesis 6: The number of students exposed to systematic skill instruction who change from non-mastery to mastery or who maintain mastery will be significantly greater than the number of students in control groups who change from non-mastery to mastery or who maintain mastery.

Test of Hypothesis 6. Anticipating a non-rejection of hypotheses 1, 2 and 3, hypotheses 6 and 7 were formulated. Both of these hypotheses address the following concern:

> Since mastery appears to have a positive effect on reading achievement, what procedure seems to produce the greatest number of students who change from non-mastery of the skills to mastery of the skills?

A test of equality of proportions was performed through adaptation of the procedure described in Appendix D. The moment system statistic described in Appendix D was designed to detect significance of difference between proportions composed of comparisons of a few subjects to a large number of subjects. Such was the case in the test of Hypothesis 6.

Four tests of equality were performed. Tests were made between the number of students who changed from non-mastery to mastery in control groups and the number of students who changed from non-mastery to mastery in treatment groups. As shown in Figure 1, of the 78 Control students who had not mastered the prereading skills in September, 41 gained mastery by November. Of the 149 Treatment students who had not mastered the prereading skills in September, 112 gained mastery by November. The proportion of students that gained mastery is shown on the next page.

FIGURE 1

STUDENTS WHO GAINED MASTERY WITH AND WITHOUT SYSTEMATIC INSTRUCTION

	CONTROL	TREATMENT	TOTAL
GAINED	41	112	153
DID NOT GAIN			
TOTAL	78	149	227
PROPORTION GAINED	.53	.75	.67

To determine if the difference between the proportions was great enough to reject the null hypothesis $p_2 = p_1$, and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, at a significance level of alpha = .05, the equality of proportions test was performed. The resultant z was 3.36, with p = .00039.

Following the same procedure, a test for equality of proportions between the number of students in control groups who gained mastery by March and the number of students in treatment groups who gained mastery by March was performed. As shown in Figure 2, of the 37 Control students who had not mastered the prereading skills in November, 16 gained mastery by March. Of the 37 Treatment students who had not mastered the prereading skills in November, 26 gained mastery by March. The proportion of students that gained mastery is shown on the next page.

FIGURE 2

STUDENTS WHO GAINED MASTERY IN MARCH WITH AND WITHOUT SYSTEMATIC INSTRUCTION

	CONTROL	TREATMENT	TOTAL
GAINED	16	26	42
DID NOT GAIN			
TOTAL	37	37	74
PROPORTION GAINED	.43	.70	.57

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the equality of proportions test was performed. The resultant z was 1.78, p = .0375.

Following the same procedure, a test for equality of proportions between the number of control students who had mastery of the skills in September but lost mastery by November and the number of Treatment students who had mastery of the skills in September but lost mastery by November was performed. As shown in Figure 3, of the 152 Control students who had mastery in September, 3 demonstrated a loss of mastery in November. Of the 308 Treatment students who had mastery in September, 8 demonstrated a loss of mastery in November. The proportion of students that lost mastery is shown on the next page.

FIGURE 3

STUDENTS IN CONTROL AND TREATMENT GROUPS THAT HAD MASTERY IN SEPTEMBER BUT LOST MASTERY BY NOVEMBER

	CONTROL	TREATMENT	TOTAL
LOST	3	8	11
DID NOT LOSE			
TOTAL	152	308	460
PROPORTION LOST	.019	.026	.023

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the test for equality of proportions was performed. The resultant z was .456, p = .3775.

Following the same procedure, a test for equality of proportions between the number of control students who had mastery of the skills in November but lost mastery by March and the number of Treatment students who had mastery of the skills in November but lost mastery by March was performed. As shown in Figure 4, of the 207 Control students who had mastery in November, 2 demonstrated a loss of mastery in March. Of the 440 Treatment students who had mastery in November, 6 demonstrated a loss of mastery in March. The proportion of students that lost mastery is shown on the next page.

FIGURE 4

STUDENTS IN CONTROL AND TREATMENT GROUPS THAT HAD MASTERY IN NOVEMBER BUT LOST MASTERY BY MARCH

	CONTROL	TREATMENT	TOTAL
LOST	2	6	8
DID NOT LOSE			
TOTAL	207	440	647
PROPORTION LOST	.0096	.0136	.0123

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the test for equality of proportions was performed. The resultant z was .4347, p = .3336.

Discussion of Hypothesis 6. Results of the equality of proportions tests reveal that the number of students exposed to systematic skill instruction who change from non-mastery to mastery is significantly greater than the number of students in control groups who change from non-mastery to mastery. The number of students exposed to systematic skill instruction who maintain mastery is not significantly greater than the number of students in control groups who maintain mastery.

Limitations of Inference. As stated in the description of the design of this study, page 48, treatments of systematic skill instruction were randomly assigned to 42 intact classrooms. While

classrooms for the study were randomly selected, students were not randomly assigned to these 42 classrooms. The unit of measurement of Hypothesis 6 is not the classroom unit but rather a unit of one measurement per individual student in each of the classrooms. For this reason, data reported may reflect sample biases. The large number of subjects used in the equality of proportions tests enabled statistical inferences based upon the normal population curve. The large number of subjects enhance the probability that results obtained are accurate representation of the universal population of students from which the sample was drawn.

Hypothesis 7: The number of students exposed to systematic instruction using letter/word stimuli who change from non-mastery or who maintain mastery will be significantly greater than the number of students exposed to systematic instruction using geometric shapes/outline figures as stimuli who change from non-mastery to mastery or who maintain mastery.

Test of Hypothesis 7. The same test of equality of proportions used in tests for Hypothesis 6 were used in tests for Hypothesis 7. Four tests were performed. Tests were made between the number of students who changed from non-mastery to mastery in treatment groups using letter/word stimuli and the number of students who changed from non-mastery to mastery in treatment groups using geometric shapes/outline figures stimuli. Tests were made between the number of

students who lost mastery in treatment groups using letter/word stimuil and the number of students who lost mastery in treatment groups using geometric shapes/outline figures stimuli. As shown in Figure 5, of the 60 students in the treatment with geometric shapes/outline figure groups who had not mastered the skills in September, 47 gained mastery following 35 days of systematic skill instruction using geometric shapes/outline figures stimuli. Of the 89 students in the treatment with letters/words groups who had not mastered the skills in September, 65 gained mastery following 35 days of systematic skill instruction using letters/words stimuli. The proportion of students that gained mastery is shown below.

FIGURE 5

STUDENTS WHO GAINED MASTERY IN NOVEMBER IN TREATMENT WITH GEOMETRIC SHAPES/ OUTLINE FIGURES GROUPS AND IN TREATMENT WITH LETTERS/WORDS GROUPS

	GEO. SHAPES	LETTER/WORD	TOTAL
GAINED	47	65	112
DID NOT GAIN			
TOTAL	60	89	149
PROPORTION GAINED	.78	.73	.75

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the test for equality of proportions was performed. The resultant z was .698, p = .2420.

Following the same procedure, a test for equality of proportions between the number of students who changed from non-mastery to mastery by March in treatment groups using geometric shapes/outline figures

stimuli and the number of students who changed from non-mastery to mastery by March in treatment groups using letter/word stimuli was perfromed. As shown in Figure 6, of the 13 students in the treatment with geometric shapes/outline figures who had not mastered the skills by November, 10 mastered the skills by March. Of the 24 students in the treatment with letters/words groups who had not mastered the skills by November, 16 gained mastery by March. The proportion of students that gained mastery is shown below.

FIGURE 6

STUDENTS WHO GAINED MASTERY IN MARCH IN TREATMENT WITH GEOMETRIC SHAPES/ OUTLINE FIGURES GROUPS AND IN TREATMENT WITH LETTERS/WORDS GROUPS

	Geo.Shapes	Letter/Word	Total
GAINED	10	16	26
DID NOT GAIN			
TOTAL	13	24	37
PROPORTION GAINED	.77	.66	.70

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the test of equality of proportions was performed. The resultant z was .705, $p = .7611$.

Following the same procedure, a test for equality of proportions between the number of students who lost mastery in November following

treatment using geometric shapes/outline figures stimuli and the number of students who lost mastery in November following treatment using letter/word stimuli was performed. As shown in Figure 7, of the 131 students in the treatment with geometric shapes/outline figures who had mastery of the skills in September, 3 students lost mastery in November. Of the 177 students in the treatment with letters/words groups who had mastery of the skills in September, 5 students lost mastery in November. The proportion of students that lost mastery is shown below.

FIGURE 7

STUDENTS WHO HAD MASTERY IN SEPTEMBER BUT LOST MASTERY IN NOVEMBER IN TREATMENT WITH GEOMETRIC SHAPES/OUTLINE FIGURES GROUPS AND IN TREATMENT WITH LETTERS/WORDS GROUPS

	GEO.SHAPES	LETTER/WORD	TOTAL
LOST	3	5	8
DID NOT LOSE			
TOTAL	131	177	308
PROPORTION LOST	.0229	.0282	.0259

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the test of equality of proportions was performed. The resultant z was .294, p = .6141.

Following the same procedure, a test for equality of proportions between the number of students who had mastery of the skills in November but demonstrated a loss of mastery in March in the treatment with geometric shapes/outline figures groups and the number of students who had mastery of the skills in November but demonstrated a loss of mastery in March in the treatment with letter/word groups. As shown in Figure 8, of the 178 students in the treatment with geometric shapes/outline figures who had mastery of the skills in November, 3 students demonstrated a loss of mastery in March. Of the 242 students in the treatment with letters/words groups who had mastery of the skills in November, 3 students demonstrated a loss of mastery in March. The proportion of students that lost mastery is shown below.

FIGURE 8

STUDENTS WHO HAD MASTERY IN NOVEMBER BUT LOST MASTERY IN MARCH IN TREATMENT WITH GEOMETRIC SHAPES/OUTLINE FIGURES GROUPS AND IN TREATMENT WITH LETTERS/WORDS GROUPS

	GEO.SHAPES	LETTER/WORD	TOTAL
LOST	3	3	6
DID NOT LOSE			
TOTAL	178	242	420
PROPORTION LOST	.0168	.0123	.0142

To determine if the difference between the proportions was great enough to reject the null hypothesis that $p_2 = p_1$ and, conversely, not to reject the alternative hypothesis that $p_2 > p_1$, the test of equality of proportions was performed. The resultant z was .424, p = .337

Discussion of Hypothesis 7. Results of the equality of proportions tests reveal that the number of students exposed to systematic instruction using letter/word stimuli who change from non-mastery to mastery or who maintain mastery was not significantly greater than the number of students exposed to systematic instruction using geometric shape/outline figures as stimuli who changed from non-mastery to mastery or who maintain mastery. On the basis of these results, Hypothesis 7 is rejected.

Limitations of Inference. The limitation of treatment assignment as discussed in reference to results of Hypothesis 6 applies to Hypothesis 7.

Limitations of Generalizability

To extrapolate results obtained from data concerning the 687 subjects of this study to other populations, one must consider the following points.

1. The population of this study comes from only one, fairly large, school district and, as such, may not adequately represent either populations from different regions of the country or those from school districts of larger or smaller size. Also, limitations of size of samples used is a limitation of extrapolation of results to population samples of greater or lesser size.

2. Data concerning physical/environmental factors (age, sex, race and socioeconomic level) and functional ability (performances on measures of independent and dependent variables) were analyzed in this study. Data concerning the cognitive differences (IQ), attitudinal differences (e.g. likes, interest and opinions) and psychological differences (e.g. motivation, self-concept and personality structure) were not analyzed and the inclusion of such data would have increased the knowledge concerning the parameters of the population under study.

3. The lack of teacher control and the lack of optimal monitoring of treatment implementation were such that teaching effectiveness and teacher qualities acted as a variable of unmeasured effect in results of Hypotheses 6 and 7. Teachers were most probably not of comparable ability, interest and dedication to proficient implementation of treatment.

4. Some plausible explanations of differences between groups were controlled by the control-group design of the study, i.e. effect of intervening historical occurences, passage of time and administration of testing instruments. Others were not, i.e. measurement errors, population idiosyncracies and favorable or unfavorable environmental conditions at the time of the study.

5. Attributing a cause-effect relationship in research design presupposes that the investigator 1) controls all intervening variables, 2) has access to reliable/valid instruments that measure all intervening variables, 3) has the ability

to manipulate the research situation sufficiently to implement control over intervening varibles with a proper degree of control, and 4) has the ability to maintain control after establishing experimental conditions and throughout the process of the study. Because such was not the case in this study, a statement that a direct cause-effect relationship of the skills of this study and reading achievement cannot be made. The design of the study did enable determination of the degree to which mastery of the selected skills led to increases in subsequent first-grade reading achievement.

These limitations were considered in drawing the conclusions that are presented in Chapter IV.

CHAPTER IV

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

This study was designed to investigate the effect of mastery of three prereading skills, letter order, letter orientation and word detail, on subsequent first-grade reading achievement. The study included 687 students from 42 classrooms in 20 elementary schools in Fort Worth, Texas. The experimental groups received systematic skill instruction through small and large group activities, games and worksheets from the PRS Prereading Skills Program (1974) or from investigator adaptations of this program. Treatments were randomly assigned with approximately one-half of the treatment groups receiving lessons involving geometric shapes/outline figures stimuli and one-half receiving lessons involving letter/word stimuli. Each of the 35 twenty minute lessons was administered on a daily bases by individual classroom teachers from September 29 - November 17, 1975.

Preceeding the period of systematic skill instruction the PRS Prereading Skills Test (1975) and the Metropolitan Reading Readiness Test (1969) were administered to all students in the 42 classrooms. Immediately following skill instruction and

18 weeks subsequent to the termination of skill instruction, the PRS Prereading Skills Test was readministered to the students and the Gates-MacGinitie Reading Achievement Tests, Primary A, Forms 1 and 2 (1965) were given.

Tests of the hypotheses of this study were made through comparisons of groups of students who mastered or did not master the selected prereading skills. Two-tailed t-tests of significance were computed for differences in reading achievement of master and non-master groups. One hundred and seventy-four comparisons were made with one hundred and fifty-two of the comparisons being between students of comparable socioeconomic level, ethnic background and age.

Results indicated that a statistically significant difference existed. 1) between the reading achievement scores of students who began first grade with a mastery of the skills and students who did not and 2) between children who attained mastery by November and students who did not. Children who first demonstrated performances of mastery in March outperformed students who never demonstrated mastery but differences in the performances between the groups were not statistically significant. While the number of students in Treatment groups who changed from non-mastery to mastery was significantly greater than the number of students who changed in Control groups, training using letter/word stimuli did not differ from geometric forms/outline figures in impact on mastery of the skills.

Conclusions

Prior to this study the skills investigated in the study had been shown to be 1) reasonably independent, measurable and teachable, 2) among the best predictors of first-grade reading achievement, and 3) a part of the repertoire of superior first grade readers. There was also some evidence that the ability to move from non-mastery to mastery of these skills was best developed through a program of systematic instruction.

The present study was designed to test seven hypotheses and to provide insights into five unanswered questions. Conclusions drawn from the tests of the seven hypotheses are given below. Following the conclusions, the findings of the study are discussed in relation to the questions raised in Chapter I.

Considering the limitations of the study, the following conclusions seem tenable.

Hypothesis 1 is not rejected. Mastery of letter order, letter orientation and word detail will significantly increase subsequent first-grade reading achievement when students who begin first grade with a mastery of these skills are compared to students who begin first grade without a mastery of the skills.

Hypothesis 2 is not rejected. Mastery of letter order, letter orientation and word detail will significantly increase subsequent first-grade reading achievement when students who entered first grade without mastery of the selected skills but who

attained mastery by November are compared to students who began first grade without mastery of the selected prereading skills and who did not attain mastery by November. Tests of differences between reading achievement scores of master and non-master groups containing fewer than ten subjects resulted in non-significant differences. For this reason, the results related to Hypothesis 2 must be interpreted with reservation.

Hypothesis 3 is rejected. Mastery of letter order, letter orientation and word detail will not significantly increase subsequent first-grade reading achievement when students who entered first grade without mastery of the selected skills and who did not attain mastery of the skills until March are compared to students who begin first grade without mastery of the skills and who do not attain mastery by March. Comparisons reveal that masters score higher on measures of reading achievement but differences between scores of master and non-master groups are not significant.

Hypothesis 4 is rejected. Students who do not consistently demonstrate mastery of all three skills at all testing periods (September, November and March) but who do demonstrate mastery at one or two of the testing times will perform more like non-masters than like masters on measures of reading achievement.

Hypothesis 5 is rejected. The relationship of scores on the three visual subtests of the PRS Prereading Skills Test

and scores on the Gates-MacGinitie Reading Achievement Test, Primary A, Forms 1 and 2 (1965) will not be the same for children of low, middle and high socioeconomic communities. The relationship of these scores is highest for children from low socioeconomic communities.

Hypothesis 6 is not rejected. The number of students exposed to systematic skill instruction who change from non-mastery to mastery or who maintain mastery will be significantly greater than the number of students in control groups who change from non-mastery to mastery or who maintain mastery.

Hypothesis 7 is rejected. The number of students exposed to systematic instruction using letter/word stimuli who change from non-mastery to mastery or who maintain mastery will not be significantly greater than the number of students exposed to systematic instruction using geometric shapes/outline figures as stimuli who change from non-mastery to who maintain mastery.

The findings of this study offer insights that are useful in answering the following questions.

1. Will the level of first-grade reading achievement of students who master the skills be higher than the level of first-grade reading achievement of non-masters?

In almost every comparison, children with a mastery of the selected prereading skills outperformed children without a mastery of the skills. Differences in achievement of the groups were over

and above differences expected to accrue from variations in age, race and socioeconomic status of subjects compared.

These results add to the body of knowledge concerning the effect of mastery of the selected prereading skills on subsequent first-grade reading achievement. Prior to this study evidence of the relationship of these skills and first-grade reading achievement came from studies involving correlational analyses or analyses of errors made by children in Kindergarten through third grade. The range of correlational coefficients of ability to attend to detail of words (.36-.84) with subsequent reading achievement suggested that these skills and the ability to read shared a close relationship. Yet no causal relationship could be inferred. Recognizing the limitations of this study, the findings strongly suggest that mastery of the letter order, letter orientation and word detail skills does lead to higher levels of first-grade reading achievement than would be the case had mastery not been attained. Masters achieved greater success in first-grade reading than non-masters in most of the comparisons.

2. Is mastery of the skills simply a concomitant of superior reading ability or does mastery of the skills contribute to reading ability?

Evidence in this study indicates that mastery of the skills precedes substantial increases in reading ability. Comparisons of

growth experienced by Anglo students from high socioeconomic communities who took measures of reading achievement both before and after attaining mastery (Table 23) reveals that a larger amount of growth occurred in the group that moved from non-mastery to mastery than in the group that did not move to mastery. Measures of growth were differences in scores on the Vocabulary and Comprehension Subtests and the Total Test score on the Gates-MacGinitie Reading Achievement Test (taken in November when March master and non-master groups were both non-masters) and the Vocabulary and Comprehension Subtests and Total test score of the March test. Growth in the mean achievement of students who moved to mastery was 8.0, 4.3 and 12.3 as compared to 1.5, 1.0 and 2.5 of non-masters. A similar pattern of growth was evidenced in comparisons of Black students of low socioeconomic status. In two of the three comparisons of this group (Table 24) March masters' growth was above non-masters' growth: 5.57, -.21 and 5.36 as compared to 2.92, 1.25 and 4.17 for non-masters.

Prior studies comparing children of low ability to children of high ability did not indicate if learning to read preceded ability to attend to orientation and order of letters and to detail of words, if attending to these skills was concomitant of superior reading ability or if the skills themselves contributed to greater reading ability. Results from comparison of scores of March masters and non-masters indicate that attending to the order and orientation of letters and to the detail of words may

precede increases in ability to read. Two comparisons, however, do not offer substantial support for such a conclusion. Before it can be determined if the growth evidence in these comparisons is valid and if mastery of the selected skills will reliably precede substantial growth in reading achievement, further research is needed.

3. Is the time at which mastery occurs related to the effect of mastery on reading achievement?

In comparisons of this study, the earlier the mastery was demonstrated, the greater was the difference in performances between master and non-master groups. The findings of this study do not demonstrate, however, if promoting mastery of the selected skills early in a child's mental or chronological development leads to a growth in achievement over and above the growth he would have experienced had mastery occurred through maturation alone.

4. Do children from different socioeconomic levels differ in the extent to which they benefit from mastery?

Scores on attending to letter order, letter orientation and word detail from children of low socioeconomic communities have a closer relationship to subsequent reading achievement scores of this groups than do the scores obtained from children of middle and high socioeconomic communities. Results of this study demonstrate that regardless of the chronological age, ethnic background and type of instructional program received,

pupils of low socioeconomic communities differed in the extent to which mastery of the selected skills effected subsequent reading performance. The effect of mastery was greatest for the low socioeconomic groups, average for the middle socioeconomic group and below average for the high socioeconomic groups. The data upon which this conclusion is drawn may reflect more than the effect of mastery, as noted on page 108.

Results of this study add to the evidence in Gates, Bond and Russell's study (1939) concerning the attributes that distinguish good first grade readers from poor first grade readers. Attributes were identified through comparison of mean scores on various readiness and achievement means of the seven poorest readers and means of the 90 average or superior readers. While the mean of the poorest readers differed only slightly from the mean of the average and superior readers on measures of chronological age, I.Q. and mental age, means of the poorest readers were lower on the several tests of word perception. Likewise, results in this study indicated that students of comparable socioeconomic status, ethnic background and chronological age differed in level of reading ability and in ability to perform the skills of the study.

5. Does training which emphasizes geometric shapes/outline figures or letter/word stimuli differ in its impact on mastery of the selected skills?

The impact of instruction using letter/word stimuli and geometric shape/outline form stimuli in producing changes from non-mastery to mastery does not differ.

Implications

Implications for Future Research. Four implications for future research and three suggestions for limiting further investigations are offered. Implications for furthering future research are:

1. Replications of the present study to increase the validity and reliability of the results are needed. Such replications should seek to eliminate the limitations of this study, i.e. non-randomization of subjects to treatment groups, small sample sizes in comparison groups, limited monitoring of instruction, exclusion of other plausible mediating variables upon achievement such as languaging abilities, attitudinal variables, psychological variables and mental age.

2. Before the effect of mastery by March of the first grade year can be more fully ascertained future research studies are needed. Results of the effect in this study are based on only three tests.

3. Investigation of the effect of mastery of the three skills on the reading performance of second grade children would support or refute the need to include such skills in remedial activities

at the second grade level.

4. Complete reinvestigation of the issue of the differences in effect of mastery on the reading achievement of children from low, middle and high socioeconomic communities should be made. Such investigations may establish if the results from this study reflect true differences or differences only resultant from a skewed set of scores on the PRS Prereading Skills Test (1975).

Results from this study and past studies offer substantial support to the following concerns.

1. The correlation between scores on tasks of attending to the order and orientation of letters and to the detail of words and tasks measuring first-grade reading achievement is moderately high. Future investigations may not add significantly to the body of knowledge already available concerning this issue.

2. Systematic skill instruction has demonstrated to be a more effective method of moving students from non-mastery to mastery than does maturation or incidental skill instruction. Additional validation of this finding may not be needed.

3. Investigations into the relationship of sex to the ability to master the skills of this study may not prove valuable as the comparisons of September, November and March

masters and non-masters evidenced that no significant differences existed between master and non-master groups in sexual composition.

Implications for Practice. The following suggestion for educational practice is warranted. Children should be led to a mastery of the skills of attending to the significance of letter order, letter orientation and word detail before beginning first-grade reading instruction. Ensuring that such mastery occurs may eliminate initial reading failures. As the results of this study indicate, early mastery leads to early reading success and does not lead to a lack of retention of the skills. Regardless of how the skills were obtained, children in this study who mastered the skills early in their school careers demonstrated high success on measures of reading achievement and retained mastery of the skills until the end of first grade. Future replication of this study as well as future studies to identify other factors that appear to lead to initial success in reading should begin. The results of these studies should form the bases of programs specifically designed to meet the needs of children in the Kindergarten classrooms in our country. The need for such programs is great.

Implications for Theory. The results of this study add support to the work of Calfee, Chapman and Venezky (1972) concerning basic cognitive skills related to reading acquisition. Matching visual forms continues to be one of the

basic cognitive skills related to initial reading success. As the comparisons of achievement scores in this study indicate, early awareness of the significance of the order and orientation of letters and of words enhance chances for success in reading. In this study, highest mean achievement scores were obtained by September masters with the difference between this group and September non-masters being greater than differences between any other master and non-master comparisons. The scores obtained by September masters were significantly higher than scores obtained by students who obtained mastery at some other time during the year or who never attained mastery.

Evidence in this study also supports the theories of Weintraub (1971) and Berger (1968) and the theory of Satz and his associates (1970;1973). Certain assumptions in these theories offer plausible explanations for the finding that matching of similar and dissimilar objects and letters has less effect on success or failure in reading when mastery is attained in later as opposed to earlier stages of reading acquisition. Weintraub and Berger contend that visual perceptual abilities are not as important in later stages of reading acquisition. Satz opposes these contentions.

Weintraub suggests that children are able to discriminate likenesses and differences among words well enough that measures of that skill are not useful in distinguishing the most able from the less able readers. Weintraub believes that the visual

modality develops in a predictable manner from discrimination to memory, with simple visual perceptual abilities usually developed before first grade. Berger agrees. She contends that most good readers are moving into or are already in the second stage--that of visual closure--by the middle or end of first grade. Because of this, mastery of the visual matching tasks of this study will have less impact upon the reading behaviors of children mastering the skills near the middle or end of first-grade years. Since the results of this study indicate that mastery of the matching tasks of this study in November and March of the first-grade year less often led to significant increases in reading achievement than did mastery in September, the assumptions of Weintraub and Berger's theory may have support. Accepting these assumptions as explanation for the results of this study is contingent upon answers to the following questions: Does mastery of visual memory tasks at the middle and end of first-grade years lead to increased reading success for masters of letter orientation, letter order and word detail? More importantly, does mastery of visual memory at the middle and end of the first grade year lead to greater increases in reading achievement of non-masters of letter order, letter orientation and word detail? If the answers to both of these questions are positive, as previously stated, Weintraub and Berger's theories become plausible explanations for the results of this study. Furthermore, positive answers would produce new theoretical

questions: Does visual perceptual skill development proceed through a non-mandatory hierarchy of skill orderings? Should middle and end of year instruction in the first grade eliminate activities in visual matching even if some children are unable to succeed in such activities? Is the effect of mastery of letter order, letter orientation and word detail on reading achievement only present in initial reading acquisitional processes?

On the other hand, if the answers to the previous questions are negative, the work of Satz offers insights into the observed decrease of effect of mastery. Satz and his associates (1970; 1973) postulate that the effect of mastery of the three prereading skills is present in the middle and end of first-grade year reading performances but the effect is less evidenced at these time periods than at previous times. Since skills other than perceptual skills are receiving more "developmental" emphasis at this time, Satz contends that perceptual difficulties are often overlooked. Satz contends that undetected difficulties with letter order, letter orientation and word detail will produce as great an effect on achievement in middle and end of first-grade years as in preschool and beginning first-grade years. The only difference in the detrimental effect is that it is less often detected at later than at early stages of reading acquisition.

In Closing. Implicit in the design of this study is the assumption that children who attain mastery of the three selected prereading skills will attain a significantly higher level of first-grade reading achievement than children who do not attain mastery. The results of this study helped to validate this assumption.

Many educators assume that mastery of the three selected skills of this study positively affect first-grade reading achievement. The results of this study validated this assumption. Children who attained mastery of the selected prereading skills did attain a higher level of first-grade reading achievement than did children who did not attain mastery. It remains to be demonstrated if the decrease in effect of mastery of letter order, letter orientation and word detail in mid-and latter-first-grade reading performances is an actuality or if the effect is not decreased but merely undetected. Regardless of the cause of the observed decrease in effect, mastery of letter order, letter orientation and word detail in September enhanced the reading success of the subjects in this study.

The findings of this study suggest that further investigation into the effects of mastery of letter order, letter orientation and word detail on subsequent first-grade reading achievement ought to be continued. Meanwhile instruction in these skills appears to be worthwhile.

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APPENDIX A

LIST OF INSTRUCTIONAL MATERIALS USED IN THE TREATMENT WITH LETTER/WORD STIMULI EXPERIMENTAL GROUPS AND SAMPLES OF MATERIALS USED IN THE TREATMENT WITH GEOMETRIC SHAPES AND OUTLINE FIGURES

STIMULI EXPERIMENTAL GROUPS

SCHEDULE FOR TEACHING THE ACTIVITIES IN THE EXPERIMENT

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISTINGUISH THE ORDER OF GEOMETRIC SHAPES/OUTLINE FIGURES

---Sept. 29 - Activity 1 - "Object Order"
Materials Used - Visual File Card 6 (Visual Preliminaries)

---Sept. 30 - Activity 2 - "Preliminaries Set Matching Game"
Materials Used - Visual File Card 17 (Visual Preliminaries)

---Oct. 1 - Activity 3 - "Touch in Order"
Materials Used - Visual File Card 22 (Letter Order)

---Oct. 2 - Activity 4 - "Memory Game"
Materials Used - Visual File Card 23 (Letter Order)
Component 33
Procedure 2 and Note only

---Oct. 3 - Activity 5 - "Ordered Shapes"
Materials Used - Visual File Card 24 (Letter Order)
Component 30 - Felt Shapes

---Oct. 6 - Activity 6 - "Shape Pick A Pair"
Materials Used - Visual File Card 25 (Letter Order)

---Oct. 7 - Activity 7 - "Arrow Game"
Materials Used - Visual File Card 45 (Letter Order)
Component 33

---Oct. 8 - Activity 8 - "Geometric Shapes and Outline Figure Dominoes"
Materials Used - Investigator constructed game

---Oct. 9 - Activity 9 - "Geometric Shapes and Outline Figures Lotto"
Materials Used - Investigator constructed game

---Oct. 10 - Activity 10 - "Visual Practice Sheets"
Materials Used - Two practice sheets using geometric form discrimination;
Two practice sheets using outline figures discrimination skill tasks;
Investigator constructed.

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISCRIMINATE THE ORIENTATION OF GEOMETRIC SHAPES/OUTLINE FIGURES

---Oct. 13 - Activity 11 - "Face Game"
Materials Used - Visual File Card 2 (Visual Preliminaries)
Components 29 (Face Cards)
Both Procedures 1 and 2 will be used, if time permits.

---Oct. 14 - Activity 12 - "Shape Game"
Materials Used - Visual File Card 5 (Visual Preliminaries)
Component 31
All three variations will be used, if time permits.

---Oct. 15 - Activity 13 - "Direction Game"
Materials Used - Visual File Card 49 (Letter Orientation)
Component 33 (Arrows)
Both Procedures 1 and 2 will be used, if time permits.

---Oct. 16 - Activity 14 - "Visual Practice Sheet"
Materials Used - Investigator constructed practice sheet

---Oct. 17 - Activity 15 - "Sorting Shapes"
Materials Used - Visual File Card 9 (Visual Preliminaries)
Pick A Pair Card (Component 37)

---Oct. 20 - Activity 16 - "Pointing Game"
Materials Used - Visual [illegible] Card 16 (Visual Preliminaries)
Visual [illegible]s Chart II
Component 33
Procedure 1 only

---Oct. 21 - Activity 17 - "Top and Bottom"
Materials Used - Visual File Card 16 (Visual Preliminaries)
Component 33
Note 1 in lesson procedure 1 will be used.

---Oct. 22 - Activity 18 - "Obstacle Course Game"
Materials Used - Visual File Card 16 (Visual Preliminaries)
Component 33
Note 2 will be used - Setting up an obstacl course using arrows for direction paths will take. Children will make several paths themselves for the other children to follow.

---Oct. 23 - Activity 19 - "Geometric Form/Outline Figure Orientation Lotto"
Materials Used - Investigator constructed game

---Oct. 24 - Activity 20 - "Outline Figures Visual Practice Sheets"
Materials Used - Investigator constructed visual practice sheets 1, 2 and 3

---Oct. 27 - Activity 21 - "Geometric Form Orientation Practice Sheets"
Materials Used - Investigator constructed visual practice sheets 1, 2 and 3

---Oct. 28 - Activity 22 - Reuse Orientation Lotto
Materials Used - Activity 19 packet
Replay game using same directions as stated for Activity 19.

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISTINGUISH THE DETAILS IN GEOMETRIC SHAPES/OUTLINE FIGURES

---Oct. 29 - Activity 23 - "Matching Shapes"
Materials Used - Two Sets of Component 31
Shapes will be marked with a grease pencil on the back to indicate the correct order for the teacher.

---Oct. 30 - Activity 24 - "Remember Game"
Materials Used - Visual File Card 6 (Visual Preliminaries)
Activities will use objects, and the objects will be of close similarity.

---Oct. 31 - Activity 25 - "Change Game"
Materials Used - Visual File Card 12 (Visual Preliminaries)

---Nov. 3 - Activity 26 - "Set Matching Game"
Materials Used - Visual File Card 21 (Letter Order)
Component 33

---Nov. 4 - Activity 27 - "Shape Twins"
Materials Used - Visual File Card 68 (Word Detail)
Procedure 1 only

---Nov. 5 - Activity 28 - "Geometric Shapes/Outline Figures Twins"
Materials Used - Reuse Activity 27 materials folder as described on Visual File Card 68.
Procedure 2 - If class size is 13 or less, activity will be an individual one; if class size is 14 or more, activity will be one that is completed in pairs with one student doing the activity and one student acting as a judge of the correctness of the first child's choices. Students will then exchange roles and play the game again.

---Nov. 6 - Activity 29 - "Outline Figures Lotto"
Materials Used - Investigator constructed game

---Nov. 7 - Activity 30 - "Geometric Shapes Lotto"
Materials Used - Investigator constructed game

---Nov. 10 - Activity 31 - "Geometric Shapes/Outline Figure Memory Game"
Materials Used - Chalkboard

---Nov. 11 - Activity 32 - "Geometric Form/Outline Figure Double Match"
Materials Used - Investigator constructed game

---Nov. 12 - Activity 33 - "Geometric Form/Outline Figure Double Match"
Materials Used - Investigator constructed game.
If class size is 12 or less, the activity will be conducted in pairs; if class size is 13-18, activity will be conducted in groups of 3; if class size is 19-24, activity will be conducted in groups of 4; if class size is 25-30, activity will be conducted in groups of 5.

---Nov. 13 - Activity 34 - "Visual Practice Sheets"
Materials Used - Investigator constructed visual practice sheets, designed to increase children's ability to discriminate details in outline figures.

---Nov. 17 - Activity 35 - "Visual Practice Sheets"
Materials Used - Investigator constructed visual practice sheets, designed to increase children's ability to discriminate details in geometric forms.

---Nov. 18 - Gates MacGinitie Test

---Nov. 19-Nov. 26 - PRS Test

---Dec. 1 - Mail tests to me.

---March 22 - Gates MacGinitie

---March 23-30 - PRS Test

---March 31 - Mail tests to me.

SCHEDULE FOR TEACHING THE ACTIVITIES IN THE EXPERIMENT

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISTINGUISH THE ORDER OF LETTERS

---Sept. 29 - Activity 1 - "Ordered Letters"
Materials Used - Visual File Card 26 (Letter Order)
Component 32 and Flannel Board

---Sept. 30 - Activity 2 - "Letter Shapes"
Materials Used - Visual File Card 27 (Letter Order)

---Oct. 1 - Activity 3 - "Order Line Drawing"
Materials Used - Visual File Card 47 (Letter Order)
Reference to Visual File Card 34 (Letter Order)

---Oct. 2 - Activity 4 - "Letter Pick A Pair"
Materials Used - Visual File Card 29 (Letter Order)
Component 37 - Pick A Pair Letters
Omit activities referring to Pick A Pair Shape
Component 33

---Oct. 3 - Activity 5 - "Letter Order Lotto"
Materials Used - Visual File Card 28 (Letter Order)
Component 36 - Lotto Board and Letters
Both Procedures 3 and 1 will be used, in this order, if time permits.

---Oct. 6 - Activity 6 - "Letter Order Lotto"
Materials Used - Visual File Card 28 (Letter Order)
Component 36 - Letter Lotto Board & Letters
Procedure 1 will be continued briefly. Procedure 2 will be implemented for the majority of the lesson time period.

---Oct. 7 - Activity 7 - "Visual Class Chart IV"
Materials Used - Visual File Card 32 (Letter Order)
Visual Class Chart IV
Visual Practice Sheets 4 and 5

---Oct. 8 - Activity 8 - "Extra Help: Practice Sheets"
Materials Used - Visual File Card 35 (Letter Order)
Visual Practice Sheets 6, 7, 13 and 14
Clear Plastic Overlay
All three Procedures will be used - 1 on Visual Practice Sheet 6, 2 on Visual Practice Sheet 7, 3 on Visual Practice Sheet 13 and 14.

---Oct. 9 - Activity 9 - "Letter Order Dominoes"
Materials Used - Visual File Card 36 (Letter Order)
Component 39 - Letter Order A Dominoes
Procedure 1 used

---Oct. 10 - Activity 10 - "Letter Order Dominoes"
Materials Used - Visual File Card 36 (Letter Order)
Component 39 - Letter Order A Dominoes
Both Procedures 2 and 3 will be used, if time permits.

---Oct. 13 - Activity 11 - "Turn Around Game" and "Letter Checking"
Materials Used - Visual File Cards 50 & 51 (Letter Orientat
Clear Plastic Overlay

---Oct. 14 - Activity 12 - "Orientation Move It To Prove It"
Materials Used - Visual File Card 52 (Letter Orientation)
Flannel Board
Component 32 - Felt Letters
Both Procedures 1 and 2 will be used, if time permits.

---Oct. 15 - Activity 13 - "Orientation Line Drawing"
Materials Used - Visual File Card 65 (Letter Orientation)

---Oct. 16 - Activity 14 - "Same and Different Game"
Materials Used - Visual File Card 54 (Letter Orientation)
Component 42 - Letter Orientation B Letter
Both Procedures 1 and 2 will be used, if time permits.

---Oct. 17 - Activity 15 - "Letter Orientation Lotto"
Materials Used - Visual File Card 55 (Letter Orientation)
Component 43 - Letter Orientation B Lotto Board and Letters
Both Procedures 3 and 1, in this order, will be used.

---Oct. 20 - Activity 16 - "Letter Orientation Lotto"
Materials Used - Visual File Card 55 (Letter Orientation)
Component 43 - Letter Orientation B Lotto Board and Letters
Procedure 1 will be continued and Procedure 2 added.

---Oct. 21 - Activity 17 - "Patience"
Materials Used - Visual File Card 59 (Letter Orientation)
Pocket Chart
Component 45 - Matching Letters
Procedure 1 only will be used.

---Oct. 22 - Activity 18 - "Patience"
Materials Used - Visual File Card 59 (Letter Orientation)
Pocket Chart
Component 45 - Matching Letters
Procedure 2 only will be used.

---Oct. 23 - Activity 19 - "Visual Class Chart VI"
Materials Used - Visual File Cards 60 & 61 (Letter Orientation)
Visual Class Chart VI
Visual Practice Sheets 8 & 17

---Oct. 24 - Activity 20 - "Visual Class Chart VIII"
Materials Used - Visual File Cards 63 & 64 (Letter Orientation)
Visual Class Chart VIII
Visual Practice Sheets 15 & 16

---Oct. 27 - Activity 21 - "Letter Orientation Dominoes"
Materials Used - Visual File Card 56 (Letter Orientation)
Component 44 - Letter Orientation Dominoes
Procedure 1 will be used if class size is 10 or less.
Procedure 2 will be used if class size is 11 or more.

---Oct. 28 - Activity 22 - "Extra Help: Pick A Pair"
Materials Used - Visual File Card 57 (Letter Orientation)
Ditto of the Take-Home Balloon Game
Procedure 1 used only

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISTINGUISH THE DETAILS IN WORDS

---Oct. 29 - Activity 23 - "Detail Dot"
Materials Used - Visual File Card 67 (Word Detail)
Flannel Board
Component 32 - Felt Letters
Three yellow dots
Procedures 1 and 2 only will be used.

---Oct. 30 - Activity 24 - "Detail Line Drawing"
Materials Used - Visual File Card 71 (Word Detail)
Procedures 1 and 2 will be used, if time permits.

---Oct. 31 - Activity 25 - "Detail Word Twins"
Materials Used - Visual File Card 68 (Word Detail)
Component 46 - Word Detail Twin Cards
Pocket Chart
Procedure 1 only will be used.

---Nov. 3 - Activity 26 - "Detail Word Twins"
Materials Used - Visual File Card 68 (Word Detail)
Component 46 - Word Detail Twin Cards
Component 50
Procedure 2 only - If class size is 13 or less, activity will be an individual one; if class size is 14 or more, activity will be one completed in groups of two.

---Nov. 4 - Activity 27 - "Word Detail Lotto"
Materials Used - Visual File Card 69 (Word Detail)
Component 47 - Word Detail Lotto Board and Letters

---Nov. 5 - Activity 28 - "Detail Pick A Pair"
Materials Used - Visual File Card 70 (Word Detail)
Component 48 - Matching Detail Cards
Procedure 1 only

---Nov. 6 - Activity 29 - "Visual Class Chart VII"
Materials Used - Visual File Cards 72 & 73 (Word Detail)
Visual Class Chart VII
Visual Practice Sheets 9, 10 & 20
This activity is designed to complete Visual Practice Sheets 9 & 10 only. Students may proceed to Visual Practice Sheet 20 if they complete 9 & 10 early.

---Nov. 7 - Activity 30 - "Visual Practice Sheets"
Materials Used - Visual File Cards 73 & 75 (Word Detail)
Visual Practice Sheets 20, 18 & 19
Students begin or complete Visual Practic Sheet 20, then proceed to work Visual Practice Sheets 18 & 19 individually and independently.

---Nov. 10 - Activity 31 - "Detail Triple Choice"
Materials Used - Visual File Card 76 (Word Detail)
Pocket Chart
Component 48 - Triple Choice Cards

---Nov. 11 - Activity 32 - "Double Match"
Materials Used - Visual File Card 77 (Word Detail)
Component 49 - Double Match Cards
Procedure 1 only

---Nov. 12 - Activity 33 - "Double Match"
Materials Used - Visual File Card 77 (Word Detail)
Component 49 - Double Match Cards
Procedure 2 will be used - If class size is 12 or less, activity will be conducted in pairs; if class size is 13-18, activity will be conducted in groups of 3; if class size is 19-24, activity will be conducted in groups of 4; if class size is 25-31, activity will be conducted in groups of 5.

---Nov. 13 - Activity 34 - "Memory Game"
Materials Used - Visual File Card 79 (Word Detail)
Flannel Board
Component 32 - Felt Letters

---Nov. 17 - Activity 35 - "Visual Practice Sheet 21"
Materials Used - Visual File Card 83 (Word Detail)

---Nov. 18 - Gates MacGinitie Test - Mail to me.

---Nov. 19-26 - PRS Test

---Dec. 1 - Mail tests to me.

---March 22 - Gates MacGinitie Test

---March 23-March 30 - PRS Test

---March 31 - Mail tests to me.

Activity -- Visual Practice Sheets

Purpose: To give practice in deciding which set of shapes and/or figures is identical to a stimulus set of shapes and/or figures.

Group Size: Individual

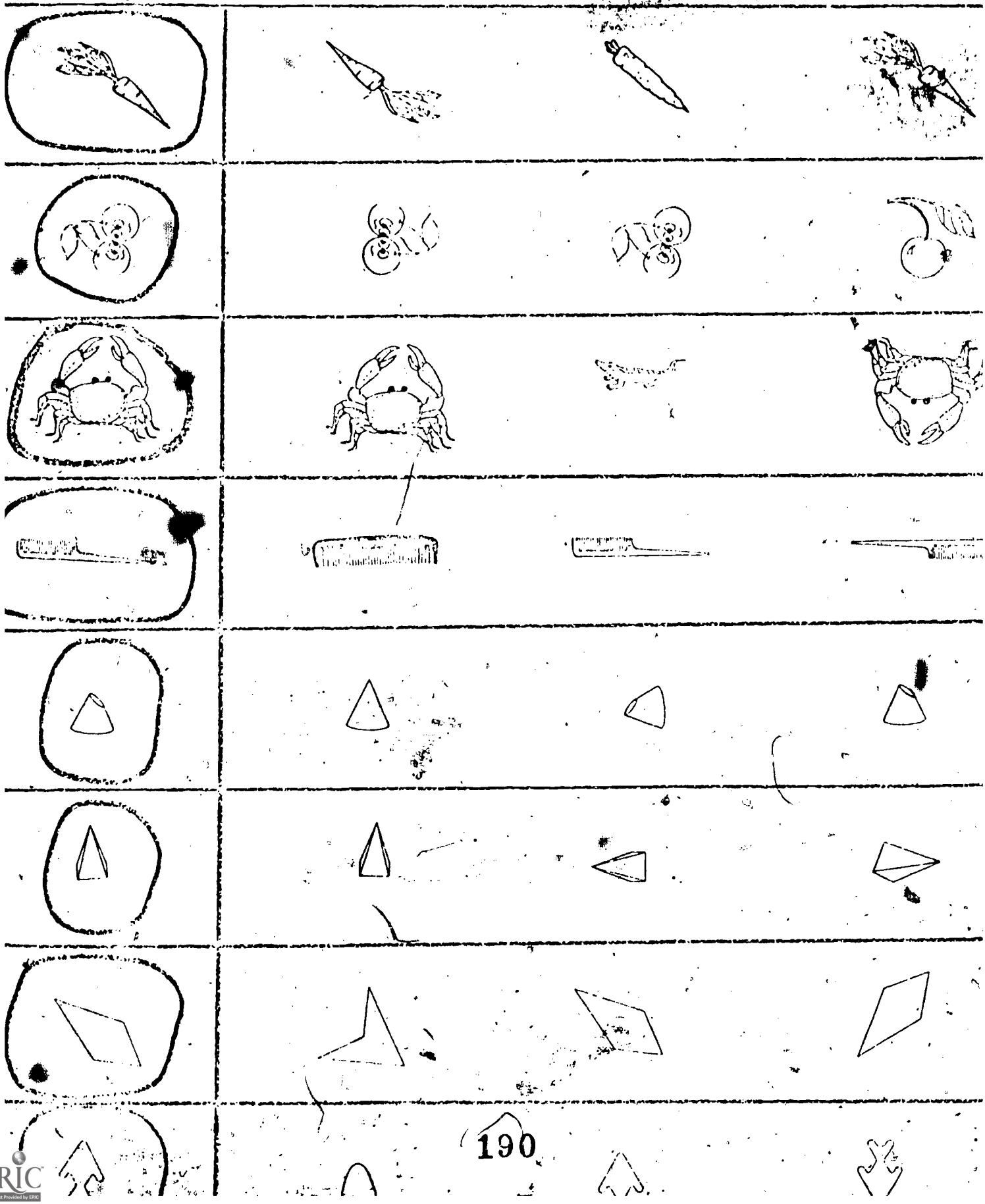
Steps: Hold up a copy of the practice sheet. Tell the children that now they will each have a turn to look for the set of shapes that is the same as the ringed set of shapes.

Have each child write his name on each practice sheet.

Let the children work independently on the practice sheets. As they work walk around the room and check that they have understood the directions and are doing each row.

As the children finish, correct their papers.

Directions: Draw a ring around the shape that looks the same as the ringed shape



Activity 8 --Geometric Shapes Dominoes

Purpose: To develop attentiveness to the order of shapes.

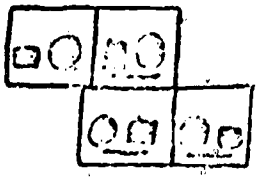
Group Size: Large group

Materials: Enclosed Dominoes

Steps: Hold up a domino and point to the line at the bottom. Tell the children that they should hold the domino so that this line will be at the bottom.

Put masking tape on the back of the domino and place it on the chalkboard.

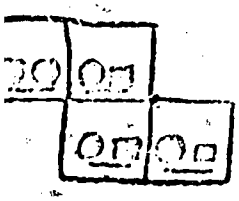
Tell the children that there are two sets of shapes on this domino. Circle each set of shapes with your finger. Explain that you will try to match one of these sets of shapes to another domino.



Pick up another domino and say that you are going to place it above the first domino to build a staircase. Point to the two sets of shapes that are above and below each other and ask if these two sets of shapes match. (The shapes should not match.)

Explain that since the two sets of shapes do not match, you cannot leave the domino where it is.

Tell the children that you are going to try to put the domino at the bottom of the staircase. Move the domino below the first domino so that it again makes a staircase.



Point to the two sets of shapes that are above and below each other and ask if these two sets of shapes are the same. (The shapes should match.)

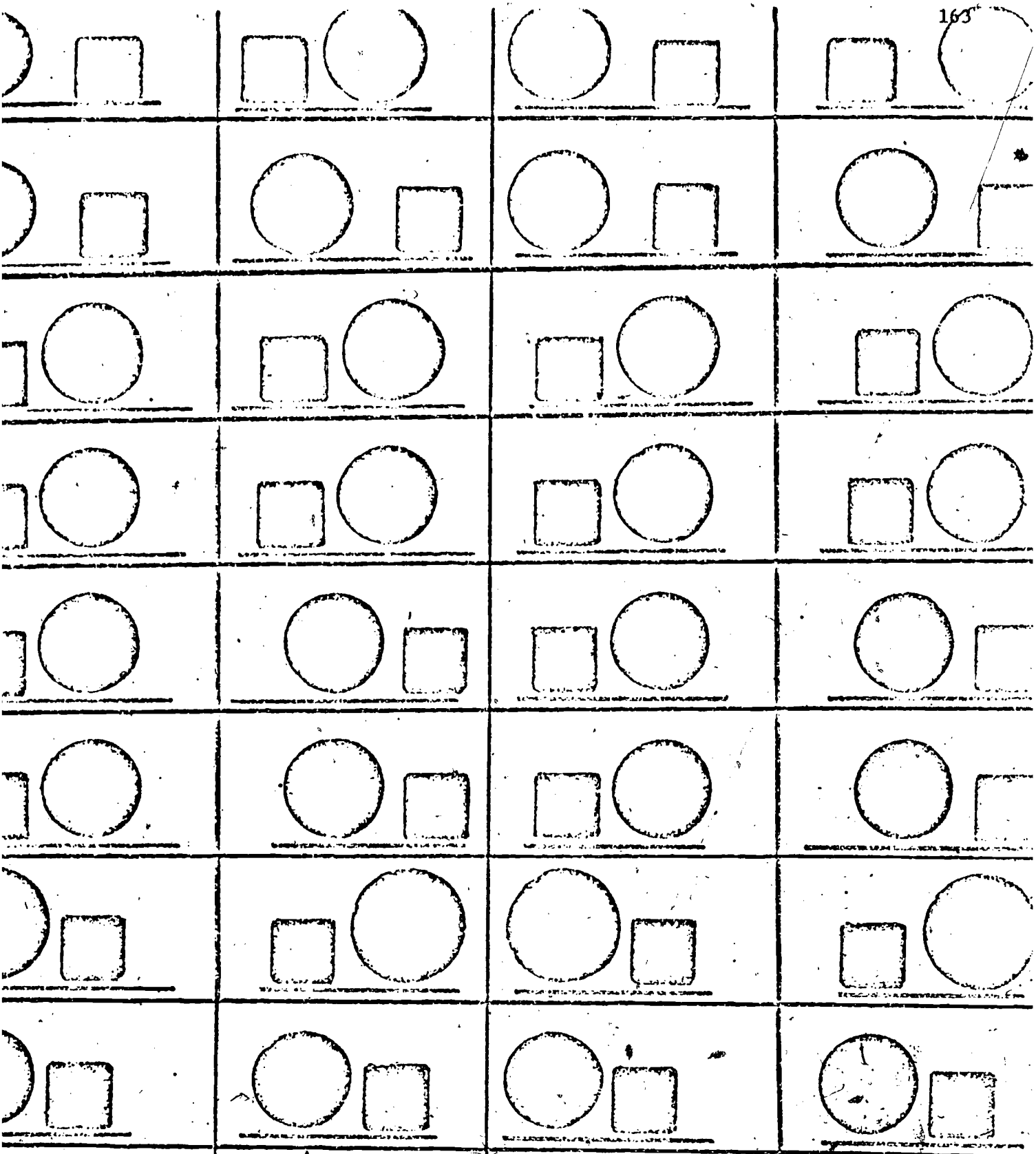
Explain that since the two sets of shapes are the same, you can leave the domino there.

Pick another domino and tell the children that you are going to add another domino. Try the domino at the top of the staircase. Point to the two sets of shapes that you have just put above and below each other and ask if these two sets of shapes are the same. (The shapes should match.) Explain that since these two sets are the same, the domino can stay where it is.

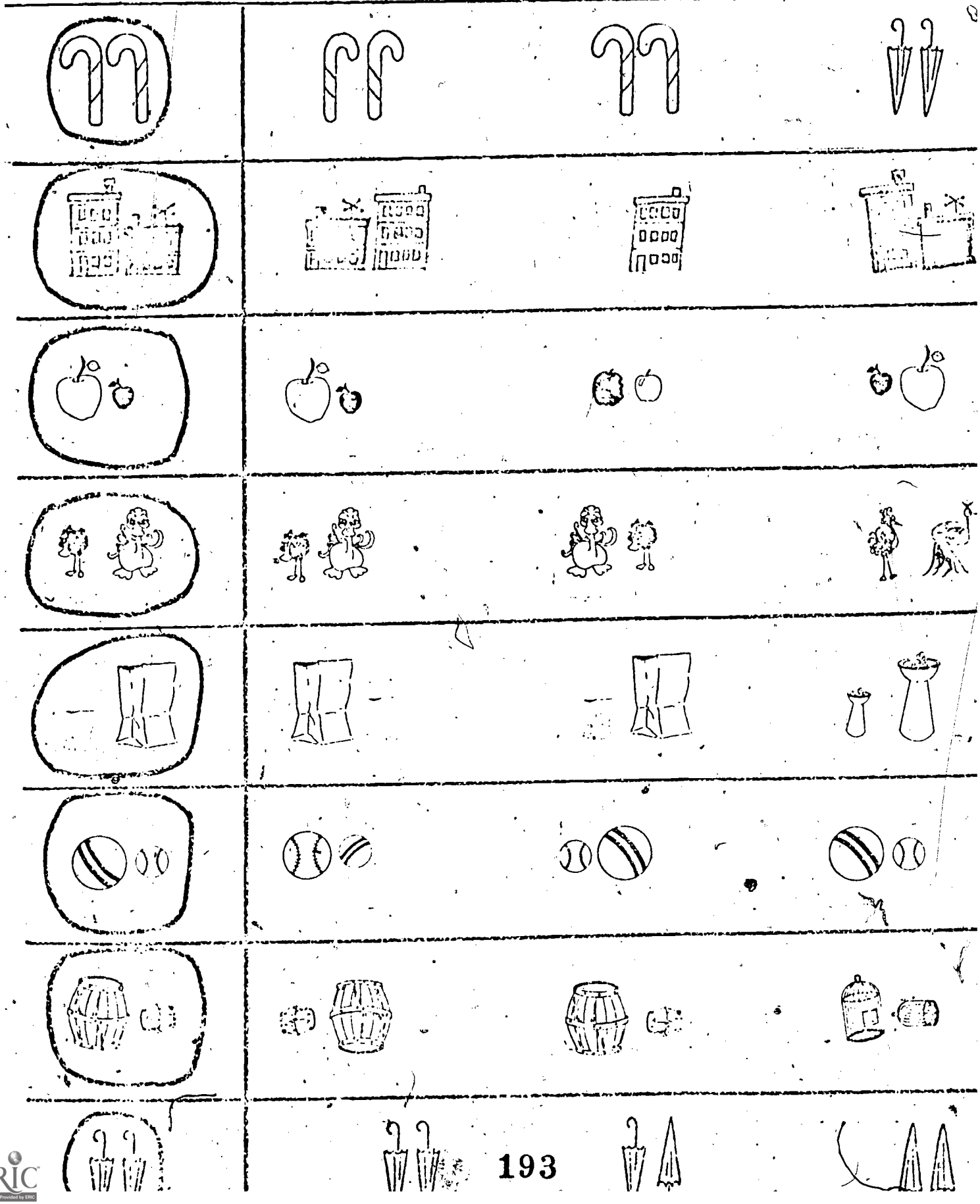
Continue building the staircase, giving different children turns to place a domino at the top and then to check to see if it can stay there. If the domino cannot stay there, the child should move it, if possible, to the bottom or select another domino to try.

Continue giving children turns until you feel confident that the children can work independently.

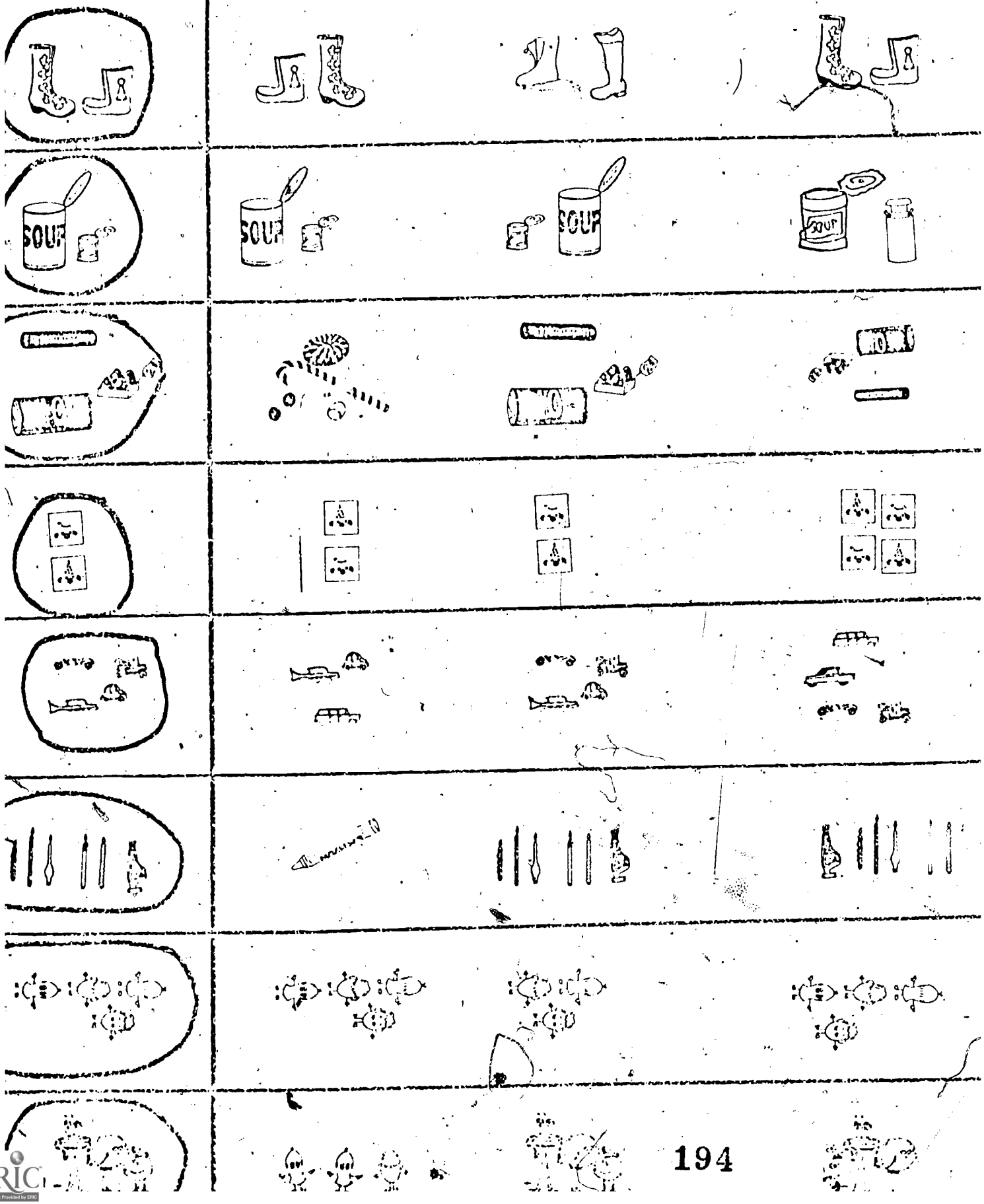
Pass out dominoes to each child. The number of dominoes each child receives will depend on the size of the total group. Be sure all children have an equal number of dominoes. Each child will then construct his own domino staircase.



Directions: Draw a ring around the shape that looks the same as the ringed sha

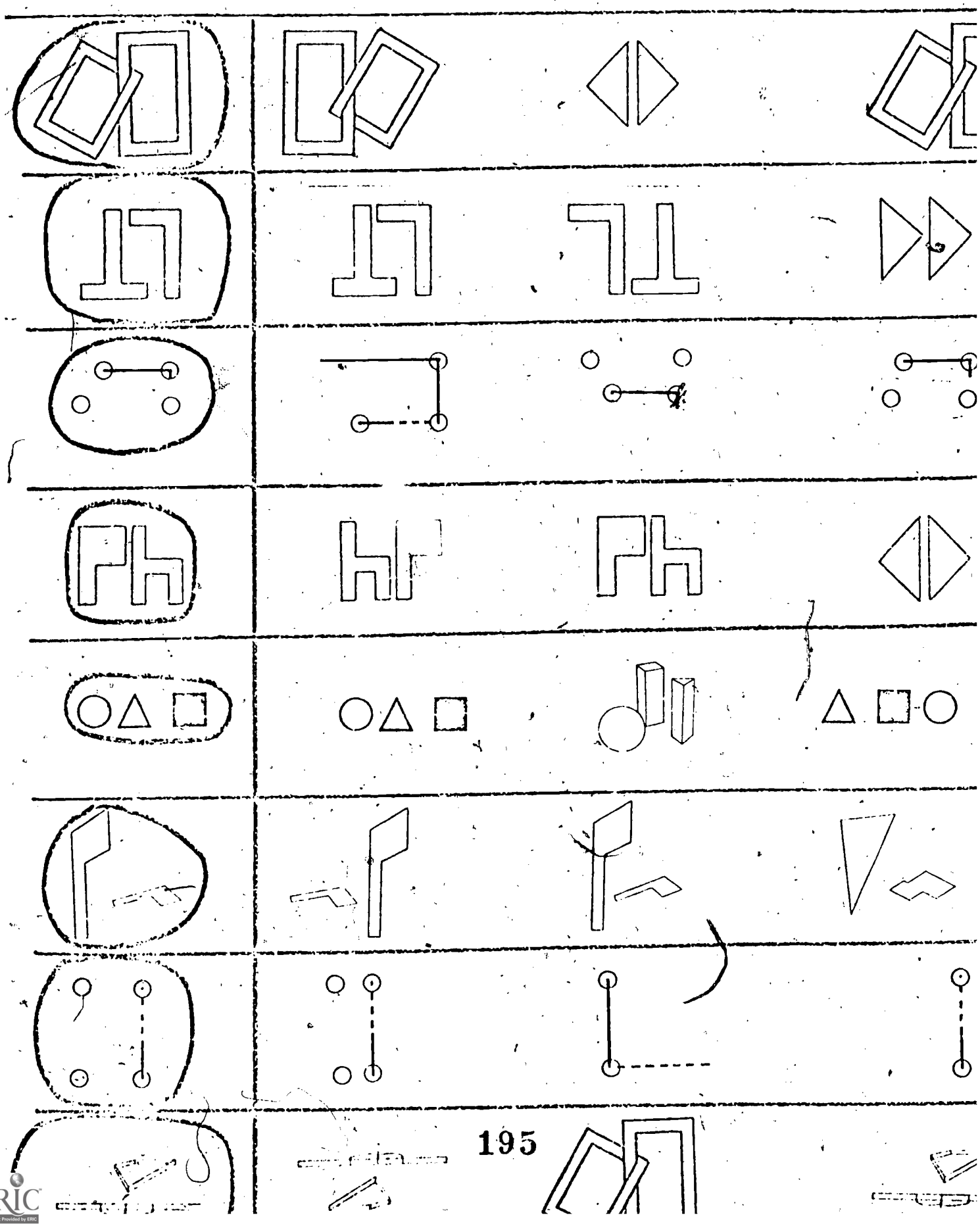


the shape that looks
the same as the ringed shape.



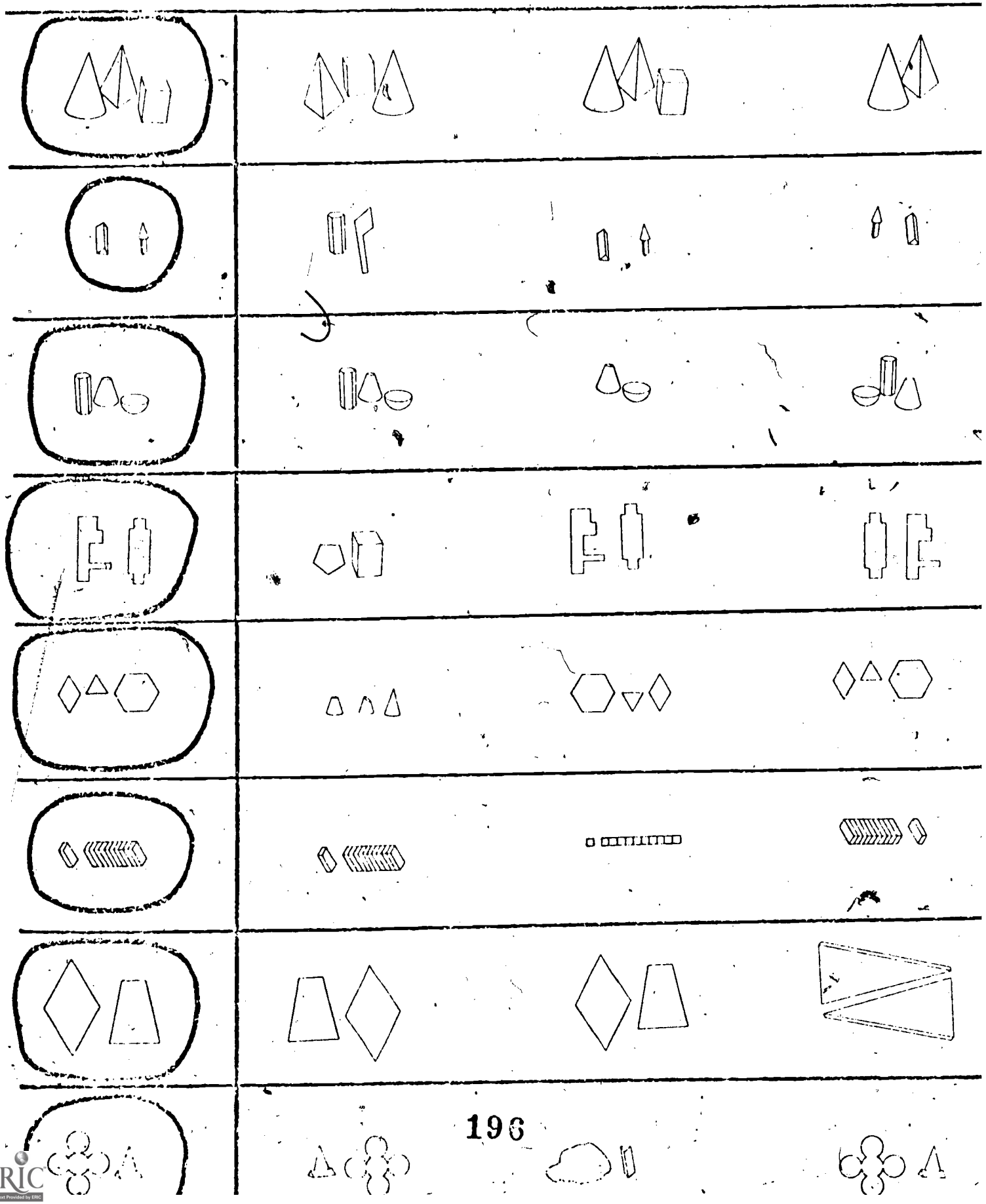
Visual Practice Sheet 3

the shape that looks
the same as the ringed sha



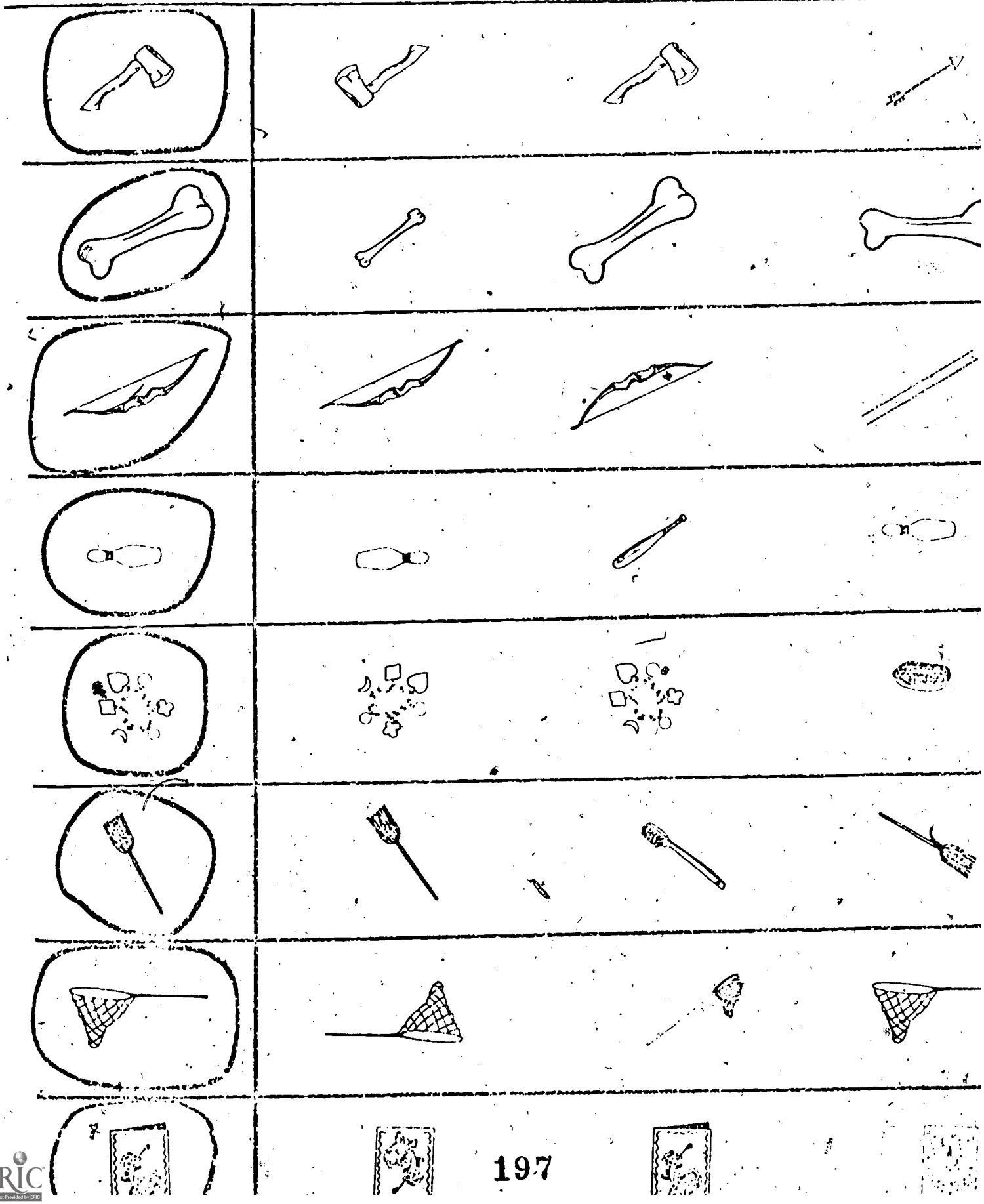
Activity 10 Geometric Shape Order
Visual Practice Sheet 4

the shape that looks
the same as the ringed shape.



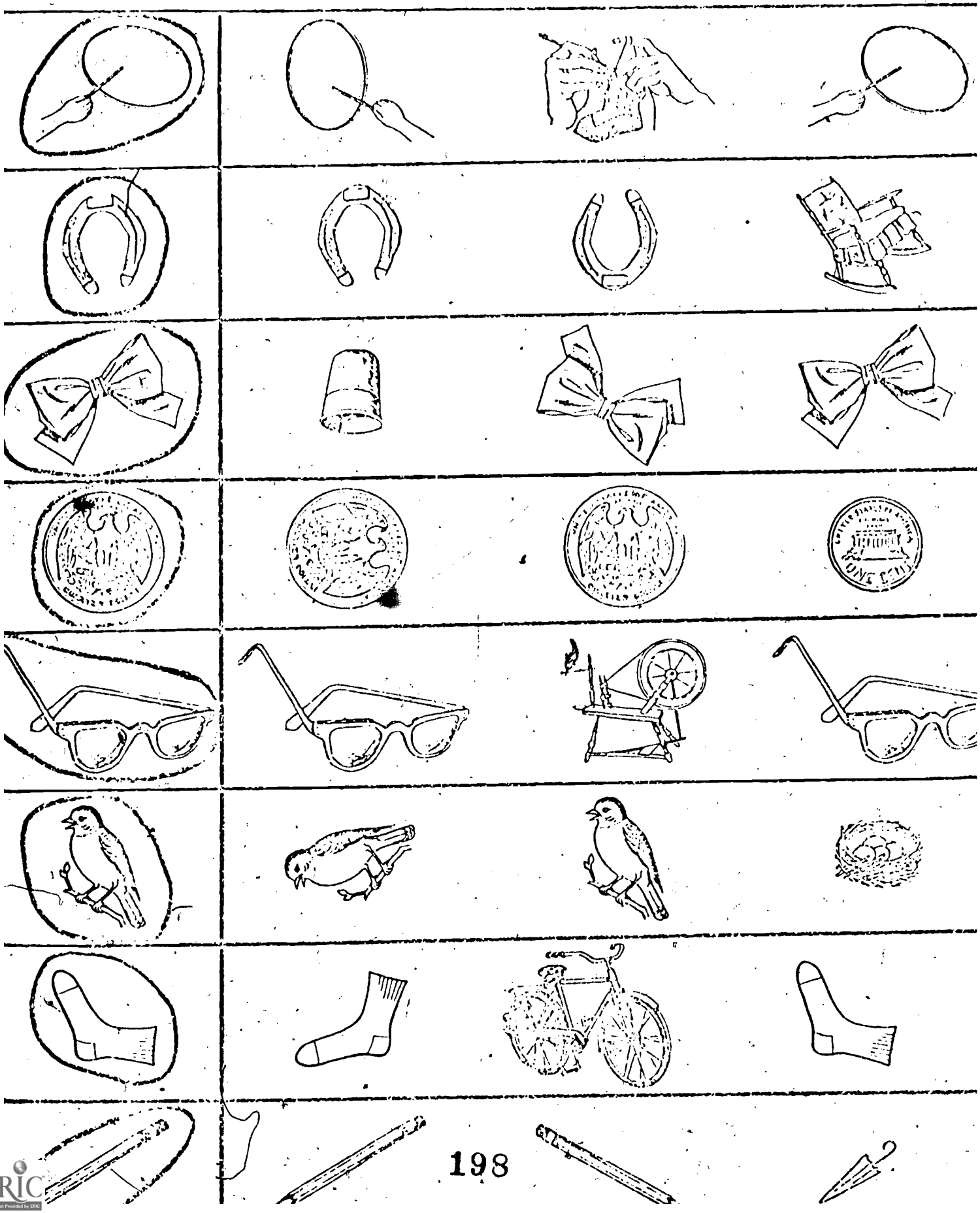
Visual Practice Sheet 1

the shape that looks
the same as the ringed sha



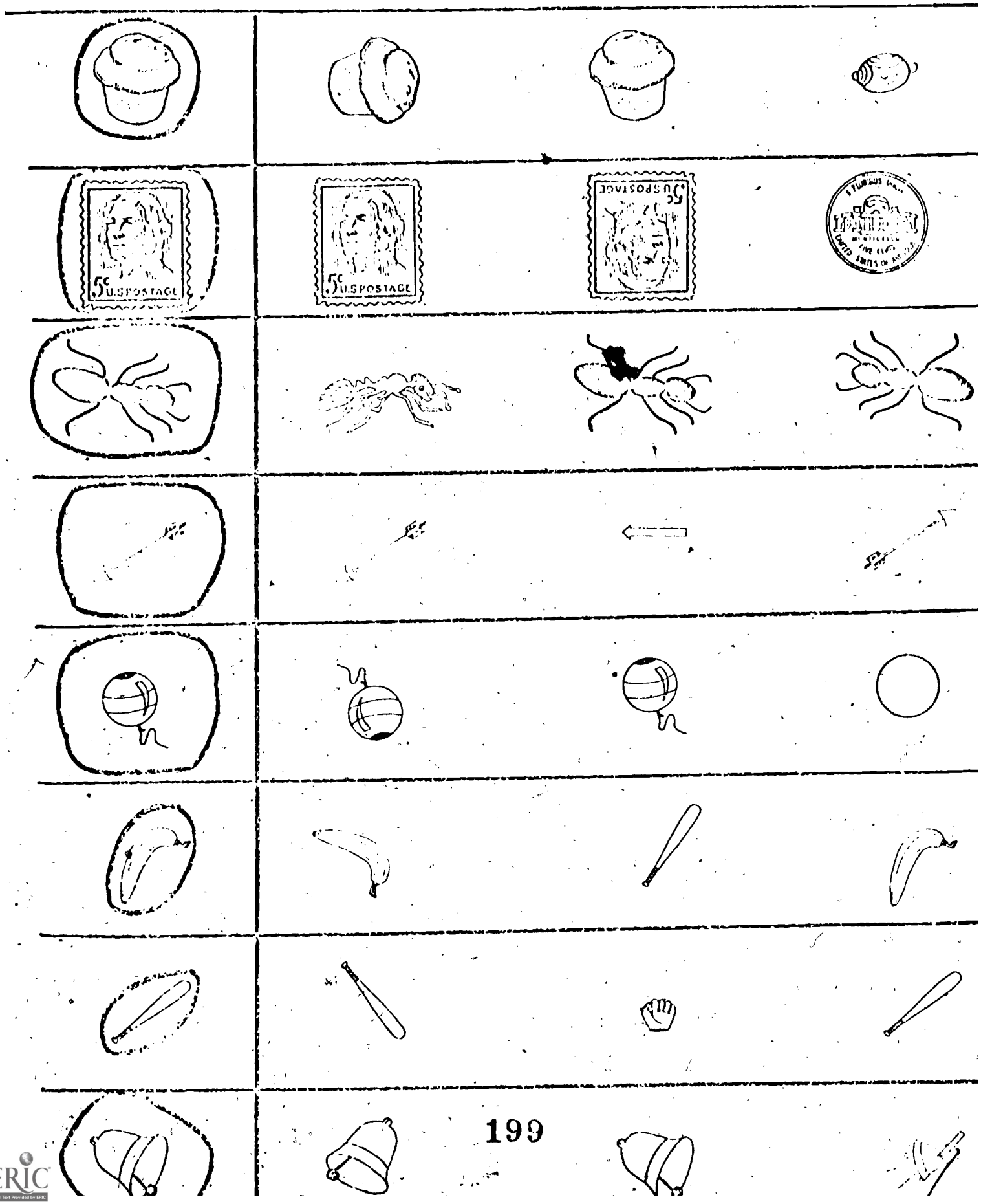
Visual Practice Sheet 2

the shape that looks
the same as the ringed shape.

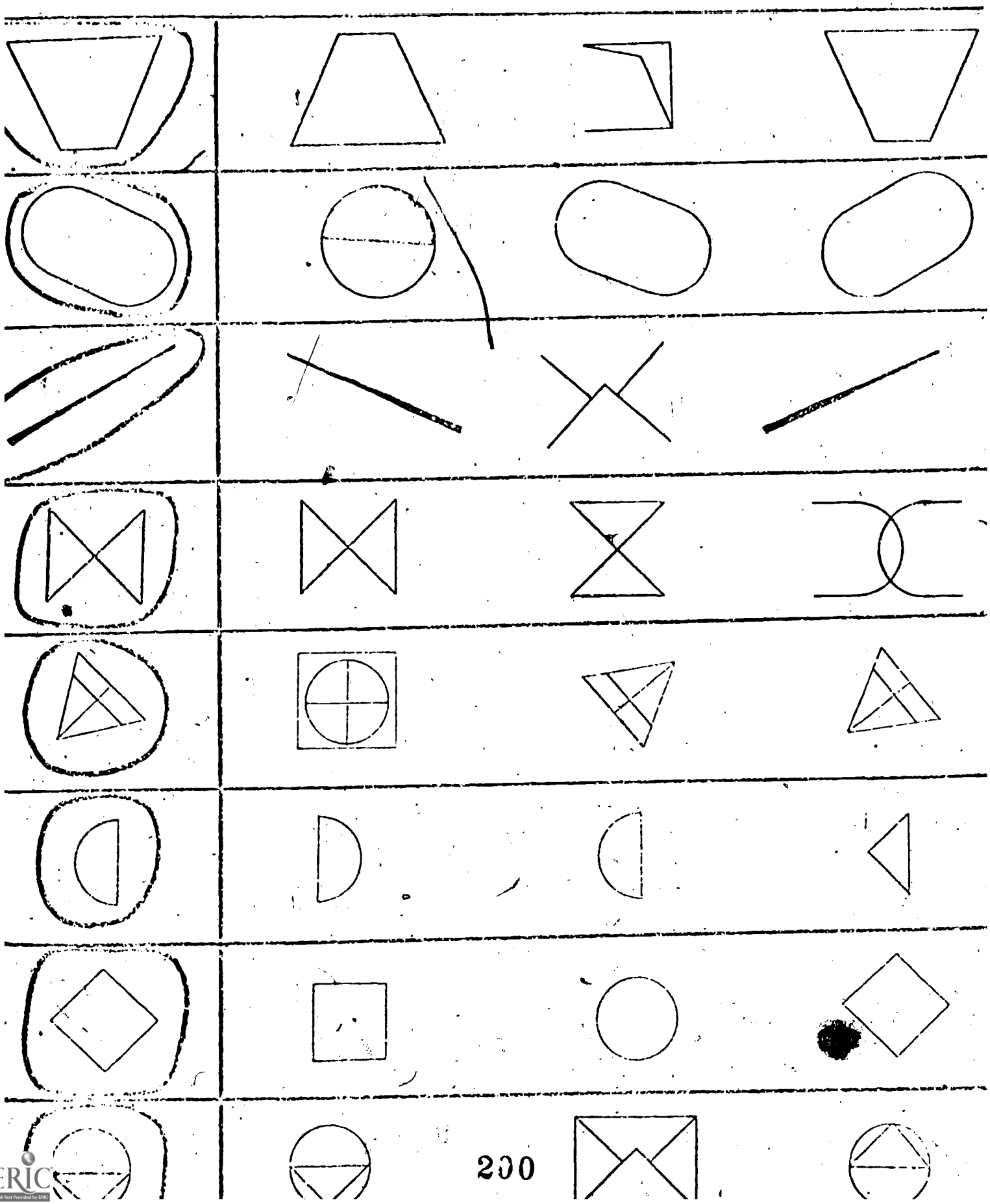


Visual Practice Sheet 3

the shape that looks
the same as the ringed sha

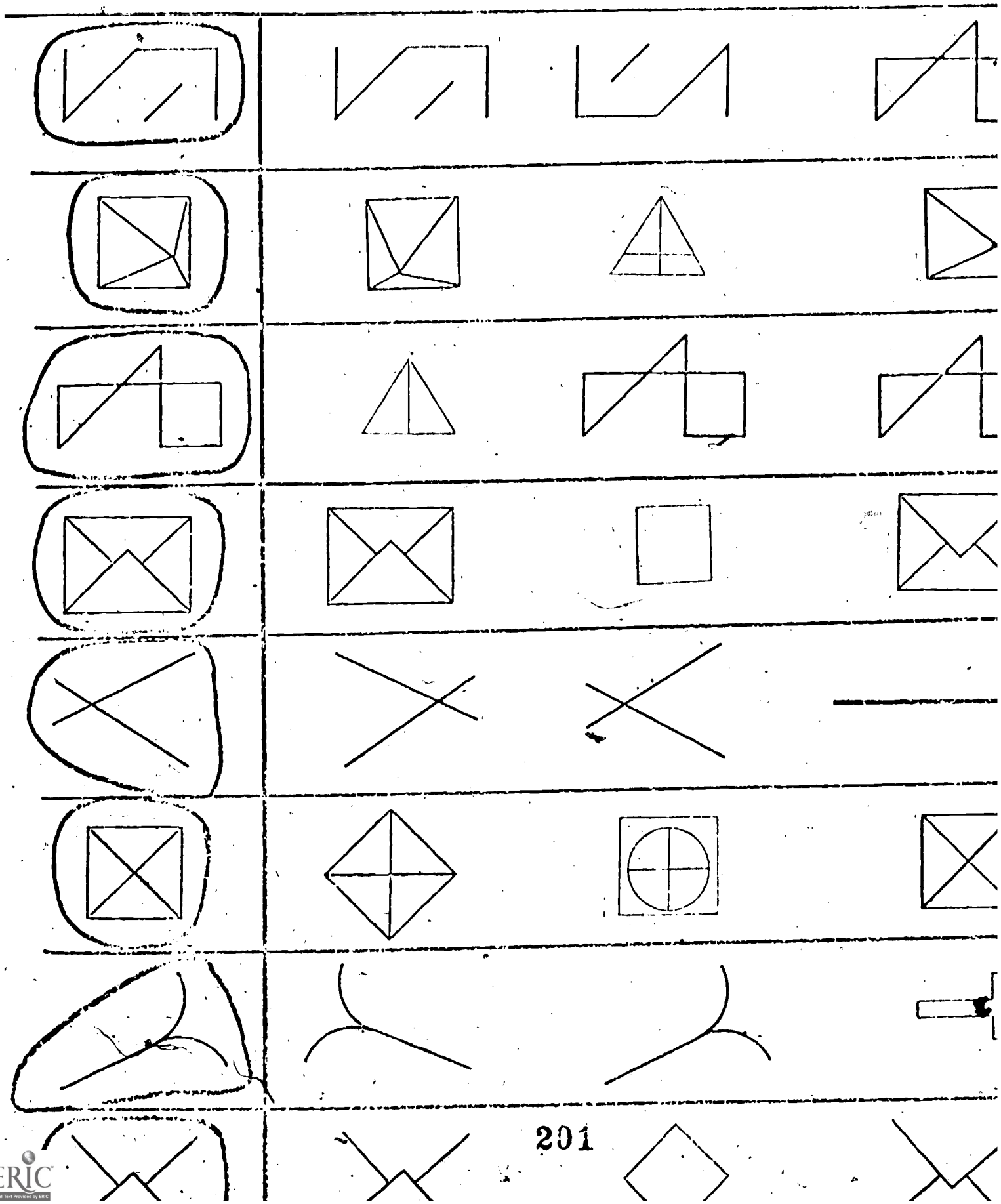


Directions: Draw a ring [illegible] the shape that looks the same as the ringed shape.



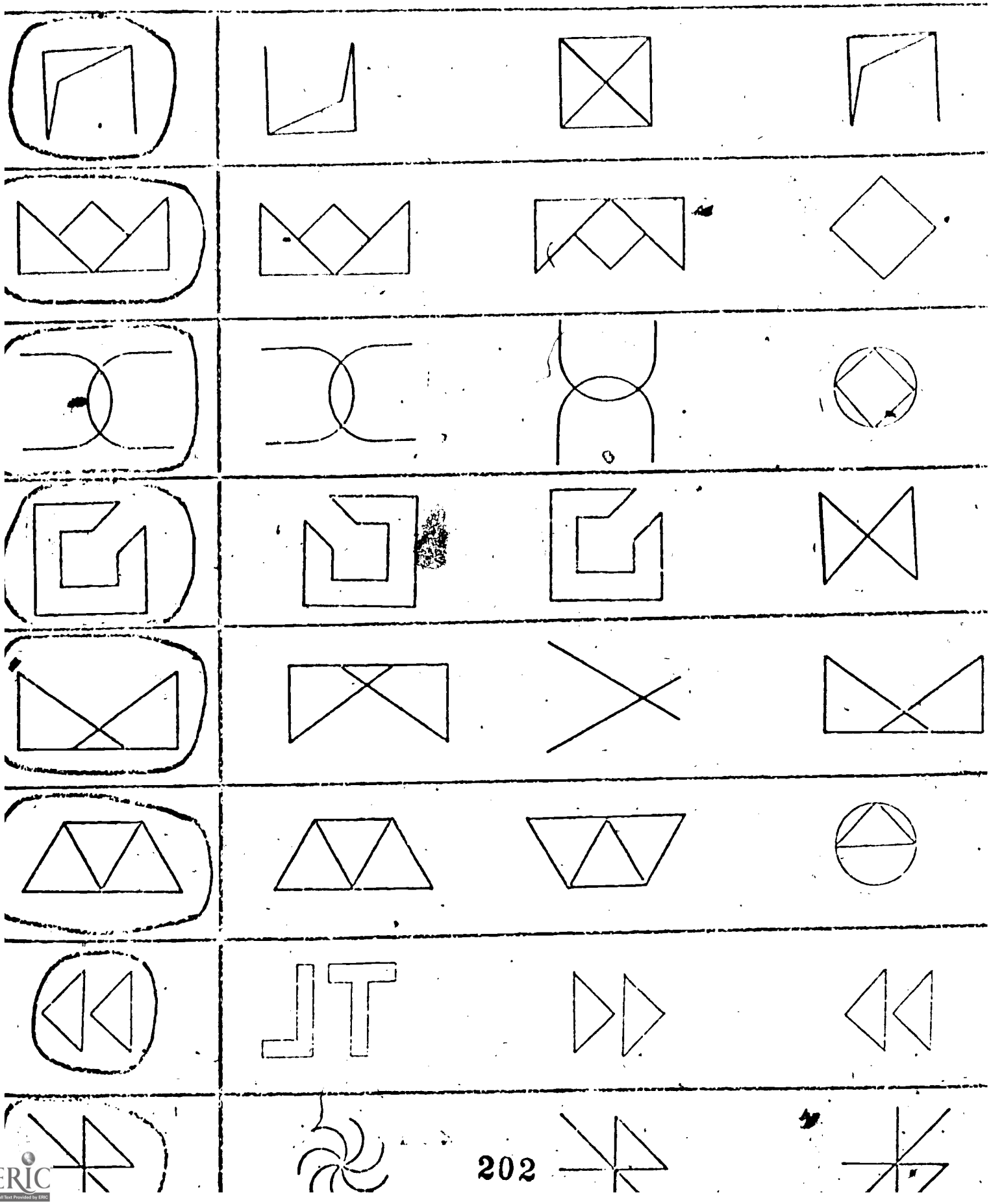
Visual Practice Sheet 2

Directions: Draw a ring around the shape that looks the same as the ringed shap



Visual Practice Sheet 3

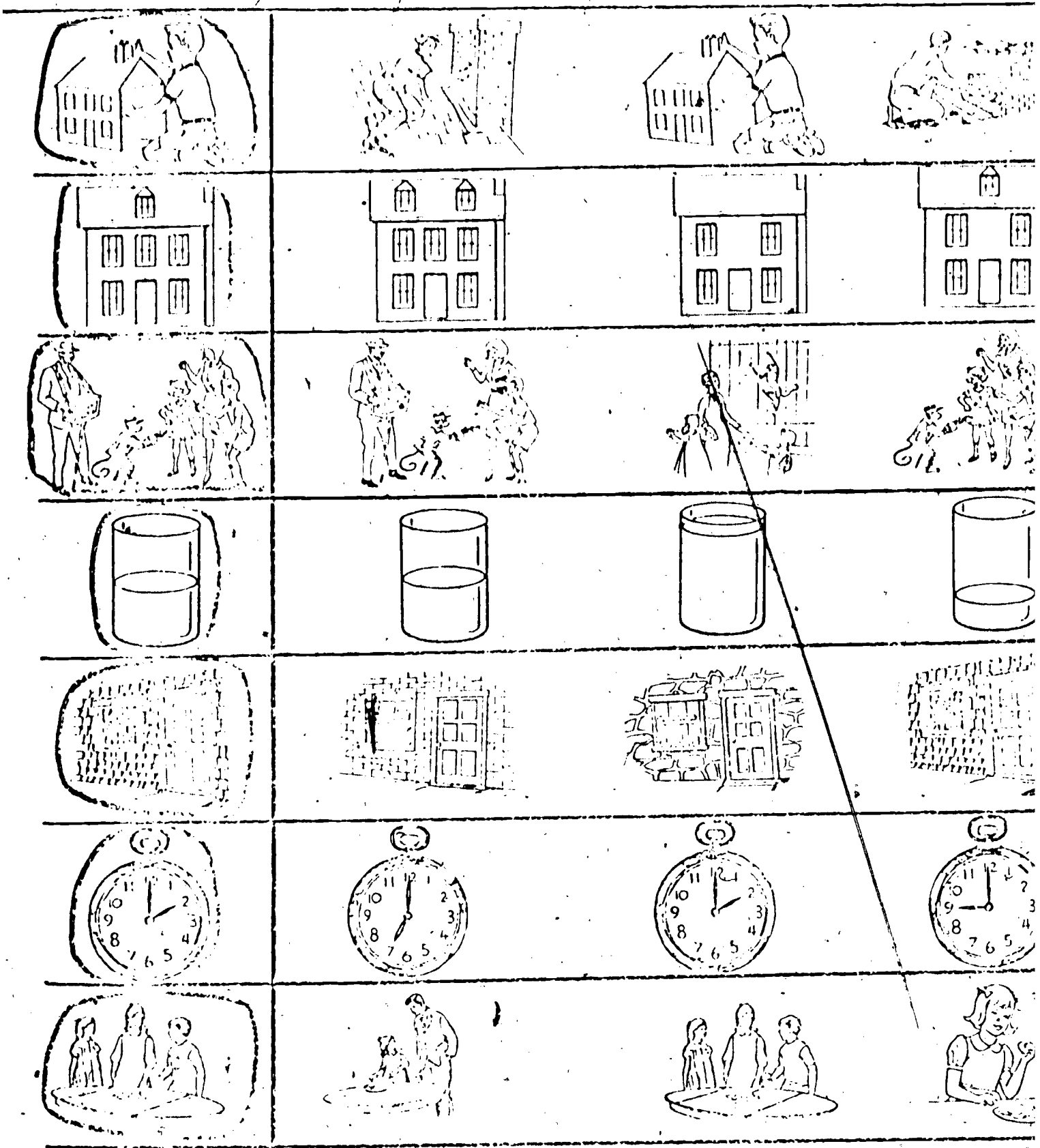
the shape that looks
the same as the ringed shape.



Activity 12--Outline Figure Detail Discrimination

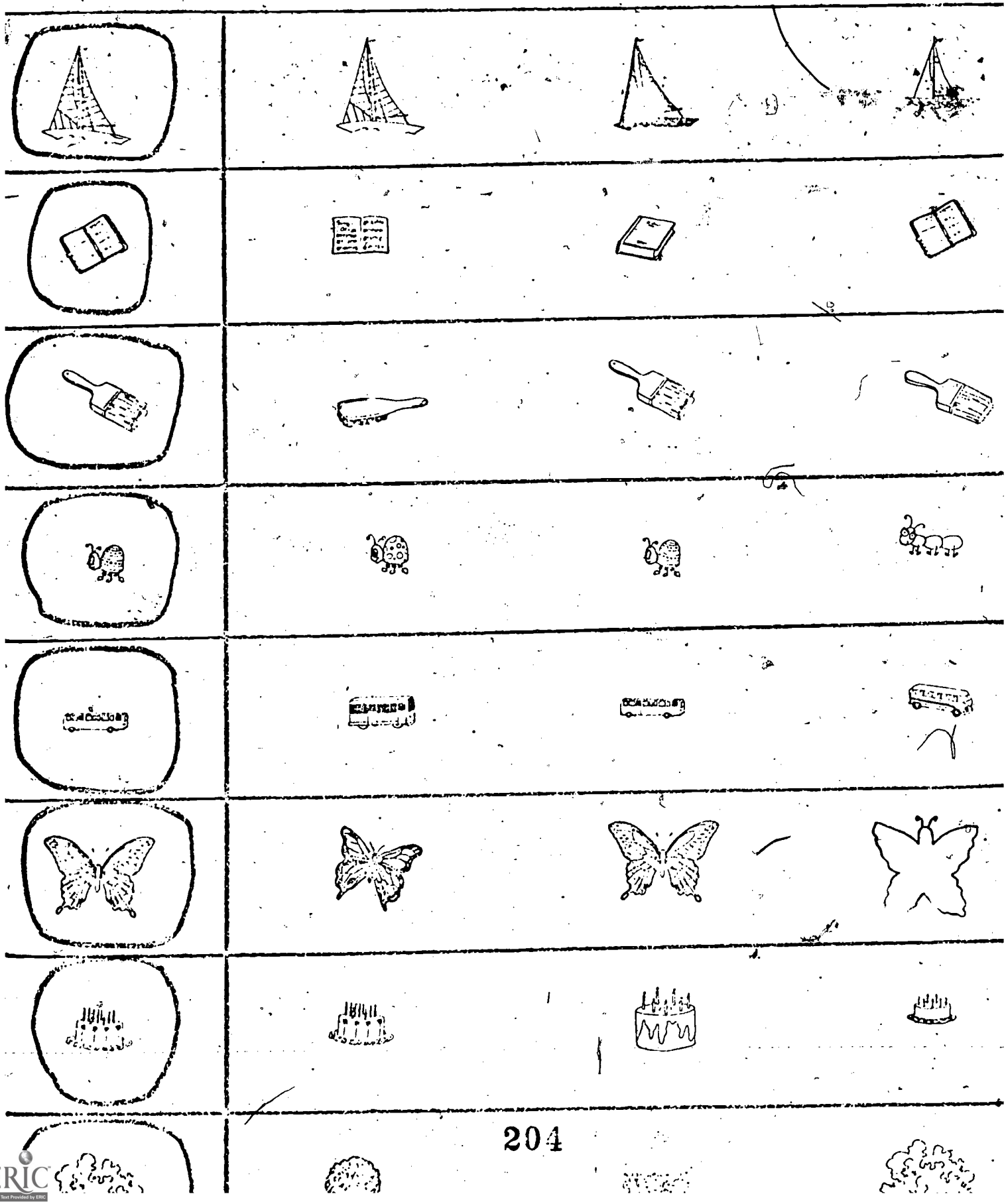
Visual Practice Sheet 3

Directions: Draw a ring around the shape that looks the same as the ringed shape



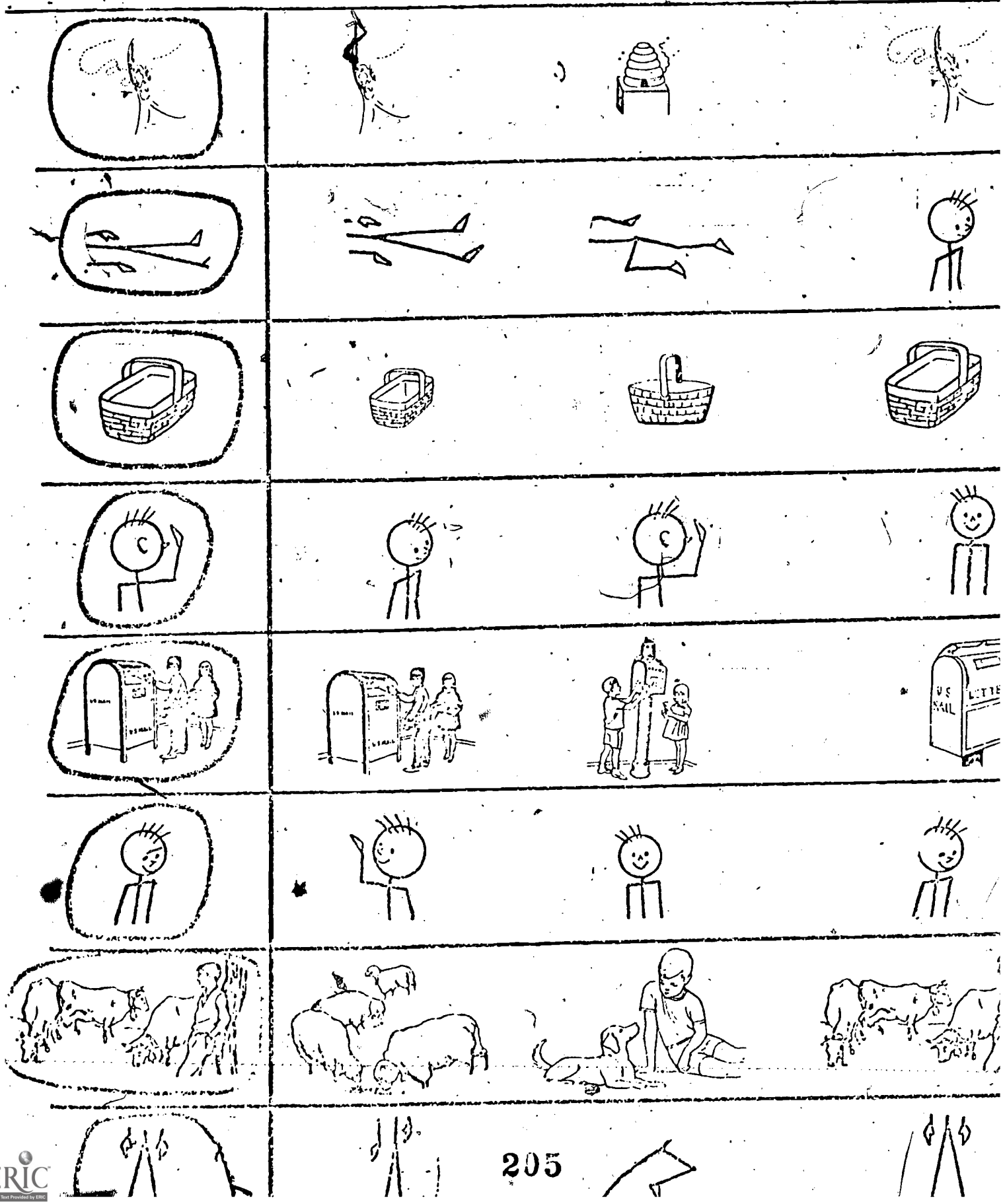
Activity 12--Outline Figure Detail Discrimination
Visual Practice Sheet 2

Directions: Draw a ring around the shape that looks the same as the ringed shape.



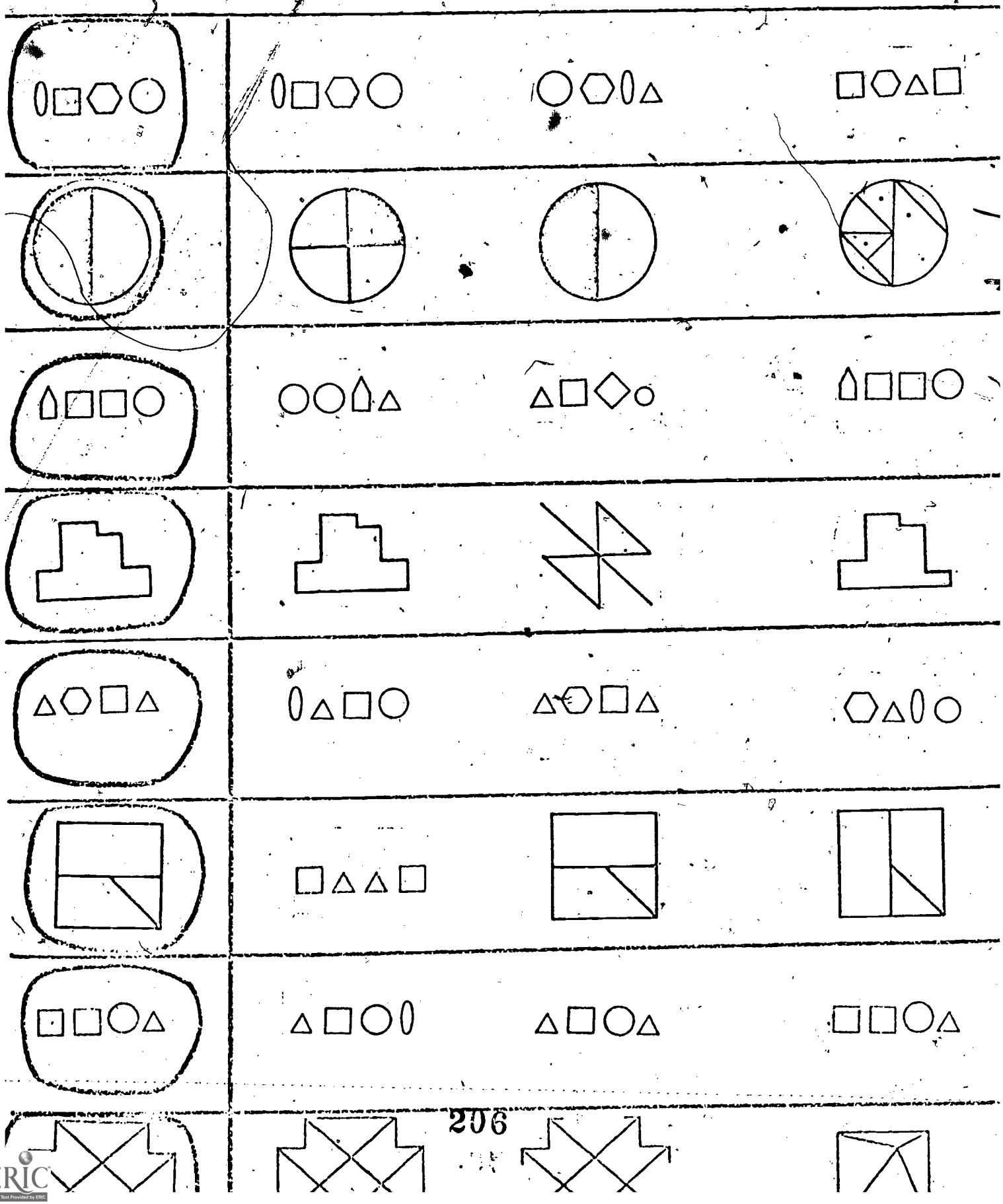
Activity 12--Outline Figure Detail Discrimination
Visual Practice Sheet 1

Directions: Draw a ring around the shape that looks the same as the ringed sha



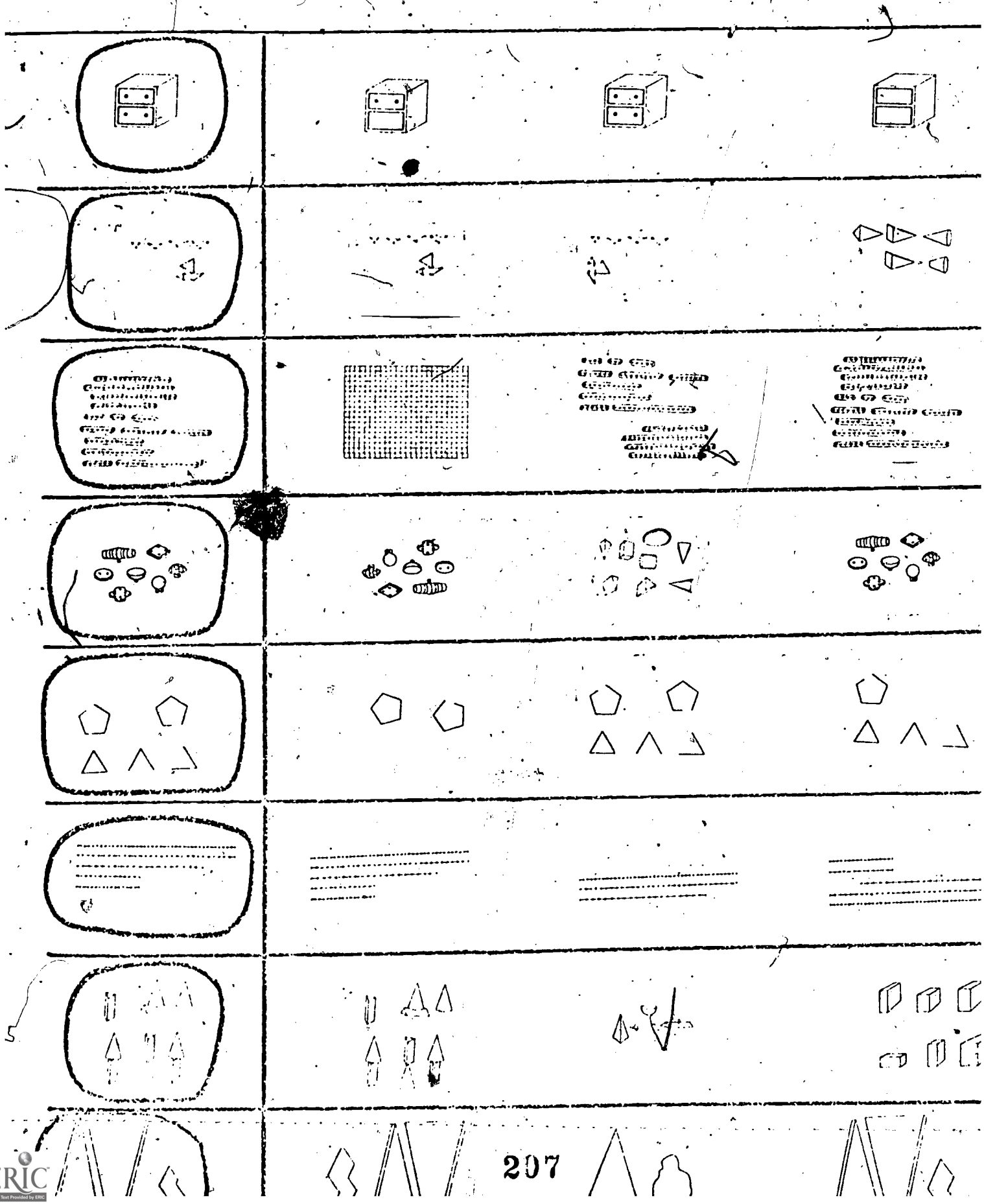
Activity 13--Geometric Shape Detail Discrimination
Visual Practice Sheet 1

Directions: Draw a ring around the shape that looks the same as the ringed shape.

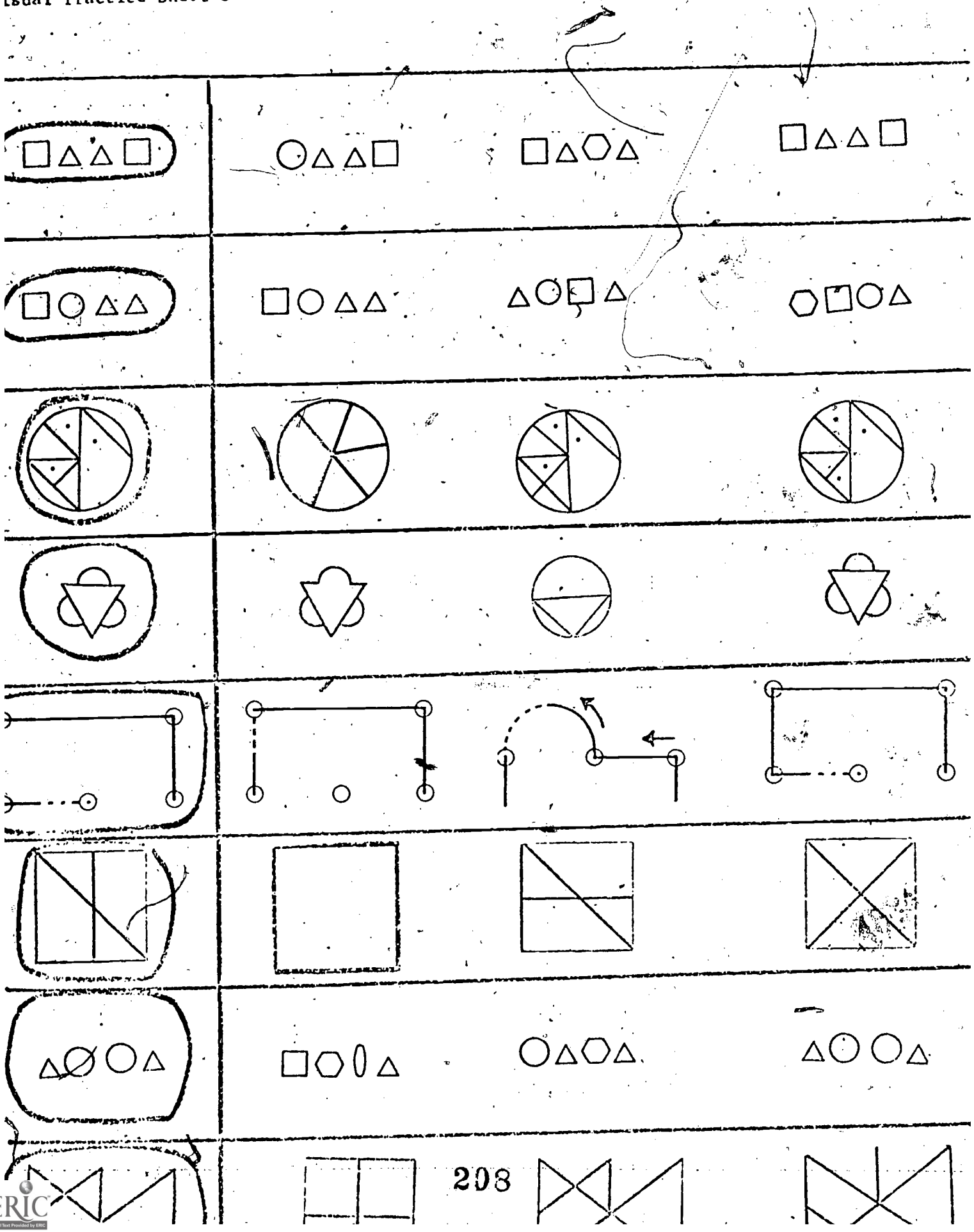


Activity 13--Geometric Shape Detail Discrimination
Visual Practice Sheet 2

Directions: Draw a ring around the shape that looks the same as the ringed sha



Directions: Draw a ring around the shape that looks the same as the ringed shape.



Activity --Geometric Shape Lotto

Purpose: To develop attentiveness to the order of shapes

Group Size: Large group

Materials: Enclosed Lotto Boards (One Lotto Board per student)
Lotto cards

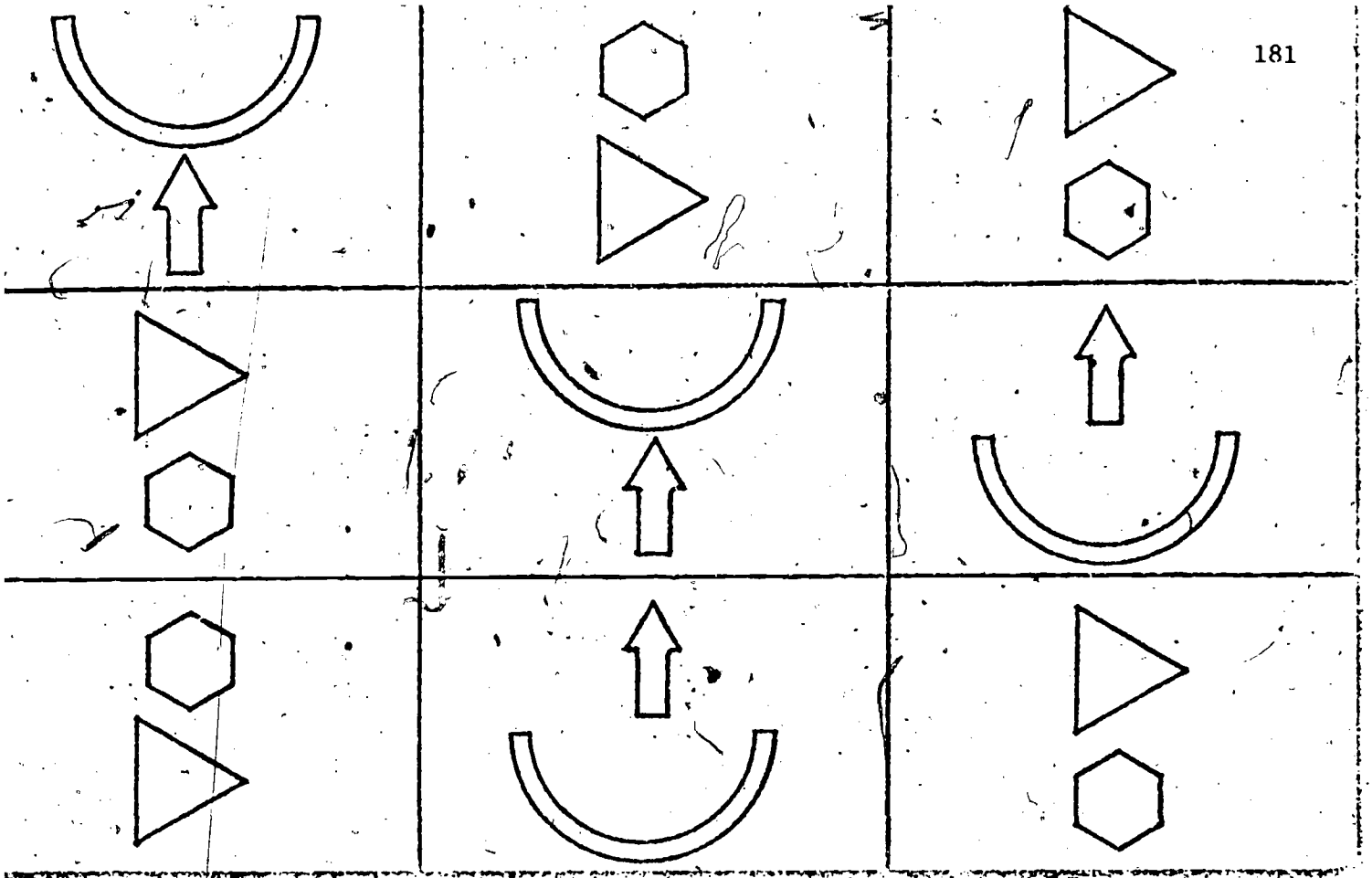
Steps: Give each child a Lotto board and have the children sit in groups of four.

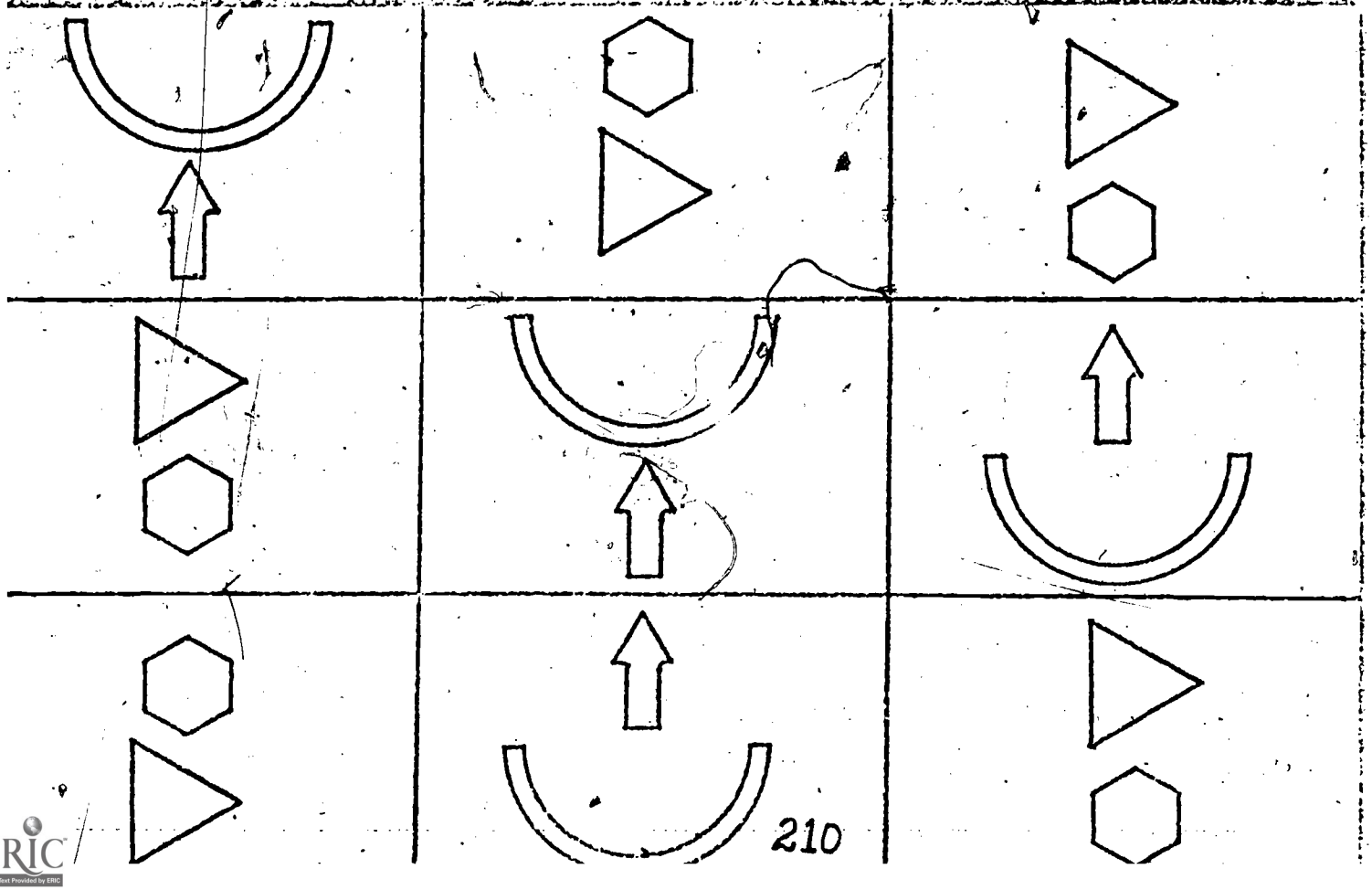
One child in each group of four places the Lotto cards facedown in the center of the playing area.

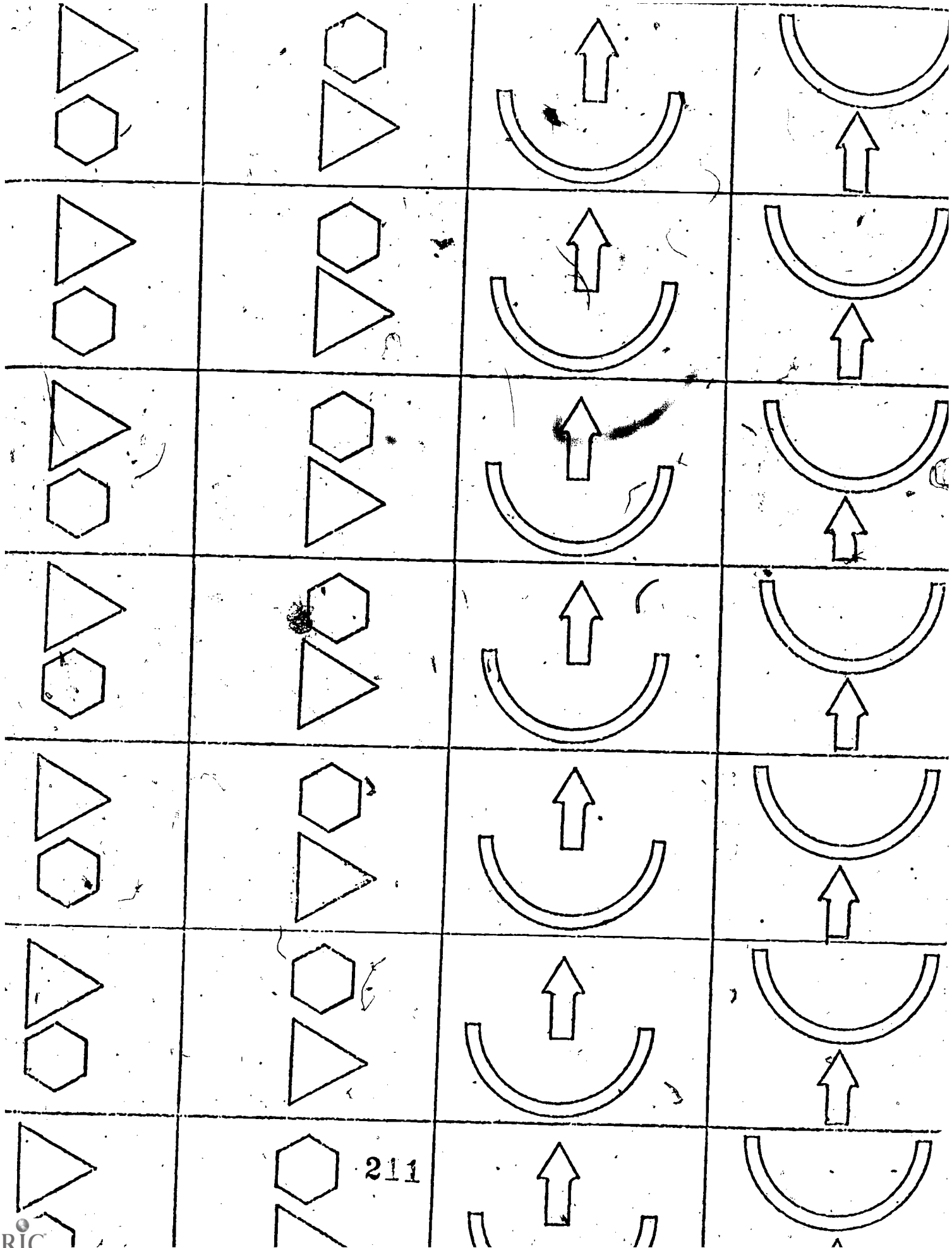
Each child draws cards from the pile at his or her own pace and places them on his or her board so that the shapes on the cards match the shapes on the board. If a child is unable to match a card to any empty square on his or her board, he or she should return the card to the pile and draw a different card.

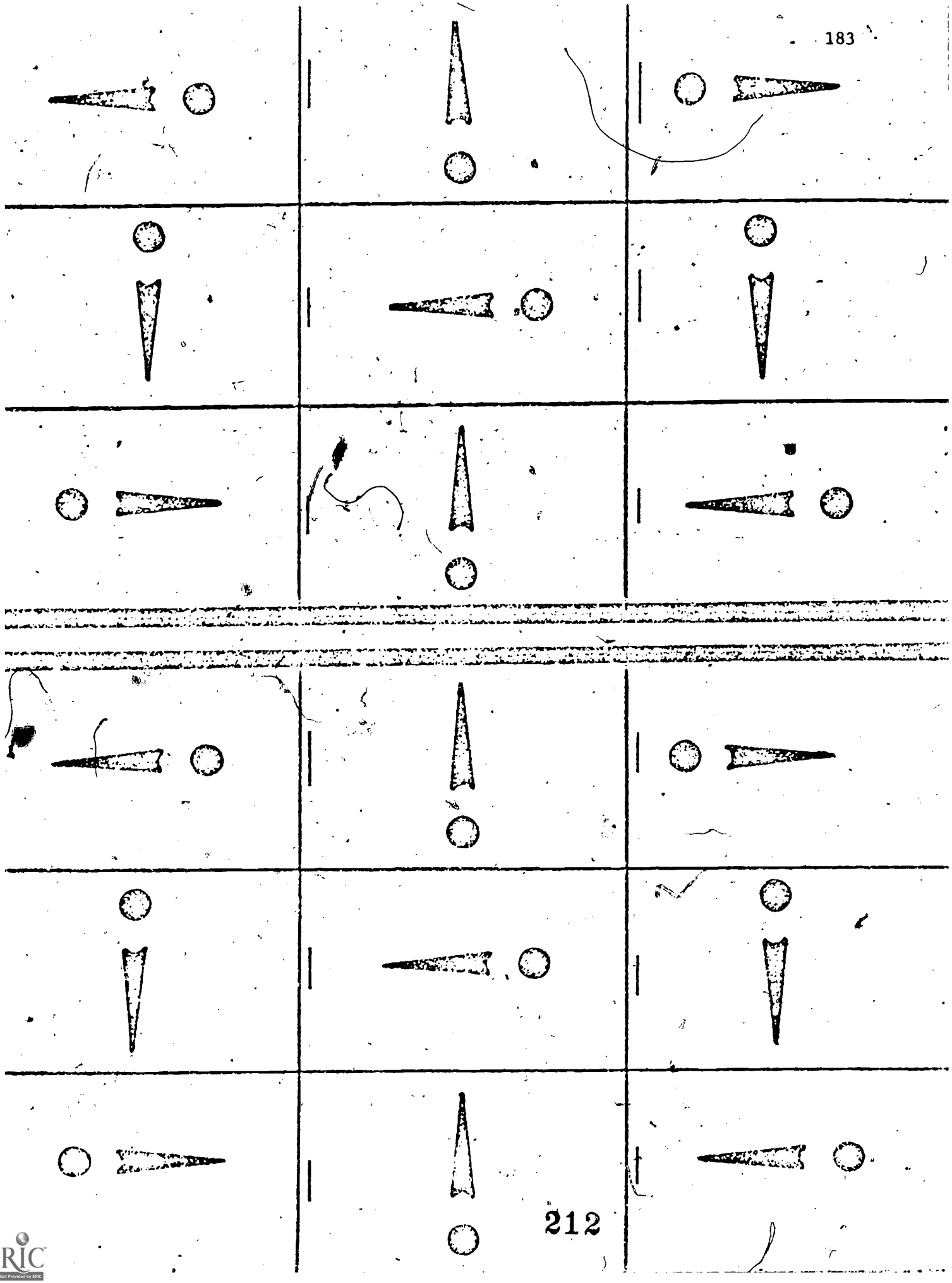
Each child should continue to draw cards until his or her board is filled.

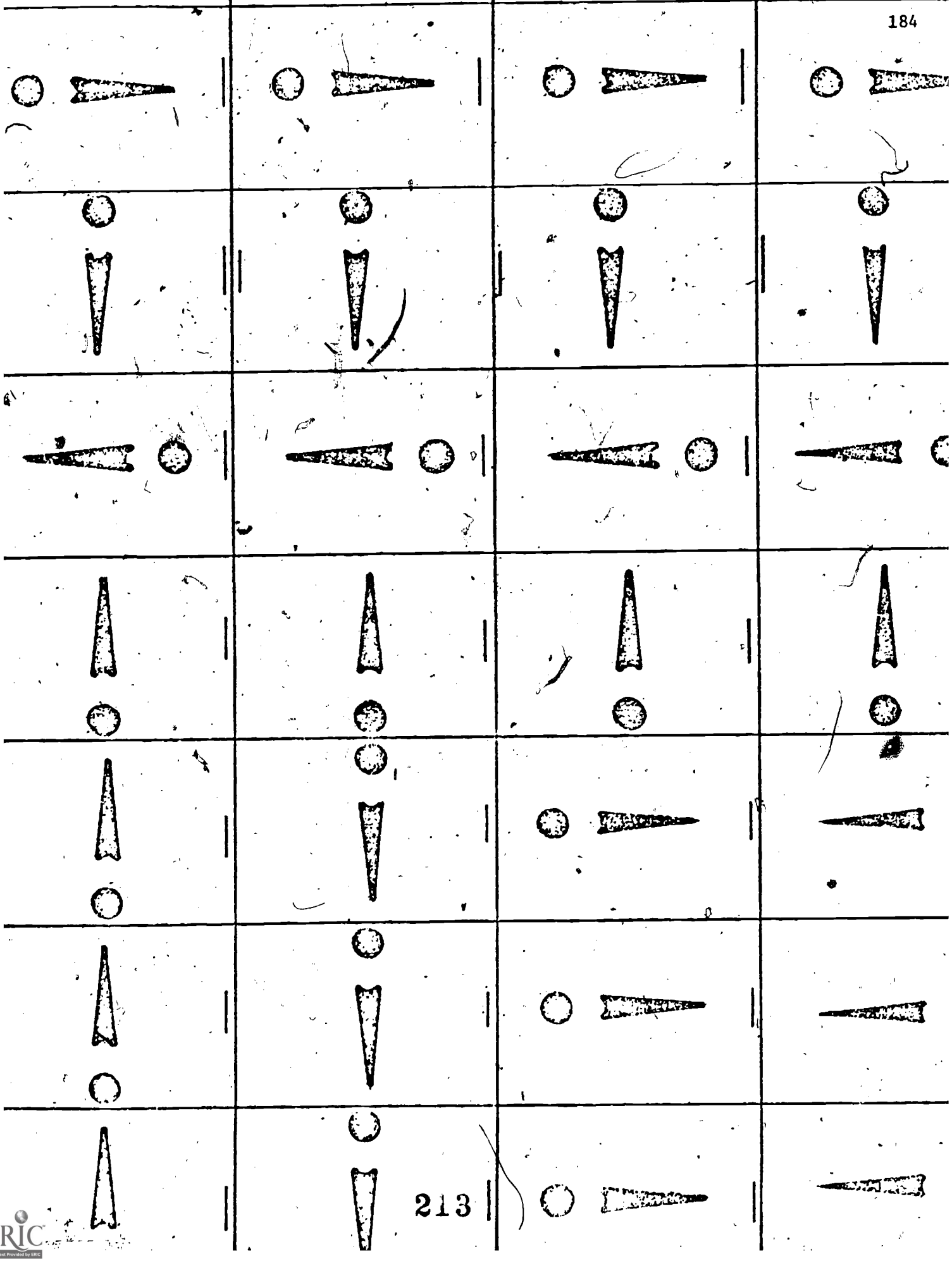
If there are enough materials, children may play Lotto in small groups of three, in pairs, or individually rather than in groups of four. As a variation, have the children play for a winner. They can take turns drawing cards and matching them to their board. If a child places a card on the wrong square or cannot match a card to any of his or her empty squares, he or she should return the card to the center. Then it is the next child's turn. The first child to fill a board is the winner. However, each child should continue to play until his or her board is filled.

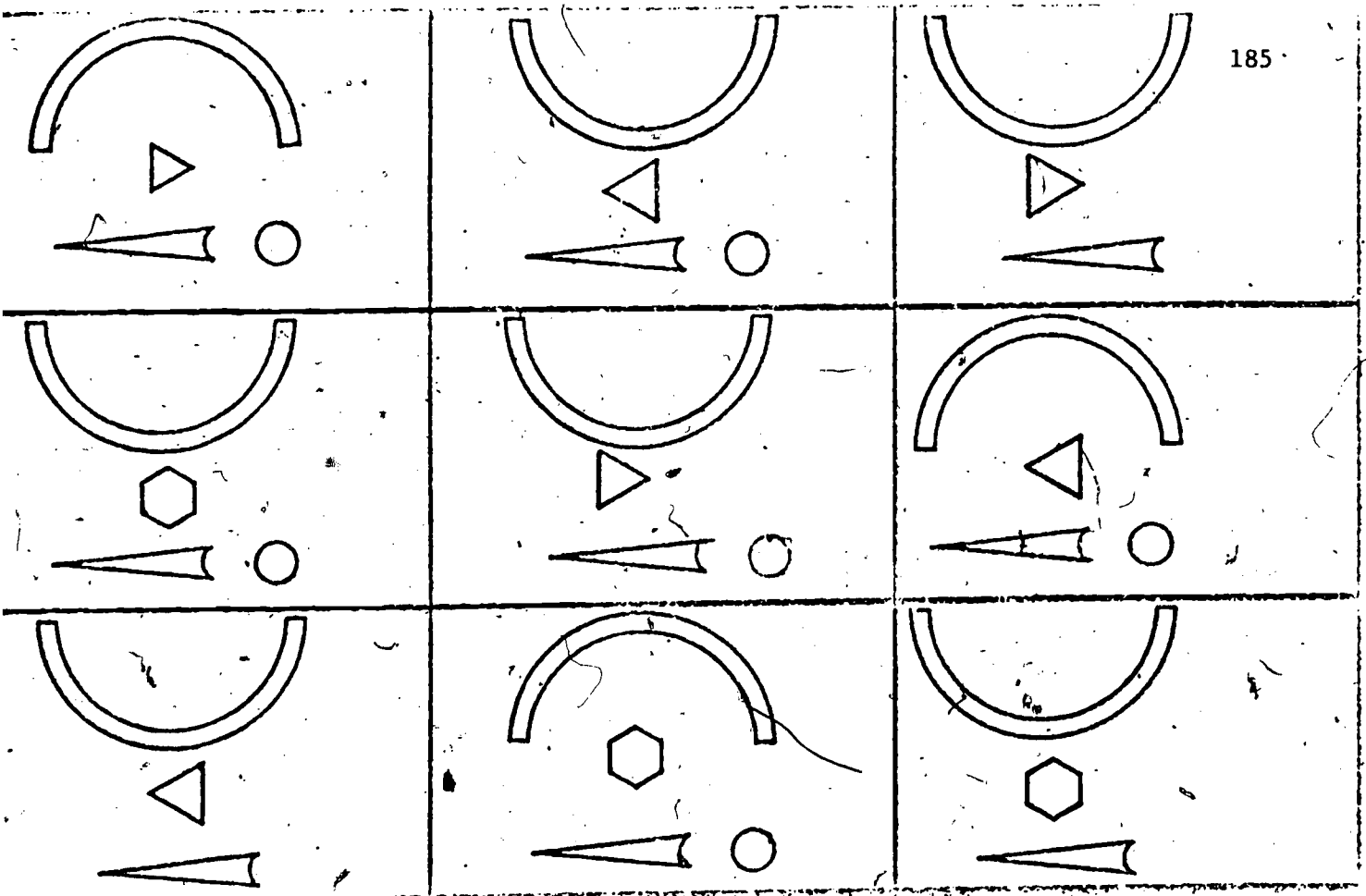


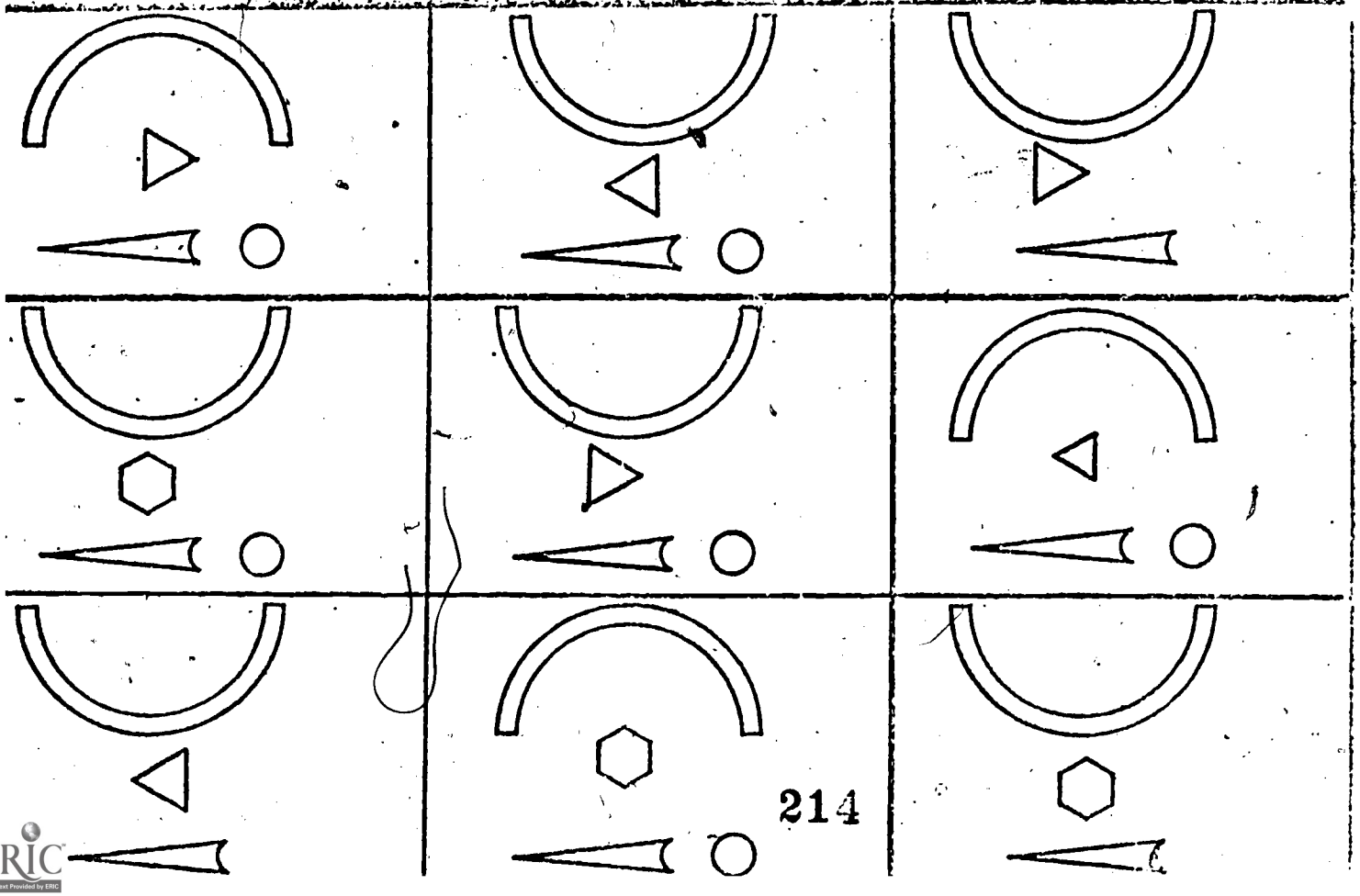


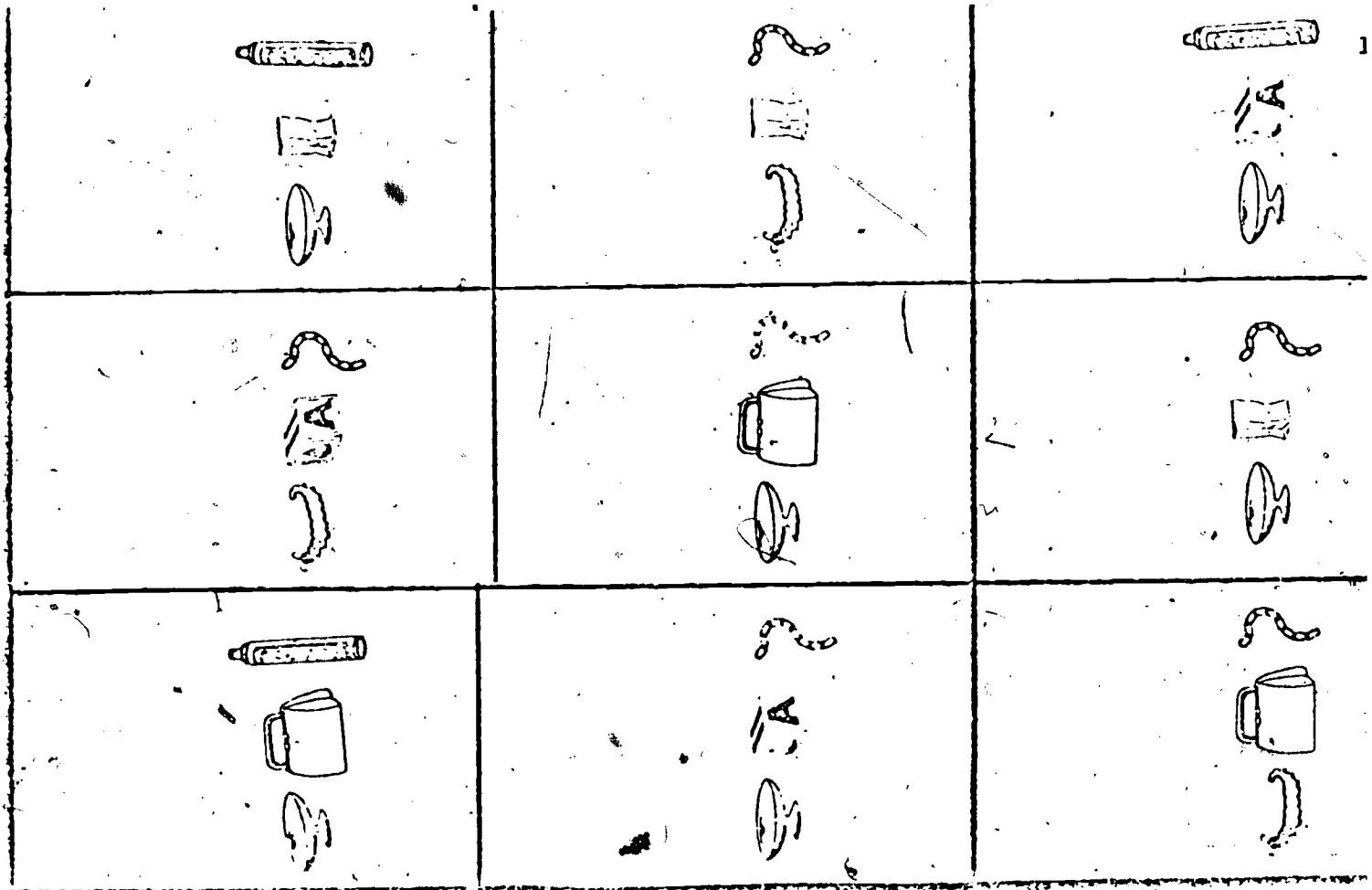












Activity 27 - Geometric Forms and Outline Figures Twins

Purpose: To develop attentiveness to each shape in a series

Group size: Large group

Materials: Enclosed cards
Chalkboard ledge

Steps: Tell the children that they are going to play a new game today. Show the children the deck of Twins cards. Point to the card and ask if anyone knows what a twin is. Discuss this. Then explain that when two series of shapes look exactly the same, you will call them twins.

Hold up a card on which the two shapes are different. Ask the children if the two shapes are twins or not. Explain why the shapes are different. Put the card on the left side of the chalk board. Say that you will always put cards with shapes that are not twins in this place.

Hold up a card on which the shapes are the same. Ask the children if the shapes are twins or not. Place the card on the right side of the chalk ledge. Say that you will put all the cards with shapes that are twins in this place.

Put the pile of cards shape side down. Call on a child to draw the top card, turn it over, and say whether or not the words are the same. Have him or her tell you which pile of cards to put it in.

Give three or four children turns to draw the top card of the deck, turn it over, say whether or not the shapes are twins, and place the card in the correct pile.

Activity 28 - Geometric Forms and Outline Figures Twins, Procedure 2

Purpose: To develop attentiveness to each shape in a series

Group size: Small group or individual

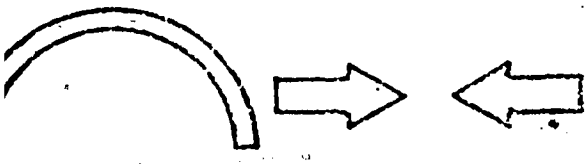
Materials: Enclosed cards

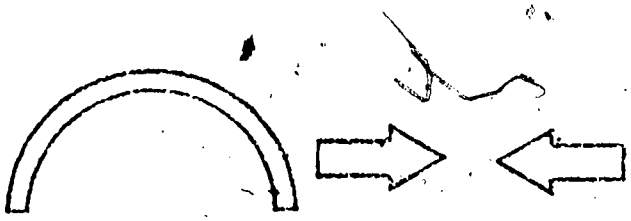
Steps: The child mixes the cards and puts them shape side down in a pile.

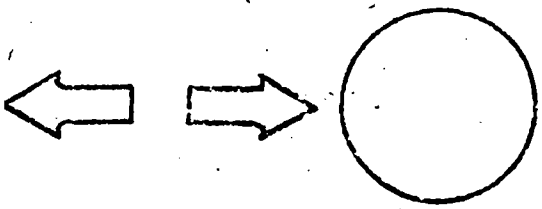
The child turns over the top card and decides whether the two forms on the card are the same or different.

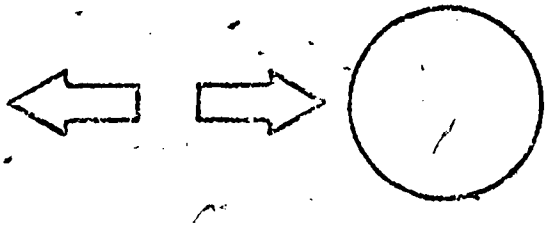
The child sorts the cards, putting all those that have two words that are the same in one pile and all those that have two words that are different in another pile.

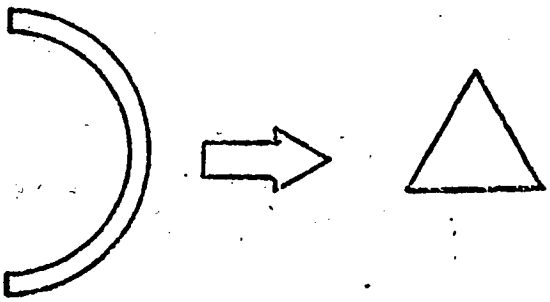
Note: If a child has difficulty, you may aid with a few cards.

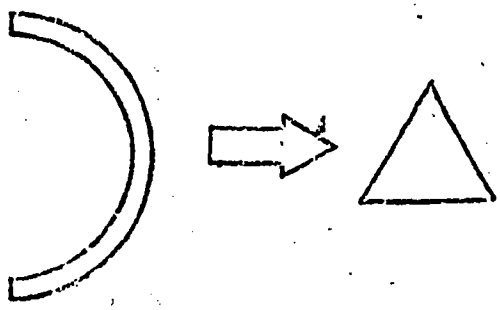


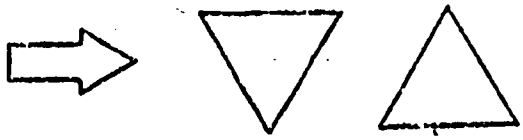


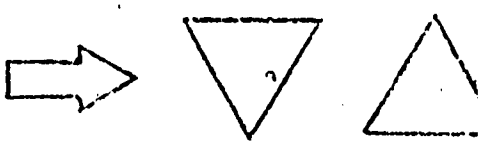


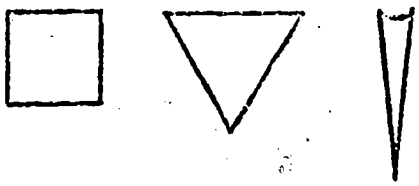


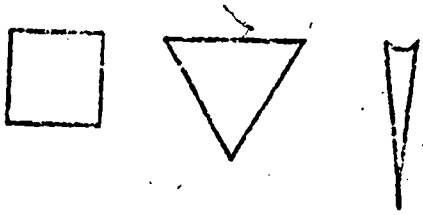


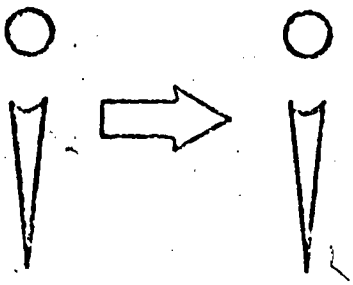


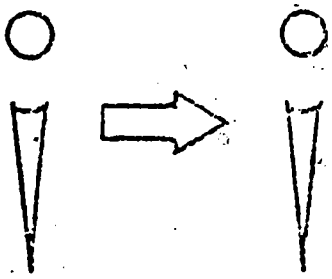


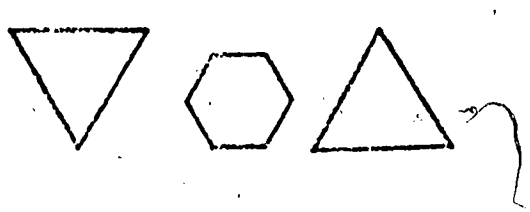


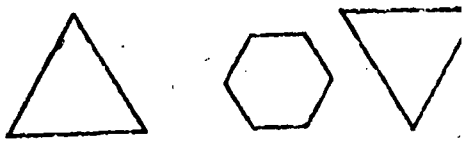


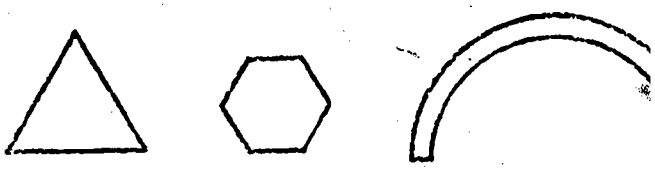


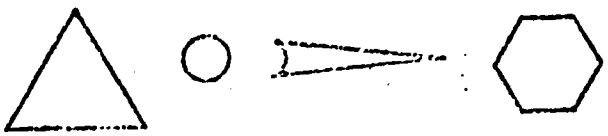


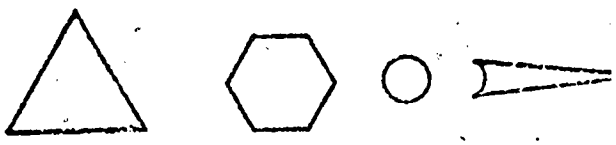












Activity 33 - Geometric Form/Outline Figure Double Match, Procedure 2

Purpose: To develop attentiveness to all the shapes in a series of shapes

Group Size: Small groups

Materials: Enclosed Double Match Cards

Steps: Give each child a Double Match board and have the children sit in groups of four.

One child in each group places the cards facedown in the center of the playing area.

Each child draws cards from the pile at his or her own pace and places them on his or her board so that the two words on the space of the board so that the two words on each card match the word shapes on the larger blue board. If a child is unable to match a card to any empty square, he or she should return the card to the pile and draw another card.

Each player draws cards until his or her board is filled.

Note: If there are enough materials, children may play Double Match in small groups of three, in pairs, or individually rather than in groups of four. Each small group, pair, or individual child should then be given one deck of cards.

Children can also play for a winner: first one to complete his card.

APPENDIX B

PREREADING SKILLS TEST

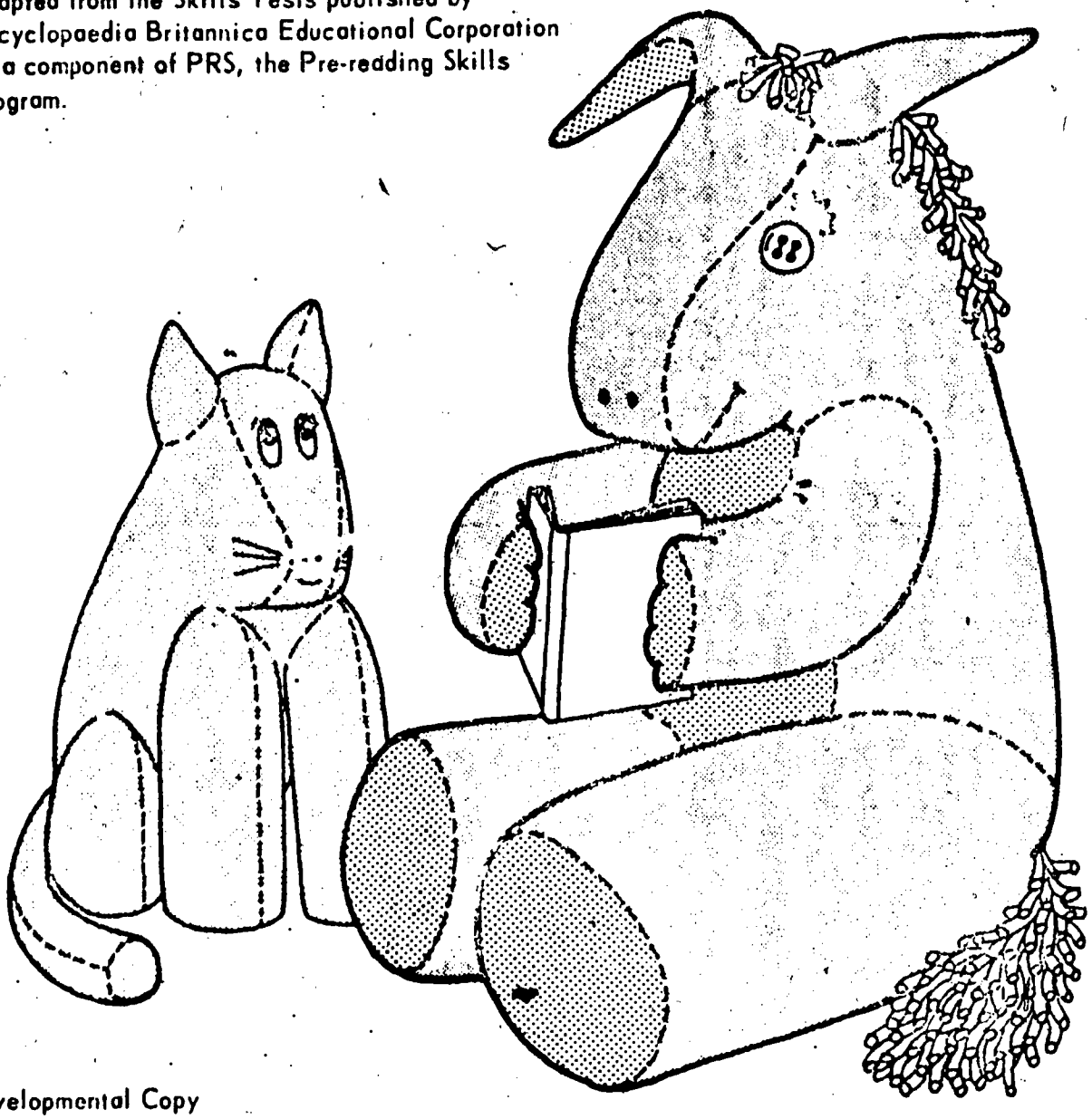
Prereading Skills Tests

Name _____

Date of Testing _____

Richard L. Venezky, Ronald C. Leslie, Marga R. Kamm, and Susan D. Pittelman

Adapted from the Skills Tests published by Encyclopaedia Britannica Educational Corporation as a component of PRS, the Pre-reading Skills Program.



Developmental Copy

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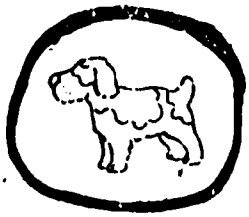			
e	m	z	e
mi	mi	xf	yo

av	nd	va	av
ash	has	ash	hsa
fe	ef	fe	np
tub	but	ubt	tub
orb	bro	orb	rob
tre	ert	ter	tre
au	au	ua	oe
pl	pl	wn	lp

sap	spa	pas	sap
rt	tr	rt	mn
ans	sna	ans	san
two	two	tow	owt
sp	fy	ps	sp
me	up	em	me
ien	ien	ine	nei
ak	ka	ak	en

p	p	q	d
b	d	b	p
w	u	w	m
q	d	p	q
b	d	q	b
z	z	s	n
d	b	q	d
n	u	n	s

b	b	p	q
q	d	q	p
p	q	p	b
d	q	b	d
p	b	q	p
q	q	p	d
b	p	d	b
d	b	d	q

rip	nip	rip	rim
avid	aver	arid	avid
bank	lank	back	bank
cage	cage	sage	cape
vow	wow	vex	vow
vine	vise	vine	fine
ern	erg	ern	urn
hate	hare	fate	hate

ode	ode	oke	ide
foul	fowl	foul	four
wide	wife	tide	wide
hart	hart	part	hurt
more	mare	more	morn
dog	dog	dug	dot
opt	oat	apt	opt
wait	wart	wait	waif

APPENDIX C

EXAMPLE OF SCHEDULE FOR TEACHING THE ACTIVITIES IN THE EXPERIMENT AS COMPLETED BY MRS. GRACIE RHYNE

SCHEDULE FOR TEACHING THE ACTIVITIES IN THE EXPERIMENT

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISTINGUISH THE ORDER OF LETTERS

---Sept. 29 - Activity 1 - "Ordered Letters"
Materials Used - Visual File Card 26 (Letter Order)
Component 32 and Flannel Board

---Sept. 30 - Activity 2 - "Letter Shapes"
Materials Used - Visual File Card 27 (Letter Order)

---Oct. 1 - Activity 3 - "Order Line Drawing"
Materials Used - Visual File Card 47 (Letter Order)
Reference to Visual File Card 34 (Letter Order)

---Oct. 2 - Activity 4 - "Letter Pick A Pair"
Materials Used - Visual File Card 29 (Letter Order)
Component 37 - Pick A Pair Letters
Omit activities referring to Pick A Pair Shape
Component 33

---Oct. 3 - Activity 5 - "Letter Order Lotto"
Materials Used - Visual File Card 28 (Letter Order)
Component 36 - Lotto Board and Letters
Both Procedures 3 and 1 will be used, in this order, if time permits.

---Oct. 6 - Activity 6 - "Letter Order Lotto"
Materials Used - Visual File Card 28 (Letter Order)
Component 36 - Letter Lotto Board & Letters
Procedure 1 will be continued briefly. Procedure 2 will be implemented for the majority of the lesson time period.

---Oct. 7 - Activity 7 - "Visual Class Chart IV"
Materials Used - Visual File Card 32 (Letter Order)
Visual Class Chart IV
Visual Practice Sheets 4 and 5

---Oct. 8 - Activity 8 - "Extra Help: Practice Sheets"
Materials Used - Visual File Card 35 (Letter Order)
Visual Practice Sheets 6, 7, 13 and 14
Clear Plastic Overlay
All three Procedures will be used - 1 on Visual Practice Sheet 6, 2 on Visual Practice Sheet 7, 3 on Visual Practice Sheet 13 and 14.

---Oct. 9 - Activity 9 - "Letter Order Dominoes"
Materials Used - Visual File Card 36 (Letter Order)
Component 39 - Letter Order A Dominoes
Procedure 1 used

---Oct. 10 - Activity 10 - "Letter Order Dominoes"
Materials Used - Visual File Card 36 (Letter Order)
Component 39 - Letter Order A Dominoes
Both Procedures 2 and 3 will be used, if time permits.

---Oct. 13 - Activity 11 - "Turn Around Game" and "Letter Checking"
Materials Used - Visual File Cards 50 & 51 (Letter Orientat
Clear Plastic Overlay

---Oct. 14 - Activity 12 - "Orientation Move It To Prove It"
Materials Used - Visual File Card 52 (Letter Orientation)
Flannel Board
Component 32 - Felt Letters
Both Procedures 1 and 2 will be used, if time permits.

---Oct. 15 - Activity 13 - "Orientation Line Drawing"
Materials Used - Visual File Card 65 (Letter Orientation)

---Oct. 16 - Activity 14 - "Same and Different Game"
Materials Used - Visual File Card 54 (Letter Orientation)
Component 42 - Letter Orientation B Letter
Both Procedures 1 and 2 will be used, if time permits.

---Oct. 17 - Activity 15 - "Letter Orientation Lotto"
Materials Used - Visual File Card 55 (Letter Orientation)
Component 43 - Letter Orientation B Lotto Board and Letters
Both Procedures 3 and 1, in this order, will be used.

---Oct. 20 - Activity 16 - "Letter Orientation Lotto"
Materials Used - Visual File Card 55 (Letter Orientation)
Component 43 - Letter Orientation B Lotto Board and Letters
Procedure 1 will be continued and Procedur 2 added.

---Oct. 21 - Activity 17 - "Patience"
Materials Used - Visual File Card 59 (Letter Orientation)
Pocket Chart
Component 45 - Matching Letters
Procedure 1 only will be used.

---Oct. 22 - Activity 18 - "Patience"
Materials Used - Visual File Card 59 (Letter Orientation)
Pocket Chart
Component 45 - Matching Letters
Procedure 2 only will be used.

---Oct. 23 - Activity 19 - "Visual Class Chart VI"
Materials Used - Visual File Cards 60 & 61 (Letter Orientation)
Visual Class Chart VI
Visual Practice Sheets 8 & 17

---Oct. 24 - Activity 20 - "Visual Class Chart VIII"
Materials Used - Visual File Cards 63 & 64 (Letter Orientation)
Visual Class Chart VIII
Visual Practice Sheets 15 & 16

---Oct. 27 - Activity 21 - "Letter Orientation Dominoes"
Materials Used - Visual File Card 56 (Letter Orientation)
Component 44 - Letter Orientation Dominoes
Procedure 1 will be used if class size is 10 or less.
Procedure 2 will be used if class size is 11 or more.

---Oct. 28 - Activity 22 - "Extra Help: Pick A Pair"
Materials Used - Visual File Card 57 (Letter Orientation)
Ditto of the Take-Home Balloon Game
Procedure 1 used only

ACTIVITIES DESIGNED TO INCREASE A CHILD'S ABILITY TO DISTINGUISH THE DETAILS IN WORDS

---Oct. 29 - Activity 23 - "Detail Dot"
Materials Used - Visual File Card 67 (Word Detail)
Flannel Board
Component 32 - Felt Letters
Three yellow dots
Procedures 1 and 2 only will be used.

---Oct. 30 - Activity 24 - "Detail Line Drawing"
Materials Used - Visual File Card 71 (Word Detail)
Procedures 1 and 2 will be used, if time permits.

---Oct. 31 - Activity 25 - "Detail Word Twins"
Materials Used - Visual File Card 68 (Word Detail)
Component 46 - Word Detail Twin Cards
Pocket Chart
Procedure 1 only will be used.

---Nov. 3 - Activity 26 - "Detail Word Twins"
Materials Used - Visual File Card 68 (Word Detail)
Component 46 - Word Detail Twin Cards
Component 50
Procedure 2 only - If class size is 13 or less, activity will be an individual one; if class size is 14 or more, activity will be one completed in groups of two.

---Nov. 4 - Activity 27 - "Word Detail Lotto"
Materials Used - Visual File Card 69 (Word Detail)
Component 47 - Word Detail Lotto Board and Letters

---Nov. 5 - Activity 28 - "Detail Pick A Pair"
Materials Used - Visual File Card 70 (Word Detail)
Component 48 - Matching Detail Cards
Procedure 1 only

---Nov. 6 - Activity 29 - "Visual Class Chart VII"
Materials Used - Visual File Cards 72 & 73 (Word Detail)
Visual Class Chart VII
Visual Practice Sheets 9, 10 & 20
This activity is designed to complete Visual Practice Sheets 9 & 10 only. Students may proceed to Visual Practice Sheet 20 if they complete 9 & 10 early.

---Nov. 7 - Activity 30 - "Visual Practice Sheets"
Materials Used - Visual File Cards 73 & 75 (Word Detail)
Visual Practice Sheets 20, 18 & 19
Students begin or complete Visual Practic Sheet 20, then proceed to work Visual Practice Sheets 18 & 19 individually and independently.

---Nov. 10 - Activity 31 - "Detail Triple Choice"
Materials Used - Visual File Card 76 (Word Detail)
Pocket Chart
Component 48 - Triple Choice Cards

---Nov. 11 - Activity 32 - "Double Match"
Materials Used - Visual File Card 77 (Word Detail)
Component 49 - Double Match Cards
Procedure 1 only

---Nov. 12 - Activity 33 - "Double Match"
Materials Used - Visual File Card 77 (Word Detail)
Component 49 - Double Match Cards
Procedure 2 will be used - If class size is 12 or less, activity will be conducted in pairs; if class size is 13-18 activity will be conducted in groups of 3; if class size is 19-24, activity will be conducted in groups of 4; if class size is 25-31, activity will be conducted in groups of 5.

---Nov. 13 - Activity 34 - "Memory Game"
Materials Used - Visual File Card 79 (Word Detail)
Flannel Board
Component 32 - Felt Letters

---Nov. 17 - Activity 35 - "Visual Practice Sheet 21"
Materials Used -- Visual File Card 83 (Word Detail)

---Nov. 18 - Gates MacGinitie Test - Mail to me.
- Nov. 19 GM Test

---Nov. 19-26 - PRS Test

---Dec. 1 - ~~Mail tests to me.~~ (Mail schedule sheets to me)

---March 22 - Gates MacGinitie Test } final testing conducted

---March 23-March 30 - PRS Test

---March 31 - Mail tests to me.

APPENDIX D

TEST FOR DIFFERENCE BETWEEN TWO PROPORTIONS WHEN NUMERATOR IS SMALL AND DENOMINATOR IS LARGE

The following discussion was included as an appendix to this study as it can not be located in English textbooks. It can be found in Pfanzagl and Puntigam, "Aussagen Duber den quozienten Zweier Poisson parameter und deren anwendung auf ein problem der", Biometrische Zeitschrift, 1961, pp. 135-142. Part of the discussion of the use of this test for statistical analysis also appears in a paper by A. W. Kimball, "Confidence intervals for recombination experiments with microorganisms", Note 156, Biometrics 17, 1961, pp. 150-153. The basis for the following discussion and the example used as illustration were taken from Statistics From Scratch, Third Edition (in press) by Peter Nemenyi, Sylvia K.Dixon and Nathaniel B. White, Jr., San Francisco, California.

If the proportion rate in the general population (in the absence of the treatment) is known from long experience to be (almost exactly) 1 per 1000, then the test for equality of proportions adhers to the formula: $p_{rad} = .001$. But if the proportion rate with treatment and the proportion rate without treatment are both unknown, then a new problem in analysis arises. Two populations with unknown "mutation" rates p_1 and p_2 exist. For example, a sample of n_1 births from the first population yields a_1 mutations and a sample of n_2 births from the second yields a_2 mutations. Presumable the rates observed in the first sample, a_1/n_1 and the rates observed in the second sample, a_2/n_2 won't be exactly equal. They could, however, be different by chance even if $p_1 = p_2$. The question of analysis becomes: Are a_1/n_1 and a_2/n_2 sufficiently different to convince us that p_1 is not equal to p_2?

If the rates weren't so small, we could use the method based on the normal approximation and compute $Z = (\frac{a_1}{n_1} - \frac{a_2}{n_2})/S.E.$ The standard error in the denominator is $\sqrt{(\frac{1}{n_1} + \frac{1}{n_2})p(1 - p)}$ with the pooled estimate $(a_1 + a_2)/(n_1 +$ substituted in for the unknown (supposedly common) p. Then rejection of equality could be based on the normal table. But mutation rates or proportions are very small fractions of the total and the normal approximation is inaccurate.

When two counts (a_1 and a_2) with Poisson probabilities and the null hypothesis says that two Poisson probability distributions have means $n_2 p$ and $n_1 p$ (same p both times). Under these conditions, it turns out that the conditional probability of a mutations in Sample 1 given the total number of metations $a_1 + a_2$ in both samples is a binomial probability, that is, a probability of the general form: $\binom{n}{x} p^a (1 - p)^{n-a}$, but with $a_1 + a_2$ in place of the sample size n and $\frac{n_1}{n_1 + n_2}$ in place of p.

(This makes $1 - p = \frac{n_2}{n_1 + n_2}$.)

a_1 plays the role of a. In other words, conditional Pr(a_1 mutations in sample 1 given $a_1 + a_2$ mutations in all) $= \binom{a_1 + a_2}{a_1} (\frac{n_1}{n_1 + n_2})^{a_1} (\frac{n_2}{n_1 + n_2})^{a_2}$.

The null hypothesis says, any one of the n_1 births in Sample 1 (Control for Hypothesis 6 and Treatment with Geometric Shapes for Hypothesis 7) is just as likely to be a mutation as any one of the n_2 births in Sample 2. Therefore picking any of the mutations at random, one should have a probability

$\frac{n_1}{n_1 + n_2}$ of coming from Sample 1. Pick $a_1 + a_2$ mutations at random: then the probability of none of them coming from Sample 1 should be $(1 - \frac{n_1}{n_1 + n_2})^{a_1 + a_2}$, the chance of one coming from Sample 1 should be $\binom{a_1 + a_2}{1}(\frac{n_1}{n_1 + n_2})^1(1 - \frac{n_1}{n_1 + n_2})^{a_1 + a_2 - 1}$ and so on, following the formula given above.