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THE RELATIVE EFFECTS OF INDIVIDUAL COMPETITION
AND GROUP COMPETITION AS MOTIVATIONAL FACTORS
IN ACHIEVEMENT IN ARITHMETIC AT THREE LEVELS
OF INTELLIGENCE

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CHAPTER I

THE PROBLEM AND ITS SETTING

In general terms, the major problem of this study is to determine the effects of competition, both individual and group, on the achievement of sixth grade pupils in arithmetic.

This investigation is also concerned with the following subproblems:

A. To determine the relative effectiveness of two types of motives, on influencing scores in an arithmetic test:

1. Individual competition motive - working for a personal gain.
2. Group competition motive - working for a group gain.

B. To determine at each of three levels of intelligence, superior, average, and low, the relative effectiveness of the two types of motives upon performance in an arithmetic test.

C. To determine the influence of age and sex on the relative effectiveness of the two types of motives upon performance in an arithmetic test.

Educational Need and Significance of the Study.- The interest of educators in the psychology and pedagogy of competition is perfectly natural. In one form or another, competition has been used as a motivating influence during the entire history of

education. It has only been within recent times, however, that any really serious attempt has been made to analyze and understand the effects of different competitive situations on behavior.¹ To be sure, Burnham² and his student, Triplett,³ called attention in a mild way to the serious consequences of the purely mechanical use of the competitive urge in classroom teaching, but cursory inspection of textbooks in educational psychology and methods of teaching indicates that these warnings have not been clearly understood. This is natural enough, however, in view of the tendency on the part of most educators to follow precedent and tradition until the need for creative achievement has been unmistakably emphasized. In the case of competition, studies have been made not only through laboratory procedures but in a much broader and more significant way in the clinic. Today, one finds hardly a book dealing with mental hygiene or abnormal psychology that does not discuss, either directly or indirectly, the important psychological effects of competition. It is, of course, well known that one entire system of psychology, that of Alfred Adler, is devoted almost exclusively to the problem of competition.

1

J. B. Maller, Competition and Cooperation. Teachers College Contributions to Education, No. 321. New York: Teachers College, Columbia University, 1929. Pp. 3-5.

2

W. H. Burnham, "The Hygiene of Home Study," Pedagogical Seminary, XII (May, 1905), 213-30.

3

N. B. Triplett, "The Dynamogenic Factors in Pace Making and Competition," American Journal of Psychology, IX (March, 1897), 507-33.

Characteristics of the Motives Investigated.- Two forms of motivation were chosen in the present investigation for study: individual motivation, appealing to the desire for personal gain, and group motivation, appealing to the desire for group gain. The former involves only the interests of the individual in action, while the latter involves, in addition, the interests of the group of which the individual is a member.

From the social point of view there is a qualitative difference between the two motives. A tendency to respond more readily to personal needs in disregard of others is considered undesirable, egotistic; a tendency to respond more readily to the needs of others, highly desirable, altruistic. It is of educational importance to know which of two motives when used will stimulate the child to do his utmost. This in turn raises the question of the effectiveness of the two motives on children of different levels of intelligence. Such knowledge would further higher productivity per unit of time as well as the cultivation of efficiency as a habit.

The Purpose.- The comprehensive aim of this study is to consider the question whether individual or group competition is more effective as a motivating factor in determining achievement in arithmetic addition on the part of sixth grade school pupils at three levels of intelligence.

Specific Purposes of the Study.- In addition to the comprehensive, major purpose, the following specific purposes are indicated:

1. To find the effects of competition, both individual and group, on the achievement of superior children in doing arithmetic addition.

2. To find the effects of competition, both individual and group, on the achievement of average children in doing arithmetic addition.

3. To find the effects of competition, both individual and group, on the achievement of dull children in doing arithmetic addition.

4. To find the relative influence of individual and group competition as motivational factors on the extreme ranges of intelligence, viz., very superior, I. Q. 120-130, and very dull, I. Q. 70-80.

5. To find the amount of decrement or increment in arithmetic scores over a period of five days.

Definitions.- For purposes of this study, the following definitions will be employed.

Operationally defined, a motivational condition is one that provides an incentive for the direction and regulation of the activity of school children in performing the task of adding in arithmetic.

A motivational increment is an increase in the speed, strength, precision, or other measurable attributes of the principle which depends on conditions to be defined as motivating.

A motivational decrement is a decrease in the same variables depending on motivating conditions.

An individual competitive situation is one which stimulates the individual to strive against other individuals in his group for a goal object of which he hopes to be the sole or principal possessor.

A group competitive situation may be defined as one which stimulates an individual to strive with the other members of his group for a goal which is to be shared equally among all of them.

Organization of Present Report.- This chapter has been devoted to a statement of the problem and the various subproblems studied, to the educational need, significance, and purposes of the study, and to definitions of terms.

Later chapters follow a logical, sequential arrangement. Chapter II is devoted to a review of the related literature. Here are considered the major problems already studied in the field of competition and the need for the present study in the light of previous studies.

Chapter III considers the problem and its treatment, including the experimental techniques employed. The introduction of the motivational variables and the isolation of the motives are also treated. A description of the experimental population and the experimental design, a description of the task of the subjects and of the testing procedure, and a discussion of the statistical technique employed are included.

In Chapter IV the general findings comparative of group and individual competition are presented.

In Chapter V the relationship between group and individual competition at three levels of intelligence is considered.

Chapter VI is devoted to a discussion of the effects of age and sex on the two variables, individual competition and group competition.

Chapter VII is a summary chapter. Here the experimental findings as regards the general relationship between individual and group competition, the influence of levels of intelligence and age and sex are reviewed and discussed.

The second division of this chapter is devoted to a theoretical interpretation and evaluation of the findings for education. This chapter considers applications of the experimental findings to general educational practice.

The third division of this chapter is devoted to a consideration of future indicated problems in this field. In the light of the questions that this investigation has raised and left unanswered, this study attempts to help point the way for further research.

CHAPTER II

REVIEW OF RELATED LITERATURE

Classification of the Literature.- Any investigation of the psychological effects of competition is of importance for education. The studies in this motivational area may be categorized as of two types: first, those in which the group rivalry motive has been employed, and second, those in which the individual rivalry motive has been employed.

The problems investigated may be further classified as follows: educational significance of various attitudinal motives, such as praise and reproof, on increasing achievement in subject matter fields; effect of knowledge of results on achievement; effects of varying degrees of motives on learning; effects of motivational stimuli on reduction of mental fatigue; effects of motives on increments of the work curve; effects of various motives on changing pupil attitudes; effects of various motives on different methods of teaching, such as the activity method, the use of projects, and the socialized recitation; effects of various motives on rivalry in pre-school children; effects of various motives on competition for grades; evaluation of certain incentives used in school work; effects of various social motives in stimulating cooperative attitudes in pupil groups; effects of cooperative motives and competitive motives on

achievement; effects of various motives on the constancy of the I.Q.; effects of various motives on intelligence test scores.

Significance of This Study in Terms of Related Literature.-

It will be seen from an inspection of the studies carried on in motivational research, that the effects of various motives on the achievement of pupils, grouped according to intelligence levels, is almost a virgin field. Maller¹ worked with the two motives of group and individual competition on achievement, but he neglected to study the effectiveness of the two motives on children of varying levels of intelligence.

In grouping the studies reviewed in this chapter, the following two-fold classification has been used. This is the same classification used by Diserens and Vaughn² in their excellent reviews of the experimental literature on competition.

1. Competition and Rivalry
2. Praise and Reproof.

¹
J. B. Maller, Cooperation and Competition. Teachers College Contributions to Education, No. 321. New York: Teachers College, Columbia University, 1929. Pp. 2-3.

²
James Vaughn and Charles M. Diserens, "The Experimental Psychology of Competition," Journal of Experimental Education, (September, 1938), 76-97.

Competition and Rivalry

The studies carried on in this field can be differentiated into three groups: one, that in which the subject is a member of a group; second, that in which he is an individual competing with other individuals; third, that in which he is competing against his own previous record. An extensive and important investigation of competition and cooperation with the pupils knowing the daily results of their work has been reported by Maller.³ His aim was to measure the effects of personal and social status. The basic questions involved were: (1) the relative effects of competition and cooperation on the efficiency of children's work, and (2) the nature of children's choices as to the type of effective motivation, i.e., personal or social. The subjects were one thousand five hundred and thirty-eight children from the fifth to eighth grades, ranging in age from eight to seventeen years. A simple measurement of initial individual differences and individual variability seemed desirable. This was found in the task of adding one place numbers. The digits 1 and 0 were not used, and combinations of like digits were avoided. Altogether, 56 possible combinations were constructed, and these were presented as four thousand examples in ten booklets. The booklets were used as test material for five

3

J. B. Maller, Cooperation and Competition, An Experimental Study in Motivation. Teachers College Contributions to Education, No. 321. New York: Teachers College, Columbia University, 1929. Pp. 3-9.

conditions, in which (1) practice was the only incentive, (2) individual prizes were given to the most rapid workers, (3) a prize was given to the most rapid group, (4) the individuals were allowed to choose between individual and group motives, and (5) the immediate and continuous effects of motivation were measured. The conclusions of these experiments were that work for the self increased while that for the group decreased. Only in the initial stages was the amount of work under the two conditions approximately equal. Both motives increased speed above the level of unmotivated work and mere performance; however, the correlation between self and group work decreased with progress in the unit of work. A comparison of the first and second minutes of work within each of the test units shows a general tendency for speed to drop at the end of the first minute. The speed of the first minute of group work was equal to the second minute of self work. When the opportunity was granted to continue work for the self or for the group, the self was chosen about three times as often as the group. Competitive desires were especially noticeable in grades five to eight. However, girls were more cooperative than the boys, as indicated by their choices for group work. A maximum of cooperation appeared in groups of considerable homogeneity, so that sectioning of classes on the basis of similar abilities might tend to promote cooperation within the sections. Maller concludes that the competitive character of our social life, illustrated on every hand, is undoubtedly

responsible for the competitive character of the individual's mind. Cooperative tendencies are mainly the product of education in general.

A brief study of cooperation and competition was also published by Forlano.⁴ The experimental conditions included: (1) practice, (2) work for the benefit of the individual's class score, (3) work for teams into which the class was divided, and (4) work against the opposite sex. Thirty-four children of both sexes, with an average age of eleven years and nine months, participated in the experiments. A cancellation test was used to measure the relative effects of the different experimental conditions. The conclusions were that the average child works for individual gain rather than for class interest, and that sex competition is the strongest motive at this age. The conclusions agree in general with those of Maller.

Greenberg,⁵ a student of Buhler, made a study for the purpose of ascertaining the causes, frequency, conditions, and

⁴
G. Forlano, "An Experiment in Cooperation," Journal of Educational Research, XXV (April, 1932), 128-31.

⁵
P. J. Greenberg, "Competition in Children, An Experimental Study," American Journal of Psychology, XLIV (June, 1924), 221-48.

characteristic phenomena of competition within a given situation. The subjects were children from two to five years of age. Pairs of children were asked to build with, and without instructions, in different series of experiments, and were afterward asked to make judgments concerning the beauty or magnitude of the constructions, in different series. The conclusions were that the competitive spirit develops gradually and is not universal in children of any one group. Ability for the task, as well as individual temperament, is a factor in the competitive situation. Growth in competitive spirit follows an orderly course, developing from a state characterized by the absence of competition, through several stages of consciousness, to a final stage of vigorous competition controlled by judgment. Greenberg's reference to competition, as partly dependent on the task and temperament, agrees with the more precise statements of Yamamoto,⁶ discussed in a later section of this chapter. His conclusion that competitiveness is not universal in a child group of this age may be compared with Whitmore's conclusion that competitiveness is not universal in adults. Perhaps competitiveness is not universal at any age, or there may be an optimum age for human competitiveness. According to Greenberg's study, competitiveness appears about the fourth year. No data are available as to a possible age at which competitiveness vanishes.

6

K. Yamamoto, "Competition and the Transposition of 'Anspruchsniveau' in Joint Works," Japanese Journal of Psychology, X (March, 1935), 409-35.

Leuba⁷ confirmed in a general way Greenberg's conclusion concerning the ontogenesis of the competitive attitude and the age at which it appears. Thirty-two children were given the task of placing pegs of uniform color in a peg-board. They worked singly and in pairs. Three stages of development were observed. The two-year-old children displayed little reaction to the presence of another child working at the same task. Three and four-year-old children varied in reaction, but some showed rivalry responses and reduced output. The five-year-old children exhibited definite rivalry responses and a markedly increased output in work.

One of the later experiments in this field, that by Bos,⁸ places the emphasis on what the author calls productive collaboration, but it appears to involve several types of competition. Bos concluded that when children work in pairs they achieve more work than when laboring individually. The result was ascribed to active collaboration or cooperative competition. The author distinguished: (1) active collaboration, (2) resistance-determined collaboration, and (3) collective-individual working. It would seem that a kind of competition is involved in the last two of these forms, and in any

⁷
G. J. Leuba, "An Experimental Study of Rivalry in Young Children," Journal of Comparative Psychology, XV (June, 1933), 368-9.

⁸
M. C. Bos, "Experimental Study of Productive Collaboration Acts," Journal of Psychology, III (November, 1937), 315-426.

event the minimal competition inherent in all situations of social stimulation and response.

Praise and Reproof

A special group of studies deals with the influence of complimentary and disparaging remarks on performance or achievement, and on the intelligence quotient and mental test scores. Hurlock⁹ studied the effects of praise and blame on the test scores of 257 white children and 151 Negro children from the third, fifth, and eighth grades. Two forms each of the National Intelligence Test and of the Otis Primary Intelligence Examination were used. After the first test, groups of equal ability were subjected to strong praise and censure, and told to take the test again. Hurlock concluded that both praise and blame were effective in raising the test scores. Certain sex and age differences appeared. Older children were most affected and the boys responded more strongly than the girls. Younger children and superior children were most strongly stimulated by reproof. In a subsequent study, Hurlock¹⁰ reported that the intelligence quotients of praised and reproofed groups were appreciably raised, while those of the control group improved but little on retesting.

9

E. B. Hurlock, "An Evaluation of Certain Incentives Used in School Work," Journal of Educational Psychology, XVI (December, 1925), 145-59.

10

E. B. Hurlock, "The Effect of Incentives upon the Constancy of the I.Q.," Pedagogical Seminary, XXXII (May, 1925), 422-34.

In general, Hurlock concluded that praise was more effective than blame. This is confirmed by the findings of Gilchrist¹¹ and of Briggs.¹² Gilchrist gave the Courtis English Test to a class of fifty college students and then divided the class into equal groups and repeated the test. One of the groups was praised and the other was reproved for performance on the initial test. The praised group improved 79 per cent, while the reproved group deteriorated in the second test. In this second test the better students of the first test deteriorated, while the poorer students improved.

Hurlock's Study on Group Rivalry.- Hurlock also studied group rivalry as an incentive to increased efficiency in school work, and the relationship of such factors as age, sex, and individual peculiarities to the effects of group rivalry. The subjects included 155 children of both sexes, from nine to twelve years of age. The work consisted of modified Courtis Arithmetic Tests. Equivalent rivalry groups were stimulated by publicity and discussion, and their achievements were compared with those of a control group. The rivalry groups were found to outstrip the control group in speed and

11

E. P. Gilchrist, "The Extent to Which Praise and Blame Affect a Pupil's Work," School and Society, IV (June, 1916), 872-4.

12

T. H. Briggs, "Praise and Censure as Incentives," School and Society, XXVI (February, 1927), 596-8.

accuracy. Girls, younger children, and those of inferior ability responded most to the competitive motive. These results agree with those of Forlano in a study involving a similar age range.

Hurlock's Study on the Relationship of Competition to Intelligence Test Scores.- In her reviews of the literature on motivation, Hurlock¹³ notes the great discrepancy between work done by children and their I.Q.'s, a discrepancy greatest in superior children. This is ascribed to the lack of a necessary incentive. Hurlock cites a number of studies in an attempt to prove this point.¹⁴ Hurlock's conclusion is intelligible in the light of the findings of the many experimental studies in competition which show that the more rapid workers are retarded by the tempo of the average group, while the slower are speeded up.

The Influence of the Group on Intelligence Scores.- Weston and English¹⁵ studied the influence of the group on psychological test scores, using two composite test forms containing items from Thurstone's "Reasoning" and "Interpretation" tests and from Brigham's

13

E. B. Hurlock, "Use of Group Rivalry as an Incentive," Journal of Abnormal and Social Psychology, XXII (April, 1927), 278-90.

14

J. A. McGrory, "A Study of the Relation Between Ability and Achievement," Educational Administration and Supervision, XII (December, 1925), 481-90.

15

S. B. Weston and H. B. English, "The Influence of the Group on Psychological Test Scores," American Journal of Psychology, XXXVII (February, 1926), 600-1.

"Opposite Test." Ten upper-classmen served as subjects, working in two equal groups, in reverse order as to solitary or group application to the tests. Other groups of varying size were tested individually and in a group by another series of differential mental tests. The first experiments show a definite improvement of test scores under social stimulation. The results of the second series of experiments show but slight improvement.

The Effect of Competition on Children's Behavior at Various Intelligence Levels.- It is significant that the results of Farnsworth¹⁶ and Anderson¹⁷ contradict those of Weston and English. In a very carefully conducted experiment Farnsworth repeated the work of Weston and English under more controlled conditions. He administered the tests once in isolation and once in the group, eliminating practice effects by using equivalent groups and by rotating the order of isolation and group conditions. No significant differences in mean group scores for the two conditions were found. There was, however, a consistent increase in variation of performance under group conditions, and a slight tendency for the individual working in

16

P. R. Farnsworth, "Concerning So-Called Group Effects," Pedagogical Seminary and Journal of Genetic Psychology, XXV (June, 1928), 587-9.

17

C. A. Anderson, "An Experimental Study of Social Facilitation as Affected by Intelligence," American Journal of Sociology, XXXIV (June, 1929), 874-81.

isolation to miss fewer of the difficult items. Farnsworth's results would seem to indicate that difficult problems may have an adverse effect on the group. Social stimulation may disrupt as well as facilitate, in which respect it is comparable to punishment.¹⁸⁻¹⁹

Anderson was not concerned with the effects of the group on mental test scores, but rather with the effects of the group on the behavior of individuals of considerably different I. Q.'s. Two groups of five senior high school boys took part in experiments involving addition, cancellation, and marble sorting. The I. Q.'s of one group were between 125 and 130, while those of the other group were between 100 and 105. A general tendency for the brighter children to be inhibited or slowed down by the presence of others was apparent, although accuracy in this group was more favorably affected than in the group of average intelligence. Anderson suggests that whatever effect the sight or sound of others at work may have as a social stimulus depends on the habits of work and the habitual patterns of response to the presence of other people which mark the component members of the group.

18

James Vaughn, "An Experimental Study of Competition," Journal of Applied Psychology, XX (March, 1936), 1-15.

19

James Vaughn and C. M. Diserens, "The Relative Effects of Various Intensities of Punishment on Learning and Efficiency," Journal of Comparative Psychology, X (February, 1930), 50-56.

The Effect of Rivalry on Intelligence Scores.- Maller and Zubin²⁰ studied the effects of competition or rivalry on intelligence test scores, utilizing alternate forms of the same test for initial and final testing. Forty-two children, divided into two equivalent groups, were observed. Some of the more important conclusions of the study follow: The repetition of an intelligence test under a very strong rivalry incentive caused no greater gain in score than repetition under normal conditions. The incentive brought about an increase in the number of items attempted, but there were more errors so that the total score was not affected. There were, however, important differences between the sub-tests in these respects. On the speed test (comparison of numbers) there was an increase in score, while in the power test (analogies) there was a decrease in score under the incentive conditions. The various intercorrelations and self-correlations of performance increased under the influence of rivalry, and the scores were more variable.

Summary of the Findings on the Relationship of Competition to Intelligence Scores.- The findings of Maller and Zubin agree in general with those of Farnsworth and Anderson. The majority of

20

J. R. Maller and J. Zubin, "The Effect of Motivation upon Intelligence Test Scores," Journal of Genetic Psychology, XXIV (December, 1932), 16-27.

experiments seem to contradict the notion that competition, or, indeed, any form of social stimulation improves mental test scores. Indeed, as tests increase in difficulty, requiring more and more deliberate and original reflection rather than speed, the reverse might be expected. Exceptions may be expected now and then, especially under conditions and in situations where competitive and cooperative attitudes have been given special attention.

In addition to these experiments bearing directly on problems of educational importance, other studies may be mentioned that are related rather indirectly to the problem of competition. These include the studies of Barton,²¹ Breed and McCarthy,²² Charles,²³ Jensen and Jensen,²⁴ McCrory,²⁵ and Turney.²⁶ These studies

²¹

W. A. Barton, "The Effect of Group Activity and Individual Effort in Developing Ability to Solve Problems in First Year Algebra," Educational Administration and Supervision, XII (October, 1926), 521-28.

²²

F. S. Breed and G. D. McCarthy, "Size of Class and Efficiency of Teaching," School and Society, IV (May, 1916), 961-8.

²³

J. W. Charles, "Competition for Marks," Journal of Applied Psychology, XLV (June, 1932), 315-21.

²⁴

M. B. Jensen and D. Jensen, "The Effect of Class Size Upon Pupil Accomplishment in High School Algebra," Educational Research, XXI (September, 1930), 120-37.

²⁵

J. A. McCrory, "A Study of the Relation Between Ability and Achievement," Educational Administration and Supervision, XII (May, 1926), 481-90.

²⁶

A. H. Turney, "Intelligence, Motivation, and Achievement," Journal of Educational Psychology, XXII (June, 1931), 426-54.

contain education, since they deal with means of increasing the efficiency of pupil learning in the various subject matter fields.

Summary

In this chapter on the survey of the related literature, an attempt has been made to summarize the major experimental studies dealing with the effects of various motives and combinations of motives on human behavior. The literature on the effects of competition, both of an individual type and of a group type, has been surveyed. However, with the single exception of the effects of competition on the constancy of the I.Q., an examination of the studies shows that no educational research has been attempted on the effectiveness of various motives with pupils of different levels of intelligence. It is significant to note that the relationship of intelligence to motivation has been opened up by this study.

The findings in studies of competition and rivalry indicated that social stimulation was definitely superior to work done in isolation. This general principle was verified by Greenberg, Muller, and Forlano. The type of task did not seem to influence the positive effects of competition, for improvement was noted in physical tasks such as ergographic tests or dynamometric tests as well as mental tasks.

A significant fact for education was brought out by Leuba when he found that competition in large groups is not nearly as

effective as in small groups. He also found that in simple tasks the dull pupils improved more than the bright pupils. However, in more complex tasks such as addition and multiplication, the bright pupils improved more than the dull pupils. In the experimental studies that used praise and reproof as motives, the following conclusions have been reached. Hurlock found that both praise and reproof served to raise test scores in arithmetic. However, older children were most affected and the boys responded more strongly than the girls. Hurlock also found that praise and reproof raised the intelligence scores of pupils subjected to these incentives. The findings of Hurlock were confirmed by Gilchrist and Briggs.

The findings of Weston and English dispute the findings of Hurlock as regards the effect of praise on raising intelligence test scores. They found no significant differences when social stimulation was applied to mental testing. The findings of Weston and English were later verified by Zubin and Anderson, who found that the repetition of an intelligence test under a very strong rivalry motive caused no greater gain in score than repetitions under normal conditions.

The present investigation is designed to deal with the following problems on which, as this review of the literature suggests, research is needed:

1. The effects of competition of two types, individual and group, on the achievement of superior children.
2. The effects of competition, both individual and group,

on the achievement of average children.

3. The effects of competition, both individual and group, on the achievement of dull children.

CHAPTER III

TREATMENT OF THE PROBLEM

The General Experimental Design of the Study

As has been pointed out in Chapter I, the major purpose of the present study is to determine the effects of competition, both individual and group, on the achievement of sixth grade pupils at three levels of intelligence in doing arithmetic addition.

In order to give an overview of the experimental design before considering the design in detail in a later section of this chapter, the following topics are treated briefly:

1. The selection and construction of the task, arithmetic addition test.
2. The introduction of the experimental motives.
3. The use of rewards as motives under both individual and group competition.
4. The selection of schools - ages and the number of pupils in the schools chosen.
5. Testing schedules for both individual and group competition.
6. Statistical technique used.

The task selected was a simple addition test consisting of the addition of simple one by one place numbers. The total possible

combinations of such numbers were fifty-six.

In both conditions the motives were introduced by setting up a competitive situation, in which the pupils worked for individual prizes in the case of individual competition or a group prize in the case of group competition. Rewards consisting of certificates of improvement signed by the teacher, principal and school superintendent were used to motivate the pupils to improve their scores on the arithmetic tests.

The number of schools making up the experimental design was forty. The forty schools were assigned to one of the two groups, individual or group competition, on the basis of a chance selection. This process resulted in two groups, each of which included twenty schools under the two motives. The sixth grade pupils in one of these groups worked under the motive of individual competition while those in the other group worked under the motive of group competition. Table I gives the number of pupils in each of these two groups. The pupils' ages, and the testing schedule used are also indicated. The testing schedule for both individual and group competition consisted of all pupils taking a pretest on Friday and then five consecutive addition tests on Monday through Friday of the following week. Since the experimental motives were not introduced when the pre-test was administered, the results on it were used as a measure of initial ability. During the five daily tests the experimental motives were introduced. So that a comparison could be made later between the

amount of improvement which a child made on the addition tests and his level of intelligence, intelligence tests were administered to the children. The tests were given to the pupils a week before the experimental schedule began.

The tests used were the Otis Group Intelligence Tests for the elementary grade, Form A. In order to insure utmost accuracy and consistency, these tests were all scored by trained assistants.

The statistical technique used was the small sample treatment. This is discussed in more detail in a later section of this chapter.

TABLE I

NUMBER OF SCHOOLS TESTED, NUMBER OF PUPILS TESTED, TESTS GIVEN, TIME OF TESTS, FOR EACH OF THE TWO EXPERIMENTAL GROUPS OF INDIVIDUAL COMPETITION AND GROUP COMPETITION

Schools Grouped According to Ex- perimental Motive	Number of Schools	Number of Pupils	Tests Given	Time of Tests
Individual Competition	20	469	5 D.T.* 1 P.T.*	5 Mins.
Group Competition	20	506	5 D.T.* 1 P.T.*	5 Mins.

* D.T. - pretest

* P.T. - daily tests

Giving the Tests.- The part of the experiment involving individual competition and that part involving group competition

were conducted independently of each other. Since tests were given only to sixth grade students, the teachers of the sixth grade in all the schools represented served as the test administrators. Each teacher was assisted by a staff of other teachers, who helped grade tests, record improvements, and prepare charts and graphs.

In all of the schools for both experimental conditions a pre-test was administered on Friday of the week previous to the giving of five daily tests. Five daily tests then were given from Monday through Friday each morning during the first period of school.

In the groups motivated by individual competition, the scores of each of the pupils on the pre-test were posted along with a display of prizes. In the case of group competition, instead of a chart with the name of each pupil being posted, a chart with the names of the class and the competing class was posted.

Posting of Test Results.— On Monday through Friday of the regular period, each day for both individual and group competition, the amount of improvement either negative or positive was posted, for each pupil in the case of individual competition, and for the class, in the case of group competition.

Description of the Experimental Samples of the Study.—

Table II presents the number of boys and girls in each class under conditions of individual competition. The total number of pupils representing each school is presented in addition to the proportionate representation of girls and boys for each school.

Tables III and IV present the ages of the pupils under the two experimental motives. The pupils are classified under one of three age groups, 11, 12, or 13.

As the last tables depicting the experimental design, Tables V, VI, VII, and VIII present the breakdown of the experimental population for each school under the two motives in terms of the three intelligence levels of low, average, and superior.

Description of the Schools Under Individual and Under Group Competition

In this study schools of various socio-economic levels are represented. These range all the way from schools in very well-to-do communities down to those in rather poor communities in both cases.

Description of Schools under Group Competition.— The schools representing group competition may be described as follows: Morton School is located in a well-to-do neighborhood of West Lafayette, Indiana. Most of the parents of the children are of professional or business status, and many of the fathers are professors at Purdue University. Almost the entire population is American-born.

Tippecanoe, Linnwood, Dayton, and Whitesville have children from a poor, congested district, the environs of Lafayette, Indiana. The parents of the children are mostly unskilled laborers. School records show that about two-thirds of them are foreign-born. Of

Tables VII and VIII present a frequency distribution of the intelligence quotients of all the pupils representing each of the two motives.

TABLE I I

NUMBER OF BOYS AND GIRLS IN EACH CLASS
UNDER CONDITIONS OF
INDIVIDUAL COMPETITION

<u>Schools</u>	<u>Boys</u>	<u>Girls</u>	<u>Total</u>
Battleground ..	22	20	42
Lengleis	16	22	38
Ford	17	15	32
Oakland	12	13	25
Dayton	10	10	20
Southside	13	15	28
Lincoln	8	5	13
Montgomery	8	5	13
Chalmers	7	7	14
Elston	4	5	9
North Central .	9	4	13
Lake View	13	10	23
Otterbein	11	11	22
Washington	10	16	26
Centennial	11	16	27
Jackson	5	7	12
Romney	5	7	12
Fowler	9	17	26
Fenton	31	27	58
Oxford	10	9	19
<u>Total</u>	<u>231</u>	<u>238</u>	<u>469</u>

TABLE III
AGES OF BOYS AND GIRLS IN CLASSES;
INDIVIDUAL COMPETITION

School	Age 11	Age 12	Age 13
Battleground ...	17	12	13
Longleis	27	4	7
Ford	18	7	7
Oakland	17	4	4
Dayton	9	7	4
Southside	17	7	4
Lincoln	3	5	5
Montgomery	2	8	3
Chalmers	5	6	3
Elston	3	3	3
North Central ..	3	4	6
Lake View	16	2	5
Otterbein	7	10	5
Washington	19	5	2
Centennial	11	9	7
Jackson	4	2	3
Romney	5	3	4
Fowler	15	7	4
Fenton	46	7	4
Oxford	13	3	3
Total	257	115	97

TABLE IV
AGES OF BOYS AND GIRLS IN CLASSES;
GROUP COMPETITION

School	Age 11	Age 12	Age 13	Total
Mace	10	7	3	20
Wingate	9	3	1	13
Darlington	12	6	5	23
Walnut	6	5	3	14
Youngs Chapel ..	8	2	1	11
Highland	14	10	7	31
Whitesville ...	5	3	3	11
Horace Mann ...	7	8	7	22
Lincoln	4	4	6	14
Oakland	22	9	3	34
Tippecanoe	16	8	4	28
Wea	4	5	5	14
Tuttle	16	5	6	27
Mills	24	6	4	34
Linnwood	24	3	3	30
Morton	50	7	3	60
Willson	24	8	3	35
Klondike	10	7	2	19
Dayton	10	7	2	19
Longleis	32	4	4	40
Total	314	115	77	506

TABLE V
INTELLIGENCE QUOTIENTS OF BOYS AND GIRLS IN CLASSES;
INDIVIDUAL COMPETITION

School	65-92 Dull	93-107 Average	108-135 Superior
Battleground	16	21	5
Longlois	11	16	11
Ford	9	12	11
Oakland	8	10	7
Dayton	9	10	1
Southside	17	8	3
Lincoln	5	5	3
Montgomery	7	3	3
Chalmers	4	7	3
Elston	3	5	1
North Central	5	6	1
Lake View	6	6	11
Otterbein	7	8	7
Linnwood	13	6	7
Centennial	7	16	4
Jackson	1	3	5
Romney	4	5	3
Fowler	3	11	12
Fenton	4	19	35
Oxford	1	7	11
Total	140	184	145

TABLE VI
INTELLIGENCE QUOTIENTS OF BOYS AND GIRLS IN CLASSES;
GROUP COMPETITION

School	65-92 Dull	93-107 Average	108-135 Superior
Mace	9	8	3
Wingate	3	3	7
Darlington	7	9	7
Walnut	6	5	3
Youngs Chapel ...	0	5	6
Highland	6	12	13
Whitesville	3	4	4
Horace Mann	10	8	4
Lincoln	6	5	3
Oakland	8	16	10
Tippecanoe	15	10	3
Wea	7	2	5
Tuttle	11	8	8
Mills	6	7	21
Linnwood	12	11	7
Morton	4	16	40
Willson	8	11	16
Klondike	5	9	12
Dayton	7	11	1
Longleis	11	17	12
Total	144	177	185

TABLE VII
FREQUENCY DISTRIBUTION OF I. Q.;
INDIVIDUAL COMPETITION

I. Q.	Frequency
135 - 139	2
130 - 134	3
125 - 129	13
120 - 124	22
115 - 119	25
110 - 114	47
105 - 109	77
100 - 105	65
95 - 99	57
90 - 94	31
85 - 89	54
80 - 84	21
75 - 79	22
70 - 74	16
65 - 69	7
60 - 64	4
55 - 59	2
50 - 54	1
Total	469

TABLE VIII
FREQUENCY DISTRIBUTION OF I. Q.;
GROUP COMPETITION

I. Q.	Frequency
135 - 139	6
130 - 134	8
125 - 129	24
120 - 124	36
115 - 119	34
110 - 114	54
105 - 109	60
100 - 104	55
95 - 99	56
90 - 94	45
85 - 89	49
80 - 84	24
75 - 79	27
70 - 74	10
65 - 69	9
60 - 64	5
55 - 59	3
50 - 54	1
Total	506

these, twenty-five per cent were born in Italy, twenty-eight per cent in Slavic countries, fifteen per cent in Ireland, and sixteen per cent in Germany. Mace, Wingate, Darlington, and Walnut Schools are all located in or near Crawfordsville, Indiana, and may be considered as having pupils from an average socio-economic group. Wea is a rural school located in Tippecanoe County and draws pupils from a well-to-do farmer group. Tuttle and Mills Schools are located in Montgomery County in a typical rural area. Klondike School is located in a small town of average socio-economic status. Lincoln School is a school exclusively for colored children, and draws from a rather poor economic group. Longlois School is located on the outskirts of Lafayette, Indiana, and draws students from an average group. Willson, Oakland, and Horace Mann are also average schools in respect to socio-economic status, and are located near Indianapolis. Highland School draws pupils from a very well-to-do neighborhood of Lafayette, Indiana. Youngs Chapel is located near Covington, Indiana, and draws pupils from a well-to-do neighborhood.

Description of Schools Under Individual Competition.-

The schools representing individual competition may be described as follows: Fenton School is located near Frankfort, Indiana, and draws its students from a very well-to-do neighborhood. As in the case of Morton School, most of the parents are of professional or business status, and many of the fathers are professors at Purdue University. Washington School, on the other hand, draws its

students from the industrial area of Lafayette, Indiana. The parents of these children are employed in the nearby aluminum factories. Ford, Oakland, and Southside Schools are all nearly average as regards the socio-economic level of the community. They are located in or near Lafayette, Indiana. Centennial School is located in the basin of Lafayette, Indiana, and draws its pupils from a rather poor industrial area. Oxford, Fowler, Romney, and Jackson Schools are rural in character, although they are located in small villages. The socio-economic level of these communities is average. Dayton and Battleground Schools are located in average communities. Lincoln School, not to be confused with Lincoln School in group competition, is located in Crawfordsville, Indiana, in an average neighborhood. Montgomery School is located in Montgomery County and draws its students from a rather well-to-do farmer group. North Central, Otterbein, and Chalmers Schools are all located in small cities and draw their pupils from an average group. Elston and Lake View Schools are located near South Chicago. They draw pupils from an average community.

It will be seen from the above description of the experimental sample that the blending of the various socio-economic levels in both experimental conditions is rather similar, even though the assignment of the schools to the two conditions was accomplished by chance. The scattered geographic area, plus the varying socio-economic levels make for a rather representative sampling of the school population in general. This representative sampling of the school population is essential

for the employment of the small sample theory technique utilized in this experiment. The wide scattering of the schools as regards geographic location, different administrative set-ups, different curricular offerings, and different socio-economic groups, should contribute to the educational significance of the results obtained in this experiment, but hardly guarantee it.

Description of the Pupil Task

Task of the Subjects.- In order to be able to measure the effect of motivation and the differences in effect produced by different motives, it was necessary to have a reliable measure of performance which was sensitive to initial individual differences and to the variability of all individual performance. The task performed by the subjects was similar to that used by Kraepelin and others, simple one by one place additions. The digits 1 and 0 were not used, and combinations of like digits, as 2 plus 2, were avoided. There were thus fifty-six possible combinations. The problems were presented to the subjects on printed sheets, two hundred problems to a page.

Construction of the Task.- This task was selected to comply with the following requirements:

1. The task should consist of small, measurable units.
2. It should be a task in which qualitative differences are reduced to a minimum. The score, for which recognition is to be

accorded the pupil, should be definitely quantitative.

3. Every individual tested should be capable of performing the task; i.e., the test should be one of speed and persistence rather than of power and capacity.

4. The function itself should be one of high reliability. If no variations are introduced, an individual's score or rank should be practically the same on one occasion as on another.

These requirements were set up so that the effects of motivation could more effectively be studied. The speed test would allow for more variability in the pupils, in terms of their solving more problems, than a power test would. A second reason these requirements were set up was to control the effects of mental fatigue. Long tasks produce mental fatigue in workers. A power test would have had to be longer than the five minutes given to the speed test. As a consequence, there might have been some elements of mental fatigue influencing the effects of the motivation, if a power test had been used.

Experimental Procedure

Individual Competition.- The procedure followed in the groups in which individual competition was the motive was in many respects similar to that followed in the groups in which group competition was the motive. In both conditions, the pupils charted the progressive improvement made day by day. For individual competition

this table of improvement consisted of the pupil's own score on a pre-test and the negative or positive improvement made upon five subsequent daily tests.

After the teacher had hung the individual chart with all the pupils' pre-test scores on the classroom bulletin board, the pupils were told that they were going to have a contest with prizes for those pupils who improved the most over their pre-test scores.

Procedure on Pre-Test.- The pre-test was given to the pupils so that a measure of their initial ability in doing arithmetic addition could be obtained. No experimental motives were introduced in the pre-test. The pupils were told only that they were to practice adding. Since the pupils were unaware that they were being tested or that any other tests were to follow, the pre-test could thus be used to gauge the amount of improvement which was made when the experimental motives were later introduced.

Experimental procedure on Day One.- After the pre-test papers were scored, the names of the pupils were put upon a class master chart in alphabetical order. Beside the name of each pupil, his grade received on the pre-test was recorded. This chart was hung in a conspicuous place in the room so that the pupils could daily observe the improvement made by each of the pupils on the daily tests.

Special emphasis was placed upon the fact that the prizes in this contest were given for improvement, and that the pre-test score would make no difference in the winning of the prizes, because they were given for the most improvement, and all the pupils could improve

if they worked hard.

To heighten the effect of the motive, knowledge of results, each child had his own individual chart upon which he recorded his own progress, in terms of more problems solved or less problems solved over the pre-test. The pupil first copied his pre-test score from the master chart, and then daily recorded his improvement on his own score chart. The classroom teachers assisted in daily keeping of this pupil chart of improvement.

The directions used in introducing the individual competition motive to the classes under that experimental condition will be found in the Appendix. The individual improvement charts, types of rewards used, and scoring directions for the tests will also be found in the Appendix.

Description of Rewards Used in Individual Competition.-

"Certificates of Improvement," signed by the school superintendent and principal, were placed upon the bulletin board as prizes for personal improvement.

The praise factor as a concomitant motive to individual competition was introduced daily by means of the teacher praising the class for the previous day's work, telling them she knew they could do better, and encouraging them to work harder to improve.

On the first day the whole stage of the experiment was, in reality, set, since at that time the pupils were told about the contest, prizes, and improvement.

Experimental Procedure on Days Two, Three, Four, and Five.-

The procedure followed on days two, three, four, and five was very similar to that followed on day one. Before the teacher gave the tests, she praised the class and encouraged the pupils to work harder to improve their scores. These statements were made objective, since it was important that the pupils in all the classes be motivated in the same manner. The specific directions given to the pupils on these days will be found in the Appendix.

Before the tests were taken, the pupils recorded on their own individual improvement charts results in terms of the amount of improvement of the previous day's work from the master chart on the bulletin board.

Conclusion of Tests for Each of the Twenty Schools.- When the pre-test and tests for the five days of improvement were finished, the total amount of improvement made by each pupil in the class was recorded on a master individual competition chart for each school. In addition to the pre-test scores, the five daily scores and the total improvement scores, this chart also contained the ages, the sex, and the intelligence quotients of all the pupils for each respective school.

Group Competition.- As was stated previously, the experimental procedure followed in the groups in which group competition was the motive, was very similar to the procedure for the groups in which individual competition was the motive. The pre-test with no competitive factors involved was given as a measure of initial ability.

After the teacher had hung the group chart with the pre-test scores of the two competing classes on the bulletin board, the pupils were told that they were going to have a contest, with a prize going to the group improving the most over their pre-test scores. The directions used in introducing the group competition motive to the classes under that experimental condition, will be found in the Appendix. The group improvement charts, types of rewards used, and scoring directions for the tests, will also be found in the Appendix.

The pre-test was given first so that when the motivational factor of group competition was introduced at the next test session, any difference in mean achievement between the two days would be indicative only of the effects of group competition. In this part of the experiment the individuality of the pupils was submerged in the group, since the pupils did not record their names on the class tests, but simply recorded the names of their class. Knowledge of results and praise were constants for the group motive as they were for the individual motive.

Pre-Test.- In giving the pre-test to the class, the pupils wrote the name of the class and school on their papers, not their own names. In this way the goal for which all the pupils composing the group were striving would be shared by all. The pre-test for group competition was given for the same purpose as that for individual competition, to derive a score of initial ability of the pupils composing the group, in doing addition in arithmetic.

Procedure on Day One.- In this part of the experiment two charts were kept for each of the twenty schools represented. One of the charts was a class bar chart with the name of the two schools competing against each other, which the children saw. The other was an individual pupil chart with the name of each pupil on it and each pupil's improvement, which the class did not see. Particular caution was exercised in group competition not to let the pupils know that their personal scores were being recorded by the teacher on a separate chart. To their knowledge this was a contest of class against class, and no one knew what each of the individual pupils composing the two classes was doing to help his own class to win. However, the teachers kept a seating chart of the pupils in the various classes and each of the seats was numbered. The papers of each of the pupils could later be identified by the teacher for analysis of results by comparing the seat number on the paper with the class seating chart. The class saw only the class bar graph of their class and that of the competing class; they never saw their own personal scores. On the separate chart containing the personal scores under group competition, the teacher recorded without the knowledge of the students the amount of improvement made by each pupil when working for the group and not for himself, as in the case of individual competition.

On the group charts which the pupils kept, the improvement of the class as a whole and the improvement of the competing class were charted. On the bulletin board, as in the case of individual competi-

tion, the record of daily improvement was charted. However, the improvement chart for the two competing groups was constructed in terms of a graph, indicating absolute scores.

Rewards for Group Competition.- The certificates of improvement for group competition were signed by the school superintendent, the principal, and the teacher, and placed on the bulletin board. Instead of carrying a space for the name of the winning pupil, the certificate carried a space for the winning class.

Procedure on Days Two, Three, Four, and Five.- The procedure followed on these days was similar to that followed on day one. Before the test was given to the class, the teacher praised the class and encouraged the pupils to work harder and improve the class score. Before the pupils took the daily group tests, they recorded the previous days scores of the two competing groups on their own class improvement charts from the Master chart on the bulletin board. The specific directions given to the class on these days will be found in the Appendix.

Conclusion of Tests for Each of the Twenty Schools.- When the tests for the five days of improvement plus the pre-test were finished, the total amount of improvement made by each pupil in the class was recorded on a master group competition chart for each school.

In addition to the pre-test scores, the five daily scores, and a total improvement score of each individual pupil exposed to the motive of group competition, this chart also contained the ages, the

sex, and the intelligence quotients of all the pupils for each respective school.

The Work Schedules

The work schedule followed for both individual and group competition was similar. The pre-test was given to the students on Friday of the week previous to the administration of the five daily tests. The work was divided into the mentioned pre-test and five daily tests. The tests were given during the first period of each school day, which was at 8:30 a.m. The instructions for introducing the constants of knowledge of results and praise, in addition to the two major variables of group and individual competition, were repeated before each test was administered daily.

Discussion of Statistical Technique Employed

The small sample technique, according to which the results are treated and presented, has been described fully by Lindquist.¹ However, since the technique departs considerably from that traditionally used, it may be well to review briefly the steps employed and the reasons for their use.

1

E. F. Lindquist, Statistical Analysis in Educational Research, pp. 40-50. Boston, Mass.: Houghton-Mifflin Co., 1940.

Comparison of the Conventional Statistical Treatment With the Small Sample Treatment.- With two independent groups of approximately five hundred pupils each, the conventional procedure would have thrown each group into a massed frequency distribution and computed the mean and standard deviation of each distribution. The standard error of each mean would have been computed by dividing the standard deviation of the distribution by the square root of the number of pupils. The standard error of the difference would have been obtained by extracting the square root of the sum of the squares of the standard errors. The difference between the means would have been divided by the standard error of the difference to obtain a "critical ratio," and the value thus obtained would have been looked up in a normal probability integral table to obtain "the chances in one hundred that the true difference is zero or less." Or, stated more rigorously, "the chances in one hundred that, with a true difference of zero, an obtained difference as large as the one under consideration would occur."

However, such a procedure involves an assumption which, in the case of the present study, is seriously false; it assumes a random selection of pupils. As in the case of most studies on pupils in schools, pupils were not selected at all; schools were selected. Forty selections were made, not one thousand.

Pertinency of the Small Sample Statistical Treatment for This Study.- Implicitly, the large sample technique assumes that the

pupils in a school (or in a class) resemble each other no more than they resemble other pupils in general. If our grouping were random and had no psychological existence, this would be the case. We might take the entering freshman class of a university and break it up into forty groups by the technique of random numbers. So long as these fictitious "groups" never operate as such, and remain only on the statistician's desk, it would not be necessary to take cognizance of them. By definition of random selection any other grouping would have been just as possible.

Unifying Factors in a School.- From the psychological point of view, a school is a genuine group and not a fictitious one, for two main reasons: (1) it does not select its pupils at random; (2) there is interaction within the group that is not shared by the population as a whole. The selection in a school is usually a rigid geographic one; rather than every pupil in the population having an equal chance of attending the school, those outside the district have no chance, and those within the district no other chance. It need hardly be pointed out that different geographical units may have extreme differences in a wide number of variables: occupation, race, economic status, cultural traditions, and many other factors may differ widely from school district to school district. To the extent that any of these are related to an experimental variable, the school must be taken as the unit. It is probable that many conclusions drawn from a school made up of the children of professional people could not

be applied to a school of steel-workers' children, however large the number of pupils might be.

The other factor unifying a school or a class is, perhaps, somewhat less obvious than the selection factor, but for psychological or educational research it may be of tremendous importance. The class is a dynamically integrated functional unit quite complete in itself. The pupils in one class have experiences in common and are exposed to influences that may be quite unique. Not only do these factors operate inevitably by the nature of the case, but they are often deliberately and vigorously injected and promoted; particularly in high school and college there is great pride in school individuality. "School spirit" is stimulated by athletic and other interscholastic competition and by vigorous exhortation, school songs, and similar integrative factors. Since these efforts have not only force but direction, it would be strange indeed if schools differed only because of the different pupils attending them. If the school had no distinctive effect on the pupil, there would be little point in paying salaries to teachers, principals, and superintendents.

The unifying effect of leadership and interaction within the group would be primarily attitudinal in nature (although it could not be ignored in informational or skills research) and of the utmost importance in a study of motivation. The groupings of the classes cannot be ignored and must, therefore, deal with two samples of twenty cases (schools) each.

It may be objected that this technique makes no use of the total number of pupils, and that one might just as well have but three pupils in a class as thirty. This is essentially true so far as the actual computation is concerned; but the larger the number of pupils in each class, the more stable will the class mean be; and this stability will be reflected in a lower variability of the class or school means.

It may be noted that using small sample technique does not commit the study to an assumption of differences between groups other than sampling differences. If the groups or schools were merely a number of random samples from the same population of pupils, the same results would have been obtained, in general, as with the traditional technique. We do not assume unification within the school; we only provide for it in case it exists.

Comparison of t to the Critical Ratio.- The customary use of the critical ratio assumes that there are sampling fluctuations in the mean but not in the standard deviation. If this were so, and the "true" standard deviation (the parameter)* were available, the sampling distribution of critical ratios would be a normal one, with a variability dependent on the standard error of the difference. However,

*

A hypothesis that the parameter (true mean) is zero is called by Lindquist and others the null hypothesis.

the variability is actually subject to sampling error, and the sampling distribution of the critical ratios is not normal. The exact shape of the distribution depends upon the number of degrees of freedom ($N-1$) involved. That is, not only is the sampling distribution of the statistic t definitely not normal, but its form differs for each different size of sample.

Description of Statistical Technique.- In its simplest terms, the present technique may be described as estimating a standard error of the mean from the group means themselves rather than estimating it from the variability of the individual pupils, and computing a standard error of the difference and a t . This statistic t , is simply a significance ratio. It is the ratio of a difference to the standard error of that difference. Essentially, it differs from the conventional critical ratio only in that an improved estimate of the standard error is used and the results are interpreted by means of a special table. The t is used to evaluate the plausibility of the null hypothesis in light of the data of this study. The individual scores are used only to obtain the school means, and their variability is not computed. As noted above, the variability of the individuals influences the variability of the school means, and is adequately taken into account in this manner.

If the schools all had the same number of pupils, it would be appropriate to obtain the mean of the school means and the deviation

of each school mean from this total mean. From the squares of these deviations the standard error of the total mean would be obtained. Since the schools do not have equal numbers of pupils, it is necessary to take the deviations from a weighted mean and to weight the square of each deviation by the number of pupils in that school. The method employed here was an algebraic equivalent of this, devised for facility in machine calculation.

Description of the Symbols Used in the Study.- In this study, the following symbols have been used: N is the number of pupils in a sample; n is the number of pupils in a school. T is the total improvement for a given school; and t is Student's t , the ratio of a statistic to its standard error; r is the number of subgroups in the sample. GT is the total improvement of the sample. M is a weighted mean of the schools' means, or $\frac{GT}{N}$. It may be noted, in connection with a discussion of terminology, that all standard errors presented in this study are estimated standard errors based on the variability of obtained means. The word "estimated" has not been written each time, primarily because the tables are sufficiently complex already.

The actual procedure employed in the statistical computations is illustrated on a sample work sheet which may be found in the Appendix.

Summary

This chapter has discussed the general experimental design of the study, the treatment of the problem, the selection and construction of the task, the nature of the rewards used, the selection of the schools, the introduction of the experimental motives to the subjects, the testing schedules for both individual and group competition, and a description of the statistical techniques employed in analyzing and interpreting the results.

The number of schools making up the samples was forty. There were twenty schools in group competition with 506 pupils and twenty schools in individual competition with 469 pupils. The age span for the boys and girls in both samples was from eleven through thirteen years. All were sixth grade pupils.

The intelligence groups in both samples were divided according to the limits devised by Otis in his self-administering intelligence examination for elementary grades. These limits were 93-107 I.Q. average, below 93 I.Q. dull, above 107 I.Q. superior. The number of pupils in each of these three categories for individual competition was 184 average, 140 dull, and 145 superior pupils. For group competition the number in the average group was 177, in the dull group 144, and in the superior group 165.

The task performed by the subjects was simple one by one place additions. The digits 1 and 0 were not used, and combinations of like digits were avoided. There were fifty-six possible combinations.

The problems were presented on printed sheets, two hundred problems to a page.

The experimental procedure under both motives was to give a pre-test, the results of which were to be used as a yard stick in measuring subsequent improvement. Then for five consecutive days under the motives of individual or group competition as the case might be, the pupils were given addition tests to determine the effects of the motive on their achievement. Daily improvement charts with the pupils' names listed were used to increase the competitive urge for individual status. Daily improvement charts with the names of the competing groups were used to increase the competitive urge for group status.

The rewards, used as incentives for improvement, were certificates of improvement signed by the teacher, the principal, and the superintendent.

The work schedule followed was to give the pre-test on Friday and the five daily tests from Monday through Friday of the following week. The tests were given during the first period of school at 8:30. The statements for introducing the motives were read each day to the pupils.

The procedures of the small sample techniques were employed to analyze the results.

CHAPTER IV

GENERAL DIFFERENCES BETWEEN GROUP AND INDIVIDUAL COMPETITION

Basic Problems Considered.- The most fundamental question to be answered by the data obtained here is whether or not there is a significant improvement in the individual competition condition and whether or not there is a significant improvement in the group competition condition. A second question to be answered is whether or not, providing that there is a significant improvement in the two conditions, there is a significant difference between the results secured under the two conditions.

Mean Improvement Under Individual Competition.- By reference to Table IX, it will be seen that the mean improvement with individual competition was 88.00. In other words, the pupils averaged 88 more problems correct on the last day than they had on the pre-test. This fact represents more than a fifty per cent improvement over the pre-test scores. The data for this improvement are given in Table XXI on page 85. The cumulative score at the end of the fifth day represents the total amount of improvement for the entire five day testing period. The basis for giving the daily scores was the amount of improvement the pupils made over the pre-test scores.

When it is considered that the function measured was one on which a great deal of previous practice and experience in school had

taken place over a considerable length of time, and that the pre-test score was obtained under the very test conditions that are usually assumed to give maximal performance, fifty per-cent improvement has important educational significance. With an estimated standard error of 11.29, this mean improvement has a t of 7.795, and with nineteen degrees of freedom, this is significant beyond the limits of probability given in available tables; that is, with nineteen degrees of freedom a t of this magnitude would be obtained by chance alone, much less than once in a hundred times. The chances that the "true" improvement is zero are practically negligible.

TABLE IX
MEAN IMPROVEMENT UNDER GROUP AND
INDIVIDUAL COMPETITION

Motivational Conditions	M	N	S.E. M^2	S.E. M	t	Significance Level
Individual Competition	88.00	469	177.50	11.29	7.795	1 per cent
Group Competition	206.30	506	152.39	12.30	16.772	1 per cent

Mean Improvement Under Group Competition.- As large and significant as is the mean improvement under individual competition, it is small in comparison with the group competition improvement of 206.30. With an estimated standard error of 12.30, the t is 16.772, and with nineteen degrees of freedom, this is significant beyond

question; that is, a t of this magnitude would be obtained by chance alone much less than once in every hundred times.

Differences Between Mean Improvements Under Individual Competition and Group Competition.- Of greater importance for the purpose of this study is the difference between the means for individual competition and group competition as shown in Table X. The pupils under group competition made a mean improvement of 118.29 more than those under individual competition, or, in terms of the latter, there was an increment of well over one hundred per cent. The data for this improvement are given in Tables XXIV and XXVI on pages 90 and 93.

The difference in improvement between individual competition and group competition is statistically significant. With an estimated standard error of 16.73, and nineteen degrees of freedom, the value of t is 7.071. Since a t of this magnitude would be obtained by chance alone much less than once in every hundred times, the hypothesis that there is no difference in the relative effectiveness of the two types of motivational conditions may be rejected with a high degree of confidence. In other words, it may be concluded that a real difference in their effectiveness exists. This difference, furthermore, is in favor of the group competition.

TABLE X
DIFFERENCE IN MEAN IMPROVEMENT BETWEEN
GROUP AND INDIVIDUAL COMPETITION

Difference Between Means	Standard Error of Difference	t	Significance Level
$M_{gr} - M_{ind}$	$S.E.M_{gr} - S.E.M_{ind}$		
118.29	16.73	7.071	1 per cent

Mean Improvements of Individual and Group Competition Compared.-

Although both of the methods resulted in real improvement, the group competition motive brought about a significantly greater improvement than did the motive of individual competition. Since the purpose of the present section is to delineate the findings rather than to interpret or generalize from them, the implications of these data will be discussed in a later section. However, still on the strictly factual level, it should be pointed out that t , as such, measures only the statistical significance of the statistic with which it is concerned. The importance or educational significance of the data must be determined by other criteria. Any difference, no matter how trivial, might be made statistically significant by increasing the precision of the experiment sufficiently. Of course, if a statistic, particularly a difference, is not statistically significant, its practical importance can be discussed only hypothetically, since, if it represents merely chance fluctuation from a zero or a reverse difference, interest in it would be very limited.

Comparison of the Means of Individual and Group Competition.-

Motivation through individual competition produced more than fifty per cent improvement; motivation through group competition produced more than one hundred per cent improvement; the advantage of group competition over individual competition is large, amounting to more than the absolute value of the latter itself. In every sense of the word, group competition as measured by improvement is the stronger motive.

Summary

The basic problem that was considered in this chapter was whether or not there was a significant improvement in the individual competition condition and whether or not there was a significant improvement in the group competition condition. As a corollary of the first problem, the second problem considered was whether, providing that there were significant improvements in the two conditions, there is a significant difference between the results secured under the two conditions.

Under conditions of individual competition the mean improvement of the pupils during the five day testing period amounted to over fifty per cent. The amount of improvement made by the subjects working under the motive of individual competition was statistically significant. With an estimated standard error of 11.29, the mean improvement for individual competition had a t of 7.795, and with nineteen degrees of freedom, was statistically significant. That is, a t of such a magnitude would have been obtained by chance alone, much less than once in every hundred times.

Under conditions of group competition the mean improvement of the pupils during the five day testing period amounted to over one hundred per cent. The amount of improvement made by the subjects working under the motive of group competition was also statistically significant. With an estimated standard error of 12.30, the mean

improvement for group competition had a t of 16.772, and with nineteen degrees of freedom, was significant beyond question. That is, a t of such a magnitude would have been obtained by chance alone, much less than once in every hundred times.

In answer to the first question, whether or not there was a statistically significant improvement in the two motives, it may be stated that there was statistically significant improvement under both motives; however, the improvement under group competition was much more than under individual competition.

The difference between the obtained means of individual competition and group competition amounted to 118.29 problems more for group competition. With an estimated standard error of 16.73, the difference in mean improvement between individual competition and group competition had a t of 7.071, and with nineteen degrees of freedom was significant beyond question. That is, a t of such a magnitude would have been obtained by chance alone much less than once in every hundred times.

In answer to the second question, whether there was a statistically significant difference in the two motives, it may be stated that the difference between the obtained means was highly statistically significant and in favor of group competition.

CHAPTER V

THE DIFFERENCES BETWEEN GROUP AND INDIVIDUAL COMPETITION AS RELATED TO INTELLIGENCE

The Relationship of Intelligence to Social Motivation

The question now arises as to how the improvement noted in the discussion in Chapter IV is related to whatever is measured in current intelligence tests. That is, what is the relationship, if any, between the level of intelligence of the pupils participating in the experiment and the amount of improvement made in the arithmetic tests.

From a priori consideration, several different results might be anticipated. There is what might be called a superstition that social motivation, in general, is less effective on the superior child. From one point of view, the superior child, perhaps because of the divergence of his interests from those of his age group, is supposed to be a "lone wolf," by himself and for himself, not participating in group games and activities but busily engaged in the development of his own conspicuous potentialities.

¹
Terman's Studies on Superior Pupils.- The work of Terman and others has cast serious doubt upon this sort of picture, but the possibility of some truth in it is not so remote as to preclude investigation.

¹
Lewis M. Terman, Genetic Studies of Genius, Vol. I, pp. 197-200. Stanford University Press, Stanford University, California, 1925.

Social Motivation and Intelligence.- On the other hand, it is conceivable that social motivation of the type involved in group competition involves a refinement of perception and conception that would necessitate an individual of superior intelligence to have much effect. It has sometimes been suggested that social plans involving group motivation with heavily socialized incentives must fail because they would work only for the "intellectuals." Without identifying "intellectuals" with high I. Q. pupils, it is worth inquiring whether the individual who can respond adequately to more complex situations is also more sensitive to "higher units" of motivation. One might also argue that sensitivity to higher social motivation is essentially attitudinal, exclusively a function of one's reactional biography, and therefore uncorrelated with "innate" intelligence.

Perhaps the mental age rather than the intelligence quotient best represents the factors just discussed, but the age range involved here is so limited that there is very little difference between the two. Furthermore, there are attitudinal factors that one might expect to be associated with high I. Q. and C. A. - M. A. disparity rather than the level of mental advancement itself.

Intelligence Limits of Three I. Q. Groups.- As was mentioned previously in Chapter III, before the pre-test or the daily arithmetic tests were given, all the pupils took the Otis Mental Ability test. On the basis of the results, the two samples with individual and with group competition were divided into three I. Q. subgroups. The middle

group comprised I. Q.'s from 93-107 inclusive, and was designated as "average"; the "superior" and "dull" were those above 107 and below 93, respectively. These are the same limits used by the Otis Mental Ability Scales to divide the pupil population into three levels of intelligence.² The estimated standard error of the mean was computed for each of these six subgroups according to the small sample procedure previously discussed, and differences evaluated in terms of their estimated standard errors by means of the statistic t .

It was planned originally to form the I. Q. subgroups according to both the divisions mentioned above and according to such divisions as would yield approximately equal numbers of pupils in each subgroup. However, when a frequency distribution was formed, it was found that the 93-107 dividing plan gave practically equal numbers in the three subgroups except for slightly fewer pupils in the dull group. An equal frequency grouping would have differed by only one point of I. Q., dividing at 94 rather than 93. Consequently the arbitrary division was considered sufficient.

Statistical Treatment of the Data.- For each of these classifications in each of the two experimental groups of twenty schools, the mean improvement during the experimental period was first determined. Then using the t test previously described, the significance of the differences between the mean improvements made by groups at each of the three levels of intelligence was next evaluated.

² Arthur S. Otis, Self-Administering Tests of Mental Ability, pp. 1-4. New York: World Book Company, 1922.

Finally, the mean improvement of those pupils motivated by individual competition was compared with those motivated by group competition. The t test was used in each of these comparisons. It is recognized that since it is not known whether or not all of the fundamental assumptions underlying the use of the t test are completely satisfied when samples of this nature are involved, its use here may not be strictly appropriate. It is believed, however, that there is not available at the present time a more valid test of statistical significance of statistics derived from such samples.

Comparison of Small Sample Statistical Technique with Product Moment Correlation.- At this point it may be inquired why the question of I. Q. improvement relationship was not answered by means of a conventional product moment correlation. It has been pointed out by Lindquist³ that throwing the individuals from a number of groups into a common scatter diagram may lead to a seriously spurious r , if the group means in the two variables are widely different. It would have been possible to compute a coefficient of correlation for each of the forty schools, to transform each correlation coefficient into Fisher's z function, to average (with weighting) the z 's for group and for individual competition, and to transform the mean z back into an r . Although such a procedure would have escaped many of the pitfalls of

3

E. F. Lindquist, Statistical Analysis in Educational Research, p. 218. Boston, Mass.: Houghton-Mifflin Co., 1940.

a massed correlation technique, it would have involved computing coefficients of correlation with very small n 's, and would have involved the assumption of essentially homogeneous correlation throughout. Even so, it would not have permitted comparisons of corresponding subgroups with group and with individual competition, and this is one of the most important sources of information for this study. It is perhaps unnecessary to note that the phenomenon of regression, which makes it difficult to correlate improvements with original scores and tends to produce negative correlations, (which can be corrected by Thomson's formula)⁴ is not operative here, since the I. Q. and both original and improved scores are computed independently.

The Relationship of Intelligence Levels to Individual Competition

Mean Amount of Improvement at Three Intelligence Levels

Under Individual Competition.— Table XI shows that on each I. Q. level the mean improvements are statistically significant for each kind of motivation, but the superior children gain more than the average, and they in turn more than the dull. For the group with individual competition, the mean improvements are 118.62, 85.80, and 59.20 for the superior, average and dull groups respectively. With nineteen degrees of freedom and t 's of such a magnitude, 8.170, 8.640,

4

J. P. Guilford, Psychometric Methods, p. 365. New York: McGraw Hill Book Co., 1936.

TABLE XI
MEAN IMPROVEMENT OF SUPERIOR, AVERAGE AND
DULL GROUPS: INDIVIDUAL COMPETITION

Three Levels of Intelligence	M	N	S.E. _M ²	S.E. _M	t	Significance Level
Superior	118.68	145	214.82	14.70	8.170	1 per cent
Average	85.80	184	98.63	9.93	8.640	1 per cent
Dull	59.20	140	74.32	8.62	6.870	1 per cent

and 6.870, the hypothesis that there is no improvement made by pupils at each of these three levels of intelligence under the motive of individual competition may be rejected with a high degree of confidence.

This represents a gain of mean improvement with a corresponding gain in I. Q., and the difference between the superior and average is approximately equal to that between the average and the dull as may be seen in Table XII.

Differences in Mean Improvement of Adjacent I. Q. Subgroups.-

The differences between adjacent I.Q. subgroups (superior-average and average-dull) just barely fail of significance at the five per cent level, with t's having values of 1.854 and 1.990. That is, with nineteen degrees of freedom, and estimated standard errors of the difference of 17.70 and 13.15, t's of such a magnitude would have been obtained by chance alone, more than five times in every hundred times. In other words, the chances that the differences are not true differences are too great to be statistically significant.

The extreme difference (between superior and dull groups) is 59.42, and is significant beyond the one per cent level, with a t of 3.495; that is, with an estimated standard error of the difference of 17.00 and nineteen degrees of freedom, the chances that a t of such a magnitude would be obtained by chance is less than once in every hundred times.

There can be doubt but that the bright pupils tend to improve more than the duller; the upper third has improved almost exactly twice as much as the lower third, and the difference is not only statistically significant but of considerable magnitude.

TABLE XII

DIFFERENCES IN MEAN IMPROVEMENT BETWEEN
SUPERIOR, AVERAGE AND DULL GROUPS;
INDIVIDUAL COMPETITION

Groups Compared	Difference	S.E. of Difference	t	Significance Level
Superior-Average	32.86	17.70	1.854	5 per cent
Superior-Dull	59.42	17.00	3.495	1 per cent
Average-Dull	26.20	13.15	1.990	5 per cent

Variabilities of the Mean Improvements.— The variabilities of the mean improvements present a curious, though interesting, picture. In Table XI, the estimated standard errors of the three means are 14.70, 9.93, and 8.62 for superior, average, and dull

subgroups with individual competition. The estimated standard error of the mean for the entire individual competition group is 11.29. The highest I.Q. third has a larger variability of the mean than the total sample. Furthermore, the difference between the standard errors of the mean for the two extreme groups is almost significant at the one per cent level, as judged by the F test of the variance ratio.⁵ The possible interpretations of this fact will be discussed later, but at its face value it gives rise to several questions. In the first place, since the number of schools is constant, the estimated standard errors are proportional to the variabilities of the obtained means involved. As such, the three subgroup S. E.'s may be considered as standard errors of estimate of the mean improvements with restricted variation in I. Q. If the sample is homogeneous⁶ with regard to the two variables, these three standard errors should be equal within the range of sampling error, and should be less than the standard error of the mean of the entire individual competition group. It is true that the upper I. Q. subgroup covers a wider range than the lower two because of the positively skewed distribution of I. Q.'s but this is not adequate to explain a larger variability of

⁵
E. F. Lindquist, op. cit., pp. 60-66.

⁶
E. F. Lindquist, A First Course in Statistics, pp. 171-172. Boston, Mass.: Houghton-Mifflin Co., 1938.

improvement than that found in the entire group. An adequate explanation of this phenomenon is not at hand, and perhaps must await further research. At any rate, the peculiar behavior of the subgroup variances confirms the caution used in refraining from Pearsonian correlation technique in dealing with this problem. The experimental results show that superior students improve more than dull students, and this has been done with a minimum of assumptions.

The Relationship of Intelligence Levels to the Amount of
Improvement Made by Pupils Working Under the Motive
of Group Competition

The comparable data for group competition in Tables XIII and XIV also show the superior pupils improving more than the average and the average more than the dull.

Mean Amount of Improvement at Three Intelligence Levels Under Group Competition.- However, the conspicuous fact is the enormously greater improvement of the superior pupils; their mean improvement is 317.50, as compared with 169.30 by the average and 102.47 for the dull.

Differences in Mean Improvement of Adjacent I.Q. Subgroups.- The mean improvements themselves are significant. All the differences between the three I. Q. levels are significant at the one per cent level, that is, with nineteen degrees of freedom and estimated standard errors of 9.90, 13.60, and 21.50, t's of such a magnitude would be obtained by chance alone less than once in every hundred

times. The hypothesis that there is no improvement made by pupils at three levels of intelligence under the motive of group competition, may be rejected with a high degree of confidence.

The superior-average and superior-dull differences are significant at far beyond the one per cent level. The striking fact, however, is not the significance of the differences but their magnitude; the superior pupils improved 148.20 more than the average, and 215.03 more than the dull. With the mean pre-test score less than two hundred, this is a tremendous improvement.

Unlike the differences in the case of individual competition, the two differences between adjacent subgroups are not even close to equal (148.20-66.83).

Variabilities of the Mean Improvements.- The behavior of the subgroup variances and standard errors is especially noteworthy in view of the pattern noted in the case of individual competition. This time the standard error of the mean is less for the superior pupils than for either of the other subgroups, and that for the dull is the largest of the three. Again, the difference between the variabilities of the extremes is significant by the F-test of the variance ratio. In the individual competition the high variability is in the superior group while in group competition it is in the dull group. In both cases the average group falls between the two extremes, suggesting systematic change.

TABLE XIII

MEAN IMPROVEMENTS OF SUPERIOR, AVERAGE AND DULL
GROUPS; GROUP COMPETITION

Three Levels of Intelligence	M	N	S.E. M^2	S.E. M	t	Significance Level
Superior	317.50	185	97.17	9.90	32.070	1 per cent
Average	169.30	176	190.68	13.80	12.270	1 per cent
Dull	102.47	145	463.82	21.50	4.770	1 per cent

TABLE XIV

DIFFERENCES IN MEAN IMPROVEMENT BETWEEN SUPERIOR,
AVERAGE AND DULL GROUPS; GROUP COMPETITION

Groups Compared	Difference	S.E. of Difference	t	Significance Level
Superior-Average	148.20	16.90	8.769	1 per cent
Superior-Dull	215.03	23.70	9.073	1 per cent
Average-Dull	66.83	25.60	2.610	2 per cent

It is difficult to advance explanations for these subgroup variance differences that will cover both group and individual competition. The skewness of the I. Q. distribution would tend to account for the higher standard error of the superior subgroup, but would militate against the situation found with group competition. Of course, the variabilities involved are not pupil variabilities, but

variabilities of school means, and it is possible that the relationship between the unitary characteristic of a school, whatever it may be, and the effect of motivation on various I.Q. levels may be more complicated than is usually assumed. The further analysis of the variables operating in this regard would require specially constructed experiments, perhaps of a Latin square type of design,⁷ which are quite beyond the scope of this study.

Comparison of the Amount of Improvement Made by Three
Intelligence Groups under Individual Competition
and Group Competition

Perhaps the most illuminating comparisons between I. Q. subgroups have not yet been discussed. The comparisons between the three I. Q. subgroups within each form of competition are presented in Tables XII and XIV. The comparisons at the same I. Q. level between group and individual competition are presented in Table XV. There is a difference between the two superior I. Q. subgroups of 198.88 in favor of group competition; between the average subgroups the difference is 83.50 and between the two dull subgroups 43.27. All differences are in favor of group competition.

⁷ Ronald A. Fisher, Statistical Methods for Research Workers, pp. 6-10. Edinburgh, Scotland: The Oliver and Boyd Press Co., 1936.

TABLE XV
DIFFERENCES OF MEAN IMPROVEMENT BETWEEN GROUP
AND INDIVIDUAL COMPETITION AT THREE LEVELS OF
INTELLIGENCE

I. Q. Sub-Group	Difference Between Group and Individual Competition	S. E. of Difference	t	Significance Level
Superior	198.88	17.70	11.236	1 per cent
Average	83.50	17.00	4.912	1 per cent
Dull	43.27	23.20	1.865	10 per cent

Differences Between Individual Competition and Group Competition at Three Levels of Intelligence.- The differences between superior group and superior individual competition and average group and average individual competition are significant at beyond the one per cent level, with t's having values of 11.236 and 4.912. That is, with nineteen degrees of freedom and estimated standard errors of the difference of 17.70 and 17.00, the chances that t's of such a magnitude would have been obtained by chance alone is less than once in every hundred times. Therefore, the hypothesis that there is no real difference between the amount of improvement made by superior and by average children under the conditions of individual and group competition may be rejected with a high degree of confidence. Furthermore, the differences in both cases are in favor of group competition.

The dull group and dull individual competition difference fails somewhat of significance at the five per cent level, with a t

having a value of 1.865. That is, with nineteen degrees of freedom, and an estimated standard error of the difference of 23.20, a t of such a magnitude would be obtained five times in every hundred times. Since the possibility exists that the difference may not be a true difference, but may be due to chance; the difference in the amount of improvement made by the dull group under individual competition, and the dull group under group competition, is not considered significant. The lack of significance in the last case is a function of the high variability of the mean for the dull I. Q. subgroups under group competition. However, the outstanding fact is the greater difference between the two forms of motivation at the superior I. Q. level; although group competition produces more improvement at all levels, the difference is especially marked at the higher I. Q. level. The social and educational implications of this fact will be discussed in Chapter VII, under the heading, Interpretation of Results.

Comparison of Four Extreme I. Q. Subgroups

In addition to the three divisions of intelligence according to the limits suggested by Otis, it was deemed advisable to break down further the samples into four extreme I. Q. subgroups to shed additional light upon the relation of I. Q. to improvement.

Intelligence Limits of the Extreme I. Q. Subgroups.- The groups were composed of those pupils who had intelligence quotients at either extreme of the intelligence distribution. Those who had

intelligence quotients below 75 were in one group, those from 75 to 85 in another. Those who had intelligence quotients above 125 were in another, and from 115 to 125 in another. These extreme groups were isolated in both the individual competition and group competition samples. Tables XVI to XX designate these extreme I. Q. subgroups by the subscripts 125, 115, 85 and 75 respectively. These subscripts are merely convenient labels to avoid confusion, and are not intended to imply that the mean I. Q.'s of the groups concerned have those exact values. The number of subjects in each of the subgroups is given in Tables VII and VIII on pages 40 and 41.

Mean Amount of Improvement Made by Extreme I. Q. Subgroups Under Individual Competition.— Table XVI shows that the mean improvements under individual competition are 149.97, 116.56, 65.48, and 45.86 for the 125, 115, 85 and 75 I. Q. subgroups. The corresponding estimated standard errors of the means are 13.00, 13.40, 7.10

TABLE XVI
MEAN IMPROVEMENT OF FOUR EXTREME I. Q. GROUPS;
INDIVIDUAL COMPETITION

Extreme I. Q. Levels	Mean	S.E. M^2	S.E. M	t	Significance Level
125 I. Q.	149.97	168.04	13.00	11.536	1 per cent
115 I. Q.	116.56	179.08	13.40	8.699	1 per cent
85 I. Q.	65.48	50.40	7.10	9.223	1 per cent
75 I. Q.	45.86	73.60	8.60	5.333	1 per cent

and 8.60. With t 's of such a magnitude, 11.536, 8.699, 9.233 and 5.333, the possibility that they were obtained by chance is less than once in every hundred times. The hypothesis that there is no real improvement in the four extreme I. Q. groups under individual competition may be rejected. In other words, it may be concluded that the pupils under individual competition at all four intelligence levels made significant improvement over their pre-test scores.

There is a regular increase in improvement with I. Q., considering the double-sized interval between the 85 and 115 groups. The standard errors do not change progressively, but the two superior groups have high and approximately equal standard errors of the mean and the two low groups have low and fairly similar standard errors. It might be noted that these "extreme" groups were tabulated directly from the original raw data independently of the three I. Q. subgroups discussed previously based on the Otis limits; the consistency of the results by both methods with regard to both means and standard errors of the means serves as an additional computational check.

Differences in Mean Improvement of Extreme I. Q. Subgroups.-

With regard to the significance of the differences between the various "extreme" I. Q. groups found in Table XVII, they likewise agree with the corresponding previous results, in that the differences between adjacent I. Q. groups fail of significance at the five per cent level by a fairly small margin, and the differences between non-adjacent groups are significant beyond doubt. It may be noted that the 115-85

difference of 51.08 has a value of t of 3.372. With nineteen degrees of freedom, and a standard error of the difference of 15.15, a t of such a magnitude would be obtained by chance alone much less than once in every hundred times.

TABLE XVII
DIFFERENCES IN MEAN IMPROVEMENT BETWEEN FOUR
EXTREME I. Q. GROUPS

Groups Compared	Differences Between Means	S.E. of Difference	t	Significance Level
125 - 115	33.41	18.02	1.794	10 per cent
125 - 85	84.49	14.78	5.744	1 per cent
125 - 75	104.11	15.53	6.704	1 per cent.
115 - 85	51.08	15.15	3.372	1 per cent
115 - 75	70.70	15.89	4.449	1 per cent
85 - 75	19.62	11.14	1.761	10 per cent

Mean Amount of Improvement Made by Extreme I. Q. Subgroups

Under Group Competition.- In Table XVIII, for group competition, the subdivision into smaller groups shows much the same picture as the subdivision into larger groups. The means are 330.73, 323.20, 137.18, and 88.05 for the 125, 115, 85, and 75 I. Q. groups, with standard errors of the means of 8.80, 10.60, 11.70, and 16.80, respectively,

TABLE XVIII
MEAN IMPROVEMENT OF FOUR EXTREME I. Q. GROUPS;
GROUP COMPETITION

Extreme I. Q. Levels	Mean	S.E. M _R	S.E. M	t	Significance Level
125	330.73	79.97	8.80	37.503	1 per cent
115	323.20	112.28	10.60	30.490	1 per cent
85	137.18	101.35	11.70	8.679	1 per cent
75	88.05	285.48	16.80	5.241	1 per cent

sufficiently close to the three-way division results to guarantee at least no gross error. Since with nineteen degrees of freedom, the chances that t 's of such a magnitude, 37.503, 30.490, 8.679, and 5.241, would be obtained by chance alone are much less than once in every hundred times. The hypothesis that there is no real improvement made by the four extreme I. Q. groups under individual competition may be rejected with a high degree of confidence. In other words, it may be concluded that the pupils under individual competition at all four extreme intelligence levels made significant improvement over their pre-test scores.

It may be noted in Table XIX that the group competition differences between adjacent groups are small and of low statistical significance. The 125-115 difference has an estimated standard error of 7.53, and the value of t is .546; and the 85-75 difference has an estimated standard error of 13.50 and the value of t is .655. With nineteen degrees of freedom, t 's of such a magnitude would be obtained

by chance alone fifty times in every hundred. In other words, no statistical significance can be attached to the small difference between the extreme adjacent I. Q. subgroups, at the superior and dull levels, under group competition. The other differences between adjacent I. Q. subgroups under group competition are all significant at the one per cent level.

There is a zone of sharp change of improvement with I. Q. between the two center groups, i.e., in the 90-110 I. Q. range. Above that zone, I. Q. has little effect on improvement, and below it only slightly more. This point will be considered at greater length later in this chapter.

TABLE XIX

DIFFERENCES IN MEAN IMPROVEMENT BETWEEN FOUR
EXTREME I. Q. GROUPS; GROUP COMPETITION

Groups Compared	Differences Between Means	S. E. of Difference	t	Significance Level
125- 115	7.53	13.80	.546	50 per cent
125 - 85	229.18	14.70	15.590	1 per cent
125 - 75	242.68	19.10	12.706	1 per cent
115 - 85	221.65	15.80	14.028	1 per cent
115 - 75	235.15	19.90	11.817	1 per cent
85 - 75	13.50	20.60	.655	50 per cent

Comparison Between Extreme I. Q. Subgroups Under Individual

and Group Competition.— Table XX showing the comparisons between corresponding I. Q. groups in the two forms of motivation again sheds light on the nature of the difference between individual and group competition effects on improvement. The differences between individual competition and group competition for the 125-115 I. Q. groups are significant at the one per cent level. The differences between individual competition and group competition for the 85-75 I. Q. groups are significant at the two per cent level. The difference between the two 125 I. Q. groups is 180.76 with a t of 11.528; between the 115 I. Q. groups the difference is 206.64 with a t of 12.105; between the 85 I. Q. groups the difference is 36.07 with a t of 2.635; and between the 75 I. Q. groups the difference is 42.19 with a t of 2.226. That is, with nineteen degrees of freedom, and t 's of such a magnitude the possibility that they would be obtained by chance alone is more than twice in every hundred times. In other words, the hypothesis that there is no real difference in improvement between individual competition and group competition with pupils at four extreme levels of intelligence may be rejected. Furthermore, the differences at the three extreme I. Q. levels are all in favor of group competition.

Since the two upper groups with individual competition differ considerably in improvement and the two corresponding group competition groups differ but slightly, it is probably natural that the difference between the two 115 I. Q. groups is the largest of the four. This would signify that the two methods of motivation differ

TABLE XX
DIFFERENCES IN MEAN IMPROVEMENT BETWEEN GROUP AND
INDIVIDUAL COMPETITION FOR EXTREME I. Q. GROUPS

I. Q. Sub-Groups	Difference Between Group and Individual Competition	S.E. of Difference	t	Significance Level
125	180.76	15.68	11.528	1 per cent
115	206.64	17.07	12.105	1 per cent
85	36.07	13.69	2.635	2 per cent
75	42.19	18.95	2.226	2 per cent

most heavily in the moderately superior group, with I. Q.'s from 110 to 119. It may be said, however, with considerable confidence, that it is the upper and not the lower I. Q. pupils who make group competition so much more effective than individual competition.

Curves of Improvement of Three I. Q. Groups Under
Individual and Group Competition

It is also possible to fractionate the data on another basis, and follow the course of improvement from day to day, both in general and for the three I. Q. subgroups. These data are presented graphically in Figure 1. The numerical data for these curves may be found in Tables XXIII and XXV. It should be noted that the curves are plotted to show the improvement of each day above the previous day, rather than the absolute level of performance on each day.

Although the latter type of curve would, of course, show the improvement, and is, as a matter of fact, the conventional type of "improvement curve," it would leave the reader to infer the improvement from the slope of the curve rather than the height. In the curves presented here the height of the curve shows the improvement.

Curves of Amount of Improvement Under Individual Competition.-

The daily improvement curves for the three I. Q. levels with individual competition show the superior group to improve more each day over the average and low I. Q. groups. The course of daily improvement decreases up to the middle of the curve, and picks up thereafter. The third day shows a decided drop in improvement in all three curves and would seem to represent a motivational lull where neither initial surge nor end spurt is operative. One must be cautious about evaluating the effectiveness of motivation as though it were a linear function of improvement. Presumably there is a physiological limit to the speed of adding. It may also be presumed that, as this limit is approached, the same amount of motivation will produce less performance increment, since at the limit itself, no increment is possible, regardless of motivation. There is good reason to suppose, from the vastly greater improvement of the group competition pupils, that the pupils with individual competition are far from their maximum possible performance, but nevertheless it must be remembered that there is a tendency for constant motivation to yield steadily diminishing returns in improvement.

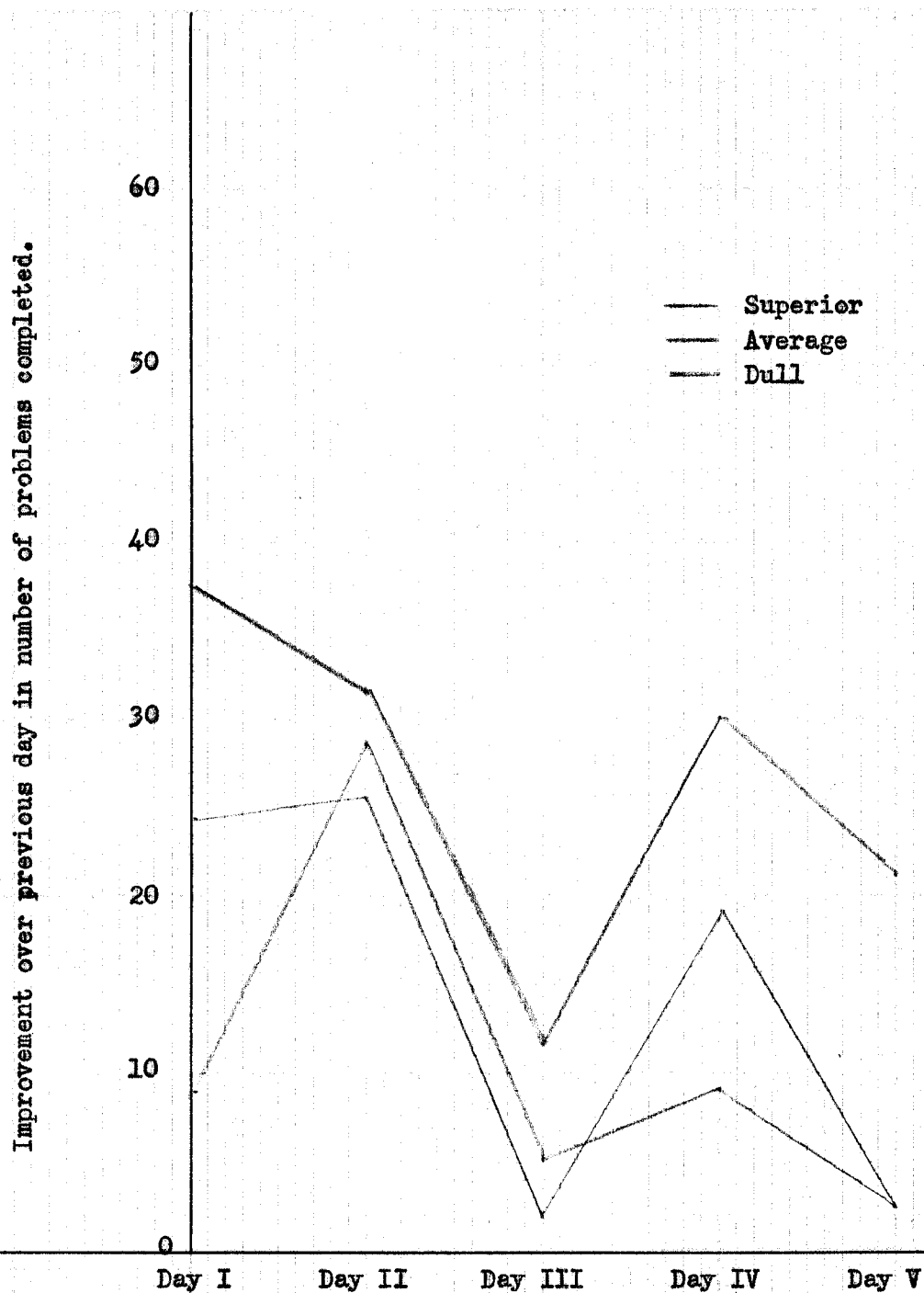


Fig. 1.- Amount of Daily improvement at three levels of intelligence under conditions of individual competition.

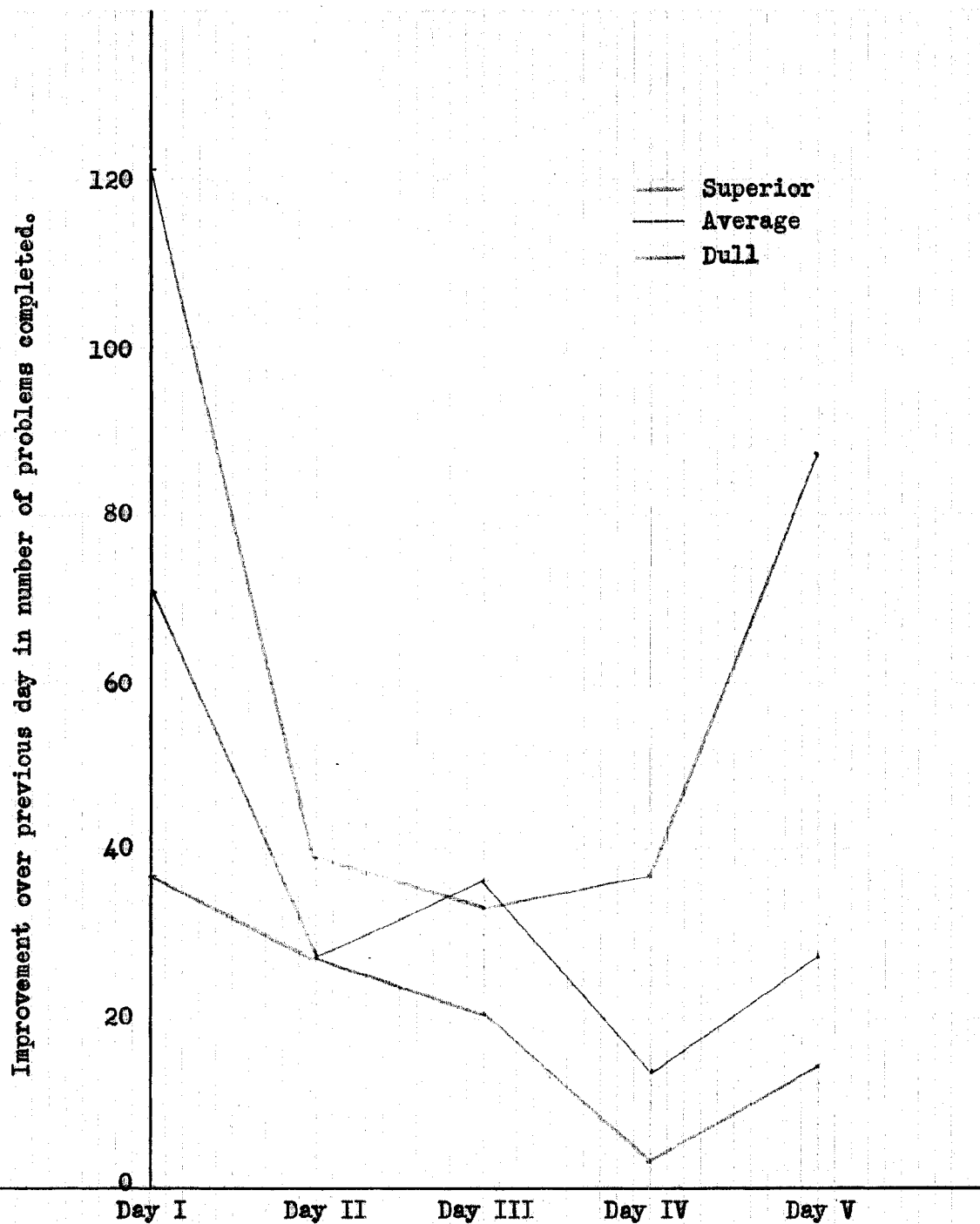


Fig. 1A.- Amount of daily improvement at three levels of intelligence under conditions of group competition.

TABLE XXI

FIVE DAYS OF IMPROVEMENT FOR EACH SCHOOL UNDER CONDITIONS
OF INDIVIDUAL COMPETITION

School	Number of Pupils	Total Pre-test Score	Total Imp.* Day I	Total Imp. Day II	Total Imp. Day III	Total Imp. Day IV	Total Imp. Day V	Total Imp. all Five Days
Battleground	42	6298	661	972	797	-519	151	2062
Longleis	38	5245	1094	730	192	500	-308	2208
Ford	32	5069	723	1488	-787	314	347	2085
Oakland	25	3773	328	543	145	1041	775	2832
Dayton	20	3622	176	637	126	254	226	1419
Southside	28	6143	-240	1619	229	223	943	2774
Lincoln	13	1990	251	356	43	261	110	1021
Montgomery	13	1406	573	573	236	209	95	1686
Chalmers	14	2825	235	339	87	263	187	1111
Elston	9	1488	66	391	143	95	44	739
North Central	13	3193	1073	-161	172	33	- 50	1067
Lake View	23	4225	676	1064	372	85	679	2876
Otterbein	22	3348	407	517	214	103	247	1488
Washington	26	4462	154	1021	-373	34	-71	765
Centennial	27	5359	-475	580	-476	542	820	991
Jackson	9	1961	-241	339	174	48	57	377
Romney	12	1935	593	-34	70	46	143	818
Fowler	26	3629	623	579	182	129	409	1922
Fenton	58	6840	4046	1416	1351	3880	959	11652
Oxford	19	3132	557	506	91	370	-141	1383
Total	469	75943	11280	13475	2988	7911	5622	41276

* Imp. - Improvement

TABLE XXII

FIVE DAYS OF IMPROVEMENT FOR EACH SCHOOL UNDER CONDITIONS
OF GROUP COMPETITION

School	Number of Pupils	Total Pre-test Score	Total Imp. Day I	Total Imp. Day II	Total Imp. Day III	Total Imp. Day IV	Total Imp. Day V	Total Imp. all Five Days
Mace	20	3095	740	615	554	510	662	3081
Wingate	13	2769	668	575	120	215	366	1944
Darlington	23	4709	808	949	895	978	952	4582
Walnut	14	2311	708	538	657	470	624	2997
Youngs Chapel	11	2489	596	438	357	484	719	2594
Highland	31	4490	2122	1506	1324	1459	2348	8759
Whitesville	11	2466	607	736	618	522	788	3271
Horace Mann	22	2646	944	710	558	593	724	3529
Lincoln	14	2647	1512	571	-16	134	412	2613
Oakland	34	6143	2115	863	834	786	870	5468
Tippecanoe	28	4641	2446	1298	1436	-502	25	4703
Wea	14	2622	1309	268	161	35	615	2388
Tuttle	27	5113	2243	456	210	132	1286	4327
Mills	34	6092	3260	896	885	811	2406	8259
Linnwood	30	5081	3338	369	136	546	662	5051
Morton	60	12090	6193	1857	1954	1709	5672	17385
Willson	35	6467	2134	1366	1232	1669	1630	8031
Klondike	26	3667	3065	928	756	1082	497	6328
Dayton	19	4277	1412	446	289	76	466	2689
Longlois	40	7109	4066	583	683	224	837	6398
Total	506	90924	40286	15968	13643	11933	22567	104392

Tables XXIII and XXIV show that on the first day, the three I. Q. subgroups with individual competition are about evenly spaced in their "proper" order, with the brighter pupils improving more (despite their higher pre-test performance level). The improvement of the superior group declines a bit on the second day, the average group stays about the same, and the dull group improves considerably more the second day, showing, as a matter of fact, their greatest improvement then. On the third day, all three groups decline considerably; and, for the three groups together, the third is the lowest day. All groups rise on the fourth day and decline somewhat on the fifth. There is no extremely pronounced "end-spurt" visible from the shape of the curves, although the fourth and fifth days are above the third. Although a day to day curve of this sort is apt to reflect chance fluctuations for the most part, the low third day is common to the three curves, and there is a slight downward general trend.

Curves of the Amount of Improvement Under Group Competition.-

Tables XXV and XXVI show that the corresponding curves for group competition look considerably different. The outstanding feature is the very large improvement on the first day, particularly on the part of the superior pupils. This tremendous increase over the pre-test level of performance as soon as the group competition motivation is applied would seem to indicate a very heavy component of motivation for the group motive, since there has been no interpolated practice.

TABLE XXIII

AMOUNT OF IMPROVEMENT OVER FIVE DAYS AT THREE LEVELS OF
INTELLIGENCE UNDER INDIVIDUAL COMPETITION

School	First Day			Second Day			Third Day			Fourth Day			Fifth Day		
	Superior I.Q.	Average I.Q.	Dull I.Q.	Superior I.Q.	Average I.Q.	Dull I.Q.	Superior I.Q.	Average I.Q.	Dull I.Q.	Superior I.Q.	Average I.Q.	Dull I.Q.	Superior I.Q.	Average I.Q.	Dull I.Q.
Battleground	176 No. 5	361 21	124 16	135	584	253	263	281	253	-196	-216	-107	61	81	9
Longlois	546 No. 11	428 16	120 11	303	296	131	59	80	53	280	194	26	-71	-180	-57
Ford	288 No. 11	294 12	141 9	617	563	308	-294	-350	-143	178	112	124	195	185	-33
Oakland	77 No. 7	157 10	94 8	213	216	114	55	34	56	461	397	183	236	310	229
Dayton	-8 No. 1	226 10	-42 9	4	319	314	13	-13	126	96	128	30	45	141	40
Southside	-71 No. 3	77 8	-246 17	231	390	998	63	43	123	82	64	77	485	365	93
Lincoln	76 No. 3	88 5	87 5	73	156	127	-1	16	28	147	101	13	63	22	25
Montgomery	156 No. 3	110 3	307 7	147	120	306	64	29	143	48	116	45	27	13	55
Chalmers	89 No. 3	98 7	48 4	131	160	48	20	61	6	96	105	62	86	91	10
Elston	-6 No. 1	51 5	21 3	56	243	92	17	52	74	46	23	26	21	3	20
North Central	186 No. 2	575 6	312 5	-37	-76	-48	20	107	45	3	15	15	-10	28	-68
Lake View	390 No. 11	198 6	88 6	484	297	283	229	51	92	40	30	15	245	300	134

TABLE XXIII (Continued)

School	First Day			Second Day			Third Day			Fourth Day			Fifth Day		
	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.
Otterbein	123 No. 7	240 8	44 7	168	175	174	51	60	103	-10	80	33	151	89	7
Washington	75 No. 7	87 6	-8 13	240	234	547	-156	-68	-149	20	-14	28	-15	20	-76
Centennial	-89 No. 4	-342 16	-44 7	81	339	160	-84	-219	-173	198	204	142	420	365	35
Jackson	-123 No. 5	-95 3	-23 1	187	122	30	129	24	21	19	16	13	22	18	7
Romney	220 No. 3	262 5	111 4	44	-35	-43	13	46	11	19	16	11	85	36	22
Fowler	325 No. 12	209 11	89 3	213	358	8	118	31	33	85	36	8	226	185	-2
Fenton	2581 No. 35	1397 19	69 4	939	278	198	1003	308	40	2460	1009	411	725	194	40
Oxford	457 No. 11	112 7	-12 1	357	112	37	62	25	4	210	160	0	29	-96	-74

TABLE XXIV

AMOUNT OF IMPROVEMENT MADE AT THREE INTELLIGENCE
LEVELS UNDER INDIVIDUAL COMPETITION

School	Total Imp. Superior I.Q. Sub- group	No. of Pupils	Total Imp. Average I.Q. Sub- group	No. of Pupils	Total Imp. Dull I.Q. Sub- group	No. of Pupils
Battleground	451	5	1245	21	366	16
Longlois	989	11	882	16	337	11
Ford	844	11	789	12	452	9
Oakland	962	7	1197	10	673	8
Dayton	17	1	830	10	572	9
Southside	322	3	890	8	1562	17
Lincoln	222	3	439	5	360	5
Montgomery	459	3	360	3	867	7
Chalmers	379	3	529	7	203	4
Elston	51	1	470	5	218	3
North Central	173	2	626	6	268	5
Lake View	1550	11	715	6	611	6
Otterbein	480	7	642	8	366	7
Washington	122	7	262	6	381	13
Centennial	104	4	529	16	358	7
Jackson	216	5	106	3	55	1
Romney	383	3	339	5	96	4
Fowler	929	12	983	11	100	3
Fenton	7602	35	3650	19	400	4
Oxford	945	11	394	7	44	1
Total	17200	145	15787	184	8289	140
Mean	118.62		85.80		59.20	

TABLE XXV

AMOUNT OF IMPROVEMENT OVER FIVE DAYS AT THREE LEVELS OF
INTELLIGENCE UNDER GROUP COMPETITION

School	First Day			Second Day			Third Day			Fourth Day			Fifth Day		
	Superior I. Q. No.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.
Mace	77 No. 3	284 7	379 10	86 372	231 95	298 108	71 134	171 -17	312 3	153 109	109 68	248 38	205 311	265 0	192 55
Wingate	8 No. 170	1 243	4 396	336 168	408 182	205 188	218 253	399 224	278 180	293 75	373 220	312 175	392 229	293 234	267 161
Darlington	7 No. 275	9 124	7 309	168 235	182 203	188 0	253 173	224 184	180 0	75 360	220 124	175 0	229 440	234 279	161 0
Walnut	3 No. 483	5 113	0 0	541 236	437 320	528 180	629 330	510 78	185 210	854 310	471 150	134 62	1491 344	525 230	331 214
Youngs Chapel	6 No. 978	5 832	3 312	222 288	228 196	260 87	241 -32	159 130	158 -114	113 16	253 92	227 26	249 370	218 -33	257 75
Highland	13 No. 181	12 289	6 137	391 392	228 196	260 87	560 -32	227 130	47 934	478 75	286 337	22 -914	532 79	332 275	6 -329
Whitesville	4 No. 319	4 234	3 391	288 307	196 340	87 216	59 807	443 48	50 50	12 12	38 38	-15 -15	443 40	40 40	132 132
Horace Mann	4 No. 414	8 706	10 392	288 307	196 340	87 216	59 807	443 48	50 50	12 12	38 38	-15 -15	443 40	40 40	132 132
Lincoln	3 No. 1387	5 674	6 54	307 87	404 45	807 107	63 63	48 48	50 50	12 12	38 38	-15 -15	443 40	40 40	132 132
Oakland	10 No. 709	16 1041	8 696	87 120	45 45	107 107	63 63	48 48	50 50	12 12	38 38	-15 -15	443 40	40 40	132 132
Tippecanoe	3 No. 931	10 169	15 209	120 120	45 45	107 107	63 63	48 48	50 50	12 12	38 38	-15 -15	443 40	40 40	132 132
Wea	5 No. 5	2 2	7 7	120 120	45 45	107 107	63 63	48 48	50 50	12 12	38 38	-15 -15	443 40	40 40	132 132

TABLE XXV (Continued)

School	First Day			Second Day			Third Day			Fourth Day			Fifth Day		
	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.	Superior I. Q.	Average I. Q.	Dull I. Q.
Tuttle	1265 No. 8	722 8	256 11	150	129	177	65	77	68	58	119	-45	926	190	170
Mills	2653 No. 21	345 7	262 6	703	143	50	710	107	68	670	86	55	2147	156	103
Linnwood	1322 No. 7	1503 11	513 12	44	176	149	24	71	41	221	266	59	658	27	-23
Merton	4978 No. 40	1007 16	208 4	1336	425	96	1197	604	153	1427	346	-64	4593	994	85
Willson	1588 No. 16	385 11	161 8	968	307	91	642	457	133	1168	310	191	1126	319	185
Klendike	1918 No. 12	894 9	253 5	690	107	131	368	306	82	625	510	-53	644	-142	-5
Dayton	215 No. 1	1075 11	122 7	70	260	116	40	197	52	-13	51	38	120	406	-60
Longlois	2254 No. 12	1683 17	129 11	268	173	142	397	136	150	112	74	38	640	101	96

TABLE XXVI
AMOUNT OF IMPROVEMENT MADE AT THREE INTELLIGENCE
LEVELS UNDER GROUP COMPETITION

School	Total Imp. Superior I.Q. Sub- group	No. of Pupils	Total Imp. Average I.Q. Sub- group	No. of Pupils	Total No. Dull I.Q. Sub- group	No. of Pupils
Mace	587	3	1065	8	1429	9
Wingate	1322	7	187	3	435	3
Darlington	1408	7	1716	9	1458	7
Walnut	1000	3	984	5	1013	6
Youngs Chapel	1691	6	803	4	100	1
Highland	4503	13	2776	12	1480	6
Whitesville	1401	4	1067	4	803	3
Horace Mann	1144	4	1092	8	1293	10
Lincoln	937	3	1069	5	607	6
Oakland	3264	10	1859	16	345	8
Tippecanoe	1009	3	2500	10	1194	15
Wea	1569	5	340	2	479	7
Tuttle	2464	8	1237	8	626	11
Mills	6883	21	837	7	539	6
Linnwood	2269	7	2043	11	739	12
Morton	13531	40	3376	16	478	4
Willson	5596	16	1726	11	709	8
Klondike	4056	12	1864	9	408	5
Dayton	432	1	1989	11	268	7
Longlois	3671	12	2167	17	555	11
Total	58737	185	29797	176	14858	145
Mean	317.50		169.30		102.47	

It must also be remembered that the still very sizeable improvements on the second, third, and fourth days are above the extremely high level of performance reached on the first day, and, as noted above, it may well require very heavy pressure even to maintain this level, to say nothing of raising it considerably.

The third day dip found in the individual competition curves is not present to any marked degree in the group competition curves, but the average and dull subgroups under group competition strike a low on the fourth day. All three subgroups, and especially the superior pupils show a very marked end spurt. The average and dull curves show a fairly consistent downward trend, and are not very markedly different from those for individual competition. The superior curve, however, is definitely U-shaped with somewhat higher initial than end level. It may be seen that a very considerable proportion of the superior efficiency of group competition lies in its effect on the pupils of higher I. Q. on the first and last days.

Comparison of the Curves of Individual and Group Competition.-

The findings of the study on the significance of the differences between individual competition and group competition with pupils at three levels of intelligence are also confirmed by the curves. It will be remembered that the differences between the superior and dull subgroups were significant with both group and individual competition, while the differences between the superior and average subgroups and between the average and dull subgroups, although fairly high, were

within a large probability of chance occurrence. In Figure 1 it can be seen that the superior and dull curves for both individual and group competition do not cross at all, and are not even close very often. On the other hand, the dull subgroup rises above the average subgroup in the middle of the individual competition picture, and the average subgroup exceeds the superior subgroup on the third day with group competition.

While graphic presentation is being considered, it may be well to examine the form of the curves showing the distributions of improvements for the two kinds of motivation. These curves are presented together in Figure 2. The numerical data for the two curves on Figure 2 will be found in Tables XXVII and XXVIII. The distribution for individual competition resembles a normal distribution curve in general outline, and is somewhat skewed positively. The distribution for group competition is hardly a normal type of curve at all, but is platykurtic to the extreme, and approaches a rectangular distribution.

Fig. 2.- Distribution of improvement in terms of more problems solved, of pupils under individual and group competition.

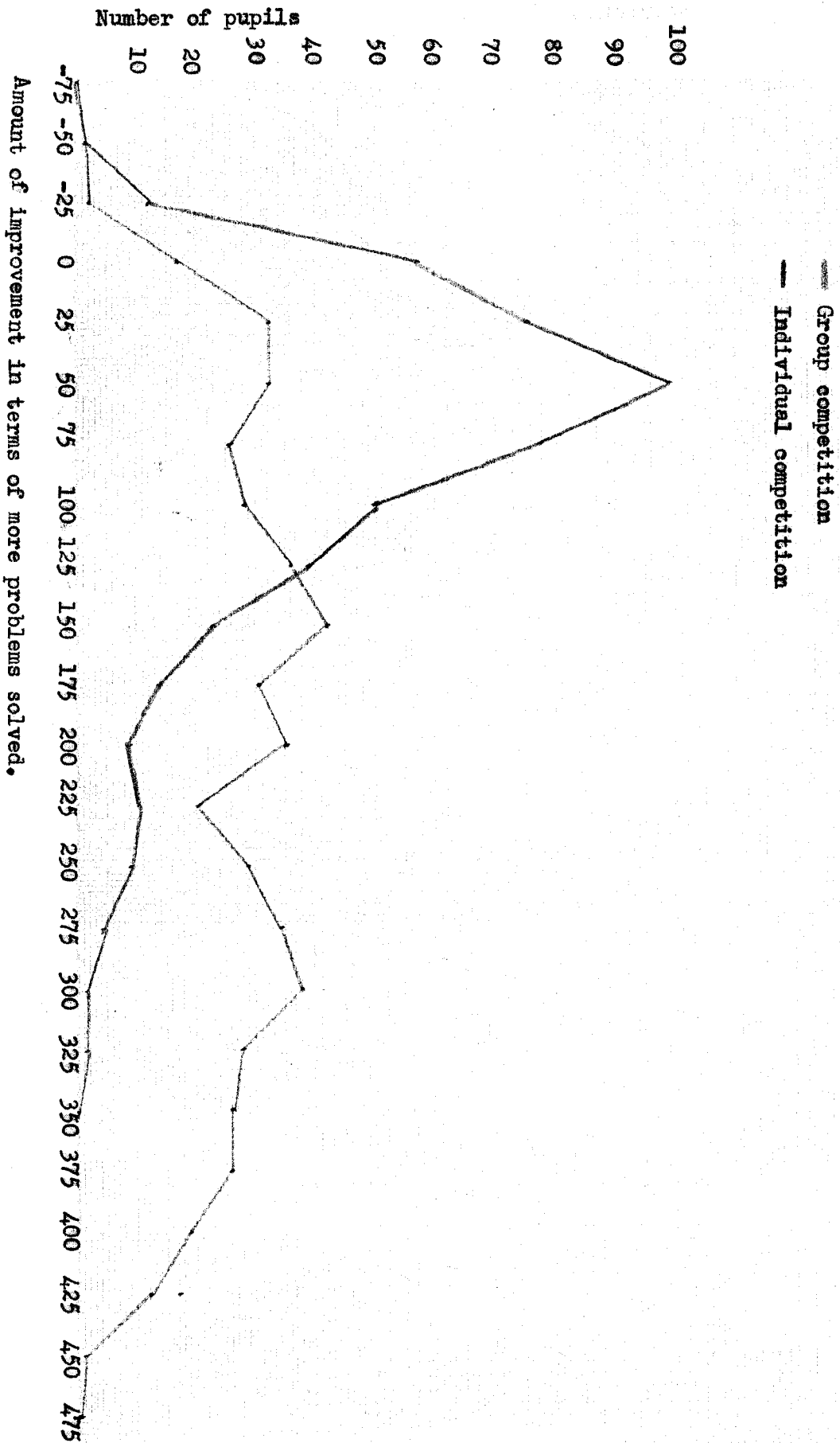


TABLE XXVII

TOTAL IMPROVEMENT MADE BY THREE INTELLIGENCE SUB-
GROUPS FOR FIVE SUCCESSIVE DAYS UNDER
INDIVIDUAL COMPETITION

	Day I	Day II	Day III	Day IV	Day V
Total Improvement of superior I.Q. sub- group	5488	4586	1644	4282	3026
N of Pupils	145	145	145	145	145
Mean Improvement	37.84	31.62	11.33	29.53	20.86
Total Improvement of Average I. Q. Subgroup	4533	4851	601	2576	416
N of Pupils	184	184	184	184	184
Mean Improvement	24.63	26.36	3.26	14.00	2.26
Total Improvement of Dull I. Q. Subgroup	1280	4037	746	1155	416
N of Pupils	140	140	140	140	140
Mean Improvement	9.14	28.83	5.32	8.25	2.97

TABLE XXVIII

TOTAL IMPROVEMENT MADE BY THREE INTELLIGENCE SUB-
GROUPS FOR FIVE SUCCESSIVE DAYS UNDER
GROUP COMPETITION

	Day I	Day II	Day III	Day IV	Day V
Total Improvement of Superior I. Q. Subgroup	22453	7227	6142	7116	15939
N of Pupils	186	186	186	186	186
Mean Improvement	120.71	38.85	33.02	38.25	85.69
Total Improvement of Average I. Q. Subgroup	12364	4809	4511	4283	4709
N of Pupils	174	174	174	174	174
Mean Improvement	71.05	27.63	36.57	14.61	27.06
Total Improvement of Dull I. Q. Subgroup	5470	3936	2990	534	1912
N of Pupils	146	146	146	146	146
Mean Improvement	37.46	26.95	20.47	2.65	13.09

Summary

The question which the data in this chapter attempted to answer was the relationship of the amount of improvement made by the pupils in adding, to the three levels of intelligence, into which they were classified.

In order to measure this relationship, the pupils were classified into three categories, dull, average, and bright, on the basis of results of the Otis Mental Ability Scales. The middle group comprised I. Q.'s from 93-107 inclusive. The bright and dull were those above 107 and below 93, respectively. In order to carry the problem to the limits at both ends of the intelligence scale, further intelligence subgroups were classified. These extreme I. Q. subgroups were comprised of pupils in the following intelligence ranges: 125 I. Q., 115 I. Q., 85 I. Q., and 75 I. Q.

The mean amount of improvement in terms of more problems solved under individual competition for the dull, average and bright I. Q. groups was 59.20, 85.80 and 118.62 respectively. The difference in mean improvement between the superior and average I.Q. groups fails of significance at the five per cent level with a value of t of 1.854. With nineteen degrees of freedom, a t of such a magnitude would have been obtained by chance alone five times in every hundred times. The difference in mean improvement between the superior and dull I. Q. groups is significant beyond the one per cent level, with a value of t of 3.495. That is, with nineteen

degrees of freedom, the chances that a t of such a magnitude would be obtained by chance alone is less than once in every hundred times. Therefore, the hypothesis that there is no real difference between the superior groups and dull groups under individual competition can be rejected with a high degree of confidence. Furthermore, the difference is in favor of the superior group.

The upper third of pupils, the superior I. Q. group, has improved almost exactly twice as much as the lower third, and the difference is not only statistically significant but of considerable magnitude.

The mean amounts of improvement in terms of more problems solved under group competition for dull, average and superior I. Q. groups were 102.47, 169.30 and 317.50 respectively. The conspicuous fact is the enormously greater improvement of the superior I. Q. group. All of the differences between the I. Q. subgroups are significant at the one per cent level; that is, with nineteen degrees of freedom t's of such a magnitude would be obtained by chance alone less than once in every hundred times. The striking fact, however, is not the significance of the differences but their magnitude; the superior pupils improved 148.20 more problems than the average, and 215.03 more problems than the dull. With a pre-test score of approximately two hundred, this is a tremendous amount of improvement over the pre-test in a test session lasting only five minutes.

The real superiority of group competition over individual

competition is revealed in the comparisons of the dull, average, and superior I. Q. subgroups in each of the motives. That is, a comparison of the superior I. Q. group competition subgroup with the superior I. Q. individual competition subgroup. The average and dull subgroups follow this same line of comparison.

There is a difference between the two superior I. Q. subgroups of 198.88 in favor of group competition; between the two average subgroups the difference is 83.50 and between the two dull subgroups 43.27. In all cases, the difference in terms of more problems finished, favored group competition. The differences between superior group and superior individual competition, average group and average individual competition are significant at beyond the one per cent level. That is, with nineteen degrees of freedom, t's of such a magnitude would have been obtained by chance alone much less than once in every hundred times. The hypothesis that there is no real difference between individual competition and group competition with pupils at four extreme levels of intelligence may be rejected with a high degree of confidence.

The dull group and dull individual competition difference fall somewhat of significance at the five per cent level. That is with nineteen degrees of freedom, a t of such a magnitude would have been obtained by chance alone five times in every hundred times.

The outstanding finding is the greater difference between the two forms of motivation at the superior I. Q. level. Although

group competition produced more improvement at all levels, the difference is especially marked at the higher I. Q. level.

CHAPTER VI

AGE AND SEX DIFFERENCES

In Chapter V the relationship of levels of intelligence to total improvement scores was discussed. The point now is raised as to the relationship of age and sex differences to total improvement scores.

Differences in Improvement According to Sex

The 469 pupils engaged in individual competition comprised 232 boys and 237 girls from twenty schools. Tables XXIX and XXX show the total improvement for each school for each sex under both forms of competition. The group competition sample included 261 boys and 245 girls from twenty schools.

Mean Improvement According to Sex.— When each form of competition is broken into two groups according to sex, the mean and standard error of the mean were computed for each subgroup by the same small sample procedure. These results are shown in Tables XXXI and XXXII. With individual competition, the mean improvement of the girls was 90.17, the mean improvement of the boys was 85.76. The difference of 4.40 has a standard error of 19.60, and with nineteen degrees of freedom the value of t is .224. The difference fails considerably of significance at even the five per cent level, that is, the probability that a t of such a magnitude would occur by chance alone is more than five times in every hundred.

TABLE XXIX

TOTAL IMPROVEMENT MADE BY EACH SEX IN THE
SCHOOLS UNDER INDIVIDUAL COMPETITION

Schools	Boys Improvement	Number of Boys	Girls Improvement	Number of Girls
Battleground	944	22	1118	20
Longlois	846	16	1362	22
Ford	1175	17	910	15
Oakland	1363	12	1469	13
Dayton	644	10	775	10
Southside	1338	13	1436	15
Lincoln	568	8	453	5
Montgomery	866	8	820	5
Chalmers	605	7	506	7
Elston	297	4	442	5
North Central	748	9	319	4
Lake View	1419	13	1457	10
Otterbein	613	11	875	11
Washington	280	10	485	16
Centennial	345	12	646	15
Jackson	196	5	181	4
Romney	320	5	498	7
Fowler	647	9	1275	17
Fenton	5947	31	5705	27
Oxford	746	10	637	9
Total	19897	232	21369	237

TABLE XXX

TOTAL IMPROVEMENT MADE BY EACH SEX IN THE
SCHOOLS UNDER GROUP COMPETITION

Schools	Boys Improvement	Number of Boys	Girls Improvement	Number of Girls
Mace	2337	15	744	5
Wingate	1102	7	842	6
Darlington	2455	13	2127	10
Walnut	1559	8	1438	6
Youngs Chapel	363	2	2231	9
Highland	4413	16	4346	15
Whitesville	2383	8	878	3
Horace Mann	1212	8	2317	14
Lincoln	1428	8	1185	6
Oakland	2687	20	2781	14
Tippecanoe	2386	15	2317	13
Wea	1668	10	720	4
Tuttle	2905	14	1422	13
Mills	3854	18	4405	16
Linnwood	1817	9	3234	21
Morton	9880	33	7505	27
Willson	3835	17	4196	18
Klondike	2559	13	3769	13
Dayton	1059	10	1630	9
Longlois	2829	17	3564	23
Total	52741	261	51651	245

TABLE XXII
DIFFERENCES IN MEAN IMPROVEMENT BETWEEN SEXES;
INDIVIDUAL COMPETITION

	Mean	N	S.E. _{M²}	S.E. _M	t	Significance Level
Girls	90.17	237	242.65	15.60	5.780	1 per cent
Boys	85.76	232	138.78	11.80	7.268	1 per cent
Difference between girls and boys	4.40	5	381.43	19.60	.224	8 per cent

TABLE XXXII
DIFFERENCES IN MEAN IMPROVEMENT BETWEEN SEXES;
GROUP COMPETITION

	Mean	N	S.E. _{M²}	S.E. _M	t	Significance Level
Girls	210.82	245	164.67	12.80	16.47	1 per cent
Boys	202.07	261	411.74	20.30	9.954	1 per cent
Difference between girls and boys	8.75	16	576.41	24.00	.360	80 per cent

The corresponding data for group competition are: mean improvement of the girls, 210.82; mean improvement of the boys, 202.07. With an estimated standard error of the difference of 8.75, the value of t is .360, likewise not significant. Therefore, under both conditions of individual competition and group competition, the hypothesis that there is a real difference in the amount of improvement made between boys and girls cannot be accepted, since the difference, although in favor of the girls in both cases, was not great enough to be statistically significant.

Amount of Difference In Improvement Scores Made by Boys and Girls.- The differences between the boys and girls are of small magnitude compared with the other differences that have been considered. The difference is about four per cent in each case. Of whatever importance this may be to differential psychology, it is no great factor in the present study. The girls show a slightly greater margin in the superiority of group competition over individual as may be seen in Table XXXIII.

Differences in Improvement According to Age

This study can shed but little light upon the genesis of the effectiveness of group competition, since the age range involved is rather small, and is associated with intelligence differences. All groups were sixth grade classes, and the ages vary relatively little. Furthermore, there is a strong tendency for age and I. Q. to have a

strong negative correlation in a given school grade. It is reported by Terman¹ that the simplest way to select the brightest pupil in the class is to select the youngest, and that such a selection is

TABLE XXXIII

DIFFERENCES BETWEEN GROUP COMPETITION AND
INDIVIDUAL COMPETITION FOR EACH SEX

	Difference between Means of Group and Individual Competition	S. E. of Difference	t	Significance Level
Girls	120.65	20.20	5.973	1 per cent
Boys	116.31	23.50	4.949	1 per cent

just as accurate as the teacher's own independent selection of the brightest child or possibly more so. The reason is quite apparent; the demands of a given school grade level of work are met in general by the mental age corresponding to the typical age of the pupils in that grade. If a younger child can hold his own, most probably his mental age is above his chronological age, and his I. Q. is high. The same reasoning applies to the retarded child, though less cogently, since illness, moving from school to school, etc., can retard even the child with somewhat superior I. Q.

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Lewis M. Terman, Genetic Studies of Genius, Vol. I, pp. 190-193. Stanford University, California: Stanford University Press, 1925.

At any rate, it may be assumed that the younger children have the higher I. Q.; and, unless there is a strong tendency for improvement to increase with age, the younger children may be expected to show the greater improvement and the greater advantage of group competition.

Mean Improvements According to Age.— Table XXXIV shows the mean improvements for the three age groups with individual competition. These are 105.49, 78.93, and 52.43 for the eleven, twelve and thirteen year olds, respectively. The school by school data are

TABLE XXXIV

MEAN IMPROVEMENT OF THREE AGE GROUPS:
INDIVIDUAL COMPETITION

Age Group	Mean	N	S.E. M^2	S.E. M	t	Significance Level
11	105.49	257	424.69	20.60	5.121	1 per cent
12	78.93	115	99.75	10.00	7.894	1 per cent
13	52.43	97	62.35	7.90	6.637	1 per cent

shown in Tables XXXV and XXXVI. The few children younger than eleven years were included under age eleven, and the few older than thirteen were included under age thirteen. Evidently the younger children, for whatever reason, improved more than the older ones. It is interesting to compare these three age improvements with those for the three I. Q. levels, 118.62, 85.80, and 59.20 for the superior, average,

TABLE XXXV

AMOUNT OF IMPROVEMENT MADE AT THREE AGE LEVELS
UNDER INDIVIDUAL COMPETITION

School	Total Imp. of 11 year Olds	No.	Total Imp. of 12 year Olds	No.	Total Imp. of 13 year Olds	No.
Battleground	1050	17	619	12	393	13
Longlois	1837	27	125	4	246	7
Ford	1219	18	440	7	426	7
Oakland	2253	17	325	4	254	4
Dayton	862	9	456	7	101	4
Southside	1808	17	688	7	278	4
Lincoln	222	3	439	5	360	5
Montgomery	236	2	1141	8	309	3
Chalmers	525	5	458	6	128	3
Elston	224	3	281	3	234	3
North Central	332	3	402	4	333	6
Lake View	2136	16	306	2	434	5
Otterbein	612	7	633	10	243	5
Washington	615	19	88	5	62	2
Centennial	714	11	275	9	2	7
Jackson	248	4	79	2	50	3
Romney	528	5	194	3	96	4
Fowler	1297	15	509	7	116	4
Fenton	9489	46	1395	7	768	5
Oxford	905	13	225	3	253	3
Total	27112	257	9078	115	5086	97

TABLE XXXVI
AMOUNT OF IMPROVEMENT MADE AT THREE AGE LEVELS
UNDER GROUP COMPETITION

School	Total Imp. of 11 year Olds	No.	Total Imp. of 12 year Olds	No.	Total Imp. of 13 year Olds	No.
Mace	1440	10	1009	7	632	3
Wingate	1143	9	550	3	251	1
Darlington	2469	12	1520	6	593	5
Walnut	1566	6	1001	5	430	3
Youngs Chapel	2050	8	370	2	174	1
Highland	4934	14	2567	10	1258	7
Whitesville	1599	5	969	3	703	3
Horace Mann	1398	7	1163	8	968	7
Lincoln	1060	4	841	4	712	6
Oakland	4092	22	744	9	632	3
Tippecanoe	3278	16	1059	8	366	4
Wea	1263	4	863	5	262	5
Tuttle	3289	16	784	5	254	6
Mills	7033	24	997	6	229	4
Linnwood	4449	24	299	3	303	3
Morton	14823	50	1952	7	610	3
Willson	6355	24	1407	8	269	3
Klondike	4997	17	1101	5	230	4
Dayton	2025	10	637	7	27	2
Longlois	6020	32	262	4	111	4
Total	75283	314	20095	115	9257	77
Mean	239.75		174.73		120.22	

and dull as shown in Table XI. The I. Q. subgroups showed higher improvements at all three levels. However, the age subgroups do not have anything like equal frequencies; the N's are 257, 115, and 97 for the eleven, twelve, and thirteen year olds, respectively.

Similar results are obtained with group competition. Table XXXVII shows that the mean improvements are 239.65, 174.73, and 120.22 for the eleven, twelve and thirteen year olds, respectively, with N's of 314, 115, and 77. The corresponding I. Q. subgroup mean improvements are 317.50, 169.30, and 102.47 as previously shown in Table XIII. In this case the relationship between I. Q. and improvement and between age and improvement seems to be much less. Although the thirteen year olds number only 77 and the low I. Q. subgroup numbers 145, the mean improvement of the thirteen year olds is 120.22 as compared with 102.47 for the low I. Q. subgroup. Although this

TABLE XXXVII
MEAN IMPROVEMENT OF THREE AGE GROUPS;
GROUP COMPETITION

Age Group	Mean	N	S.E. M^2	S.E. M	t	Significance Level
11	239.75	314	173.86	13.20	18.163	1 per cent
12	174.73	115	179.33	13.40	13.040	1 per cent
13	120.22	77	81.02	9.00	13.358	1 per cent

is hardly enough evidence to warrant a conclusion, the discrepancy suggests the possibility that there is a tendency for the older pupils of the same I. Q. to improve more under group competition than the younger ones.

Amount of Difference in Mean Improvement Scores of Three Age Groups.— If the differences between the mean improvements at these various age levels are evaluated with the t test employed in the previous comparison the differences between the eleven and twelve year olds under individual competition are not statistically significant. The differences between the twelve and thirteen year olds and between the eleven and thirteen year olds are likewise not significant. Therefore, the hypothesis that there are real differences between the three age groups under the individual competition condition cannot be accepted, since the differences are not great enough to be statistically significant.

It must be remembered that since it is not known that this technique is strictly appropriate for situations of this type, these results cannot be held to be wholly conclusive.

Similar data for group competition are shown in Table XXXIX. In this case, however, all three differences are significant at the one per cent level. That is, the chances that t 's of such a magnitude, 3.459, 7.471, and 3.386, would have been obtained by chance alone is less than once in every hundred times. Furthermore, the hypothesis that there are no real differences between the three age groups under group competition can be rejected.

TABLE XXXVIII

DIFFERENCES IN MEAN IMPROVEMENT BETWEEN THREE AGE GROUPS;
INDIVIDUAL COMPETITION

Groups Compared	Difference Between Means	S.E. of Difference	t	Significance Level
11 and 12	26.55	22.90	1.160	30 per cent
11 and 13	53.06	22.10	2.401	5 per cent
12 and 13	26.50	12.70	2.070	10 per cent

TABLE XXXIX

DIFFERENCES IN MEAN IMPROVEMENT BETWEEN THREE AGE GROUPS;
GROUP COMPETITION

Groups Compared	Difference Between Means	S.E. of Difference	t	Significance Level
11 and 12	65.020	18.800	3.459	1 per cent
11 and 13	119.530	16.000	7.471	1 per cent
12 and 13	54.510	16.100	3.386	1 per cent

The differences between group and individual competition at each age level, shown in Table XL, are all significant at the one per cent level. Therefore, the hypothesis that there is no real difference between the three age groups under conditions of individual competition and group competition can be rejected. Furthermore, the differences are all in favor of group competition.

TABLE XL
SIGNIFICANCE OF DIFFERENCES IN IMPROVEMENT BETWEEN
GROUP AND INDIVIDUAL COMPETITION
AT THREE AGE LEVELS

Age Level	Difference in Means Between Group and Individual Competition	S.E. of Difference	t	Significance Level
11	134.26	24.50	5.480	1 per cent
12	95.79	16.70	5.736	1 per cent
13	67.79	12.00	5.649	1 per cent

Summary

The question which this chapter attempted to answer was the relationship of age and sex differences to the total improvement scores of boys and girls in doing arithmetic addition under the motives of individual competition or group competition.

The 469 pupils engaged in individual competition comprised 232 boys and 237 girls from twenty schools. The group competition sample included 261 boys and 245 girls from twenty schools.

For individual competition, the mean improvement of the girls was 90.17. The mean improvement of the boys was 85.76. The difference of 4.40 was not statistically significant. With a standard error of 19.60, and nineteen degrees of freedom, the value of t , was .224. A t of such a magnitude would have been obtained by chance alone more than five times in every hundred times.

For group competition, the mean improvement of the girls was 210.82 and of the boys 202.07. The difference in the improvement between boys and girls under group competition was 8.75, likewise not statistically significant. With nineteen degrees of freedom and an estimated standard error of 24.00, the value of t was .360. A t of such a magnitude would have been obtained by chance alone more than five times in every hundred times. Compared with the magnitude of the differences evidenced between I. Q. groups, these differences are low. However, even though the statistical significance is low, the fact remains that the girls improve a trifle more than the boys with both forms of motivation; the difference is about four per cent in each case. The girls show a slightly greater margin in the superiority of group competition over individual competition.

This study shed but little light upon the genesis of the effectiveness of group competition, since the age range was small and all the pupils came from the sixth grade.

Under individual competition, the mean improvements for the three age groups were 105.49, 78.93, and 52.43 for the eleven, twelve and thirteen year olds, respectively.

Under group competition the mean improvements were 239.75, 174.73, and 120.22 for the eleven, twelve and thirteen year olds, respectively.

In general, it may be stated that, under both forms of competition, the girls improved somewhat more than did the boys, but

that the difference was not statistically significant. With regard to age, the younger pupils improved more than did the older ones; however, since the younger pupils were also the brighter pupils, no valid conclusions can be drawn. The differences between the eleven, twelve and thirteen year olds under both motives were statistically significant.

CHAPTER VII

SUMMARY AND INTERPRETATION

The Experimental Procedure

The problem of this study was to determine the relative effectiveness of individual competition and group competition as motivational factors in modifying the achievement of sixth grade boys and girls in doing arithmetic addition. This was studied by an experiment involving the selecting of two samples, each containing twenty sixth grade classes taken one each from twenty different schools. After the schools were selected, the subjects were given a pre-test consisting of five minutes of addition problems to determine their initial ability to do addition. At the end of the pre-test, the subjects were given a five-minute addition test on each of five successive days to determine the change over the previous scores. A measure was taken of the number of problems answered correctly for each pupil on the pre-test and on each subsequent test. The score for each of the five days was recorded as the improvement of that day over the previous one. The improvements, either positive or negative, for the five days were added to give a total improvement score for each pupil.

The pupils in the one sample of twenty schools were motivated by individual competition. This involved posting the score for each pupil in a given class each day and offering a prize for the highest

individual total improvement. Since it was improvement and not gross scores that was the basis of the competition, the students scoring low in the pre-test presumably had as much opportunity to win as the high-scoring ones.

The pupils in the other sample were motivated by group competition. The identity of the individual pupils was submerged into the group. The entire class competed with some other class for a group prize on the basis of group improvement.

There were 506 pupils in the twenty schools under group competition and 469 pupils in the twenty schools under individual competition.

The twenty school means were taken as the statistical units in treating the data, and the significance of the improvements and the differences in improvement were computed by the small sample technique, considering the sample to be made up of twenty units. Student's t test of significance was employed to test the statistical significance of the mean improvement scores and the differences between obtained means.

Summary of Experimental Findings

1. It was found that significant improvement occurred with both forms of motivation and within all I. Q., age, and sex, subgroups in each sample.
2. However, the improvement with group competition was much

greater than with individual competition, and the difference was statistically significant.

3. It was also found that for all comparable subgroups, the group competition pupils improved significantly more than the corresponding subgroup of pupils with individual competition.

4. With both forms of motivation, the pupils of higher I. Q. improved more than those of lower I. Q.

5. This was true when the pupils were divided into three fairly equal classes of I. Q. and when extreme groups were isolated on the high and low I. Q. ends.

6. The superiority of group competition was especially marked with the high I. Q. pupils, although not restricted to them.

7. With individual competition, there was more variability in the school means for dull children than in the school means for superior children.

8. With group competition the situation was reversed. That is, there was more variability in the school means for superior children than in the school means for dull children.

9. The F test of the variance ratio showed the differences in variability between superior and dull subgroups to be significant in each case.

10. The course of daily improvement showed a slight downward trend in all I. Q. subgroups for both individual and group competition, except the superior I. Q. pupils who were motivated by group competition.

11. There was evidence of initial surge and, in the case of group competition, a marked end-spurt.

12. The distribution of improvements for individual competition appeared fairly normal.

13. The distribution of improvements for group competition appeared almost rectangular.

14. In both forms of competition, the girls improved a little more than the boys. The difference was not statistically significant.

15. The younger pupils improved significantly more than the older pupils. When divided into those that were twelve years of age and those that were older and younger than twelve, the youngest group improved significantly more than the oldest.

Interpretation of Experimental Findings

In interpretation, it must be remembered that a very complex interplay of causal factors may be manifested, in a restricted situation, by a very simple concomitant variation of two observed factors; and an attempt to analyze back to the basic causes is fraught with danger. This danger is especially serious when such a sensitive variable as motivation is involved, because of the pupil attitudinal factors involved.

Possible Generalization on the Basis of the Available Data.-

Perhaps the first question in the evaluation of the findings is the range of generalization possible. Group competition has been found to be greatly superior to individual competition under the conditions

of this experiment. To what degree can this relationship be affirmed in general? Several sorts of questions arise. In the first place, the term "group" is rather broad; one should hesitate to state that competition in terms of any group would be more effective than individual competition, since the unity that makes a group may vary greatly in several dimensions. Groups differ in the range of activities integrated. A group may be organized to perform one specific function on very few occasions, such as a student council group on school activities. At the other extreme, there are groups whose basis of integration is almost as broad as life itself, such as the family. Although one would not wish to say that the effectiveness of group competition is restricted to those activities within the specific scope of the group, it is true that a definitely academic function in an academic group was measured.

Integrating Forces in the Group.- Groups also differ in the intensity of the integration involved. Some organizations imply very high degrees of loyalty with possibilities of high potentials of motivation; more often the integration is more casual, as in a school club. In this dimension especially, one is dealing not only with generic differences but with specific individual differences. Two groups of the same kind may differ widely in the degree to which members identify themselves with the common cause. In this case, it is commonly conceded that "school spirit" varies over a wide range from one school to another. Moreover, the factors which determine

the intensity of the loyalty to the school are quite multiplex. One of the most important factors is the leadership personnel involved. In the elementary schools, the personality of the teacher is a dominating factor. She can, in general, attract or repel the pupils with reference to the classroom situation; and sometimes the "for" or "against" attitudes thus aroused may be generalized to include all of society. If the classroom teacher arouses only negative response tendencies, one would expect morale to be low; and, in such a case, individual competition might be more effective than group competition. If the teacher is rather poor, a quite compact "opposition" group may be organized with fairly high morale, but it is doubtful if such morale would be available as a motivating factor in a situation such as this.

The emphasis above does not mean that "school spirit" emanates from the teacher or principal without a causal basis; it merely means that there are large individual differences in the degree to which teachers employ and value the techniques which produce "school spirit." Morale, like any other psychological response-tendency, is the definite results of its causes, and can be produced as well as arithmetic skills or any other modifiable reaction. The difference is primarily one of standardization of curriculum and pedagogical procedures in the relatively simple case of specific skill as against the unsystematized and chaotic treatment of attitude formation.

Relationship of the Integrative Group Factor to the Statistical Technique Employed.- It is precisely because there may well be group differences in "school spirit" and attitudes of classroom unity that the use of the small sample technique is imperative here. Suppose, for example, that one investigator studied this question with several hundred pupils from a school with extremely low "esprit de corps." He might well conclude that the effectiveness of group competition was equal to or even less than that of individual competition. His standard error formula would assure him that his results were not due to "sampling error," and as a result, he might generalize his findings to all school pupils. Another investigator might make a similar study in a school where group loyalty was exceedingly high, and obtain diametrically opposite results, like-wise with high statistical significance. Obviously, each one is sampling but one value of group morale.

The Schools Comprising the Experimental Samples.- The present study included forty different schools, twenty in each sample. Practical considerations would allow sampling within only a fair sized geographic area, and to the extent that this area differs in general from the rest of the universe, the generalization of the results must be restricted. This, of course, is a limitation on any study and is particularly important in social studies. However, the size of the classes included here covers a rather wide range of from 9 to 60 pupils. Both rural and urban schools were included.

Pupils Comprising the Samples.- The subjects in this experiment were mostly pre-adolescent. The possibility exists that high school and college students might show quite different results. The negative relation between age and effectiveness of group competition should not be taken, however, as an indication that the growth trend is away from cooperation. It may be that such is the case, but the results here would seem to be more directly concerned with I. Q. than with age as such.

Relationship of Intelligence to Improvement.- The decided relationship of I. Q. to improvement, and especially the fact that the superiority of group competition is especially marked for the higher I. Q. levels, makes the role of I. Q. important. An interpretation of this relationship must be cautiously guarded against confusing correlation with causation. The fact that in this sixth grade sample the children of higher I. Q. are more responsive to group competition does not mean that I. Q. per se is the determining factor. It has previously been discussed whether or not greater mental maturity, with presumably higher capacity to react to more complex stimuli and possibly to appreciate more subtle incentives, is the causal element, or whether the very disparity between mental age and chronological age itself may be associated with attitudinal constellations of importance for this study. Although, from lack of sufficient evidence on the attitudes of children of different I. Q.'s and the same mental age and children of different I. Q.'s and the same chronological age, the discussion must be somewhat

speculative, the fact remains that the child of higher I. Q. is probably more successful in academic work. Children of the same I. Q. and different mental ages would presumably be equally successful at different grade levels. If the child of higher I. Q. is, and always has been, in a situation where his efforts have been successful and where the school situation has tended to produce gratification of basic personality needs such as social approval, it is plausible to advance the hypothesis that his attitude toward the school in general and the class in particular will be a favorable one, conducive to loyalty and conducive to the arousal of enthusiasm and cooperation. A pupil should certainly be more ready to identify himself with a friendly agency than a hostile one, and the sharp rise in the effectiveness of group competition as one gets above the mean I. Q., as seen in Figure 1, page 84, would suggest the operation of some differentiating factor. Furthermore, it is a commonplace observation that confidence of success is helpful to morale and enthusiasm (although there is the negatively motivated morale of desperation).¹ Although the brighter child's success has been his own and not the group's, it is not implausible that the attitude might carry over into the group competition situation. There might

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H. A. Edgerton and H. A. Toops in Willard Valentine, Readings in Experimental Psychology, "The Correlation of an Intelligence Test and Three Criteria of Scholastic Success," p. 557. New York: Harpers, 1931.

simply be a carry over of general emotional tone associated with such tasks as addition problems.

Possible Explanation for the Superior Improvement of the Brighter Child.- Another factor may help account for the superior improvement of the brighter child with both forms of incentive. The regression of achievement on intelligence is commonly a negatively accelerated curve. That is to say, the brighter child does not gain as much achievement over the average child as the dull one loses. This is usually interpreted as indicating more motivational pressure upon the average and dull child. With classes heterogeneous as to intelligence, the general norm is enforced upon all students alike, and the bright child has little difficulty in achieving the minimum essentials. Consequently, his pre-test performance may have been at a moderate motivational level, and his real potentialities realized only under special pressure. Since he has previously engaged in little high pressure practice, this effect might be spread out over the entire five day period. Another influence perhaps associated with I. Q. is the accompanying cultural constellation. In general, the bright child is from a family of superior socio-economic status, higher education, etc. Again, the possibility presents itself that not I. Q. in itself or mental age in itself, but an associated variable is producing the effect. It happens that two of the schools in this study, one in the individual competition sample and one in the group, draw their pupils, to a large extent, from academic families.

The improvements in both cases are very high, and especially so in the case of group competition. The children who are in the high I. Q. group are from "good" homes, and very possibly are exposed to a more "idealistic" culture than the other children. Unfortunately for the analysis, these factors are usually found together, and it is difficult to isolate them experimentally.

Relationship of Pure Practice to Improvement.- The question may arise as to the extent to which pure practice has influenced the results. In the first place, the study was concerned primarily with the relative effectiveness of group and individual competition rather than their absolute effect. Since exactly the same practice took place in both methods, the higher effectiveness of group competition must be a motivational difference alone. Whatever the practice effect, if it were subtracted from both, the difference between the two forms of motivation would remain as it is. The difference is so large that it would seem highly implausible to attribute it to possible variations in the practice effect. Furthermore, the great improvement with group competition came immediately, the first day the competition started. It is true that initial practice may be expected to yield large return, but the function studied here is hardly in its initial practice period; sixth graders are presumed to have had considerable experience with addition problems.

Perhaps too much emphasis has been placed on the limitations of the findings; the data have, after all, established a superiority of group competition over individual competition with two samples each composed of twenty quite different schools, and in arithmetic, a quite typical function. It can be said that, with no undue or unusual program to build group loyalty, it was possible to utilize the cooperative spirit available in the classroom and attain results far superior to those of individual competition.

Indicated Motivational Problems for Future Educational Research

To a considerable extent, the value of an investigation lies in the problems it raises as well as those it settles. Accordingly, some of the approaches to the problem, which, in the light of this study, might be illuminating are indicated below.

The entire resources available for this study were employed in determining the relative effectiveness of group and individual competition.

1. It would also be of interest to know the approximate absolute values of both individual competition and group competition, and this would necessitate a control group with the same practice with no especial motivation.

2. Although the task employed here was well suited to its purpose, it would extend the range of applicability of the results

if the experiment were duplicated with different tasks - very similar tasks, such as subtraction, multiplication, etc., and quite different tasks, both mental and motor.

3. The relative effectiveness of the two forms of competition should be tried over a wide range of grades and ages, to determine if the relationship found in the sixth grade varies as one goes up or down the grades.

4. The high improvement in the schools with children from college instructors' families, suggests the advisability of measuring the socio-economic status of both children's families and communities, especially the latter, to determine the relation to motivational sensitivity.

5. By means of an attitude scale, the verbal expressions of attitude toward competition, both group and individual, could be obtained and correlated with the actual reaction to the two situations. By means of a rating scale the social impression of individual competitiveness and cooperative readiness could be obtained and used similarly.

6. With one long test and a previous pre-test, instead of five daily tests, the effect of competition might be found, without the effect of praise and knowledge of results. Motivational complexes are difficult to purify entirely, but a simpler structure might be obtained in this manner.

7. There is considerable question as to the degree of

modifiability of the attitudes involved in these two forms of competition. It would be instructive to "propagandize" the subjects experimentally, some in the direction of individual competition, and some in that of group competition. Looking at the matter from the other point of view, the technique used here might be useful in evaluating different methods of producing experimental attitude changes on the part of school pupils.

8. The school classes represented here were previously compact groups with pupils selected according to geographic locality. The pupils had been exposed to unifying and integrating experiences for quite some time, possibly resulting in very real group differences. If an artificial group were used, composed by random or controlled sampling, greater experimental precision could be attained and the unknown individual characteristics of given groups eliminated. Once the superiority of group competition under the conditions of this study has been established, it would seem logical to eliminate some of its possible causes, such as, school spirit, community loyalty, etc., as a step toward analysis.

9. Working in the other direction, the effect of other unifying factors might be tested for their influence on the superiority of group competition, e.g., boys vs. girls, schools that are traditional rivals in athletics, etc.

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A P P E N D I X

SAMPLE WORK SHEET

School	T	n	T ²	$\frac{T^2}{n}$
Battleground	2062	42	4,251,844	101,234.38090
Longlois	2208	38	4,875,264	128,296.42100
Ford	2085	32	4,347,225	135,850.78120
Oakland	2832	25	8,020,224	320,808.96000
Dayton	1419	20	2,013,561	100,678.05000
Southside	2774	28	7,627,076	272,395.57140
Lincoln	1021	13	1,042,441	80,187.76920
Montgomery	1686	13	2,842,596	218,661.23070
Chalmers	1111	14	1,234,321	88,165.78570
Elston	739	9	546,121	60,680.11110
North Central	1067	13	1,138,489	87,576.07690
Lake View	2876	23	8,271,376	359,625.04340
Otterbein	1488	22	2,214,144	100,642.90900
Washington	765	26	585,225	22,508.65384
Centennial	991	27	982,061	36,373.37037
Jackson	377	9	142,129	15,792.11110
Romney	818	12	669,124	55,760.33333
Fowler	1922	26	3,694,084	142,080.15380
Fenton	11,652	58	135,769,104	2,340,846.62000
Oxford	1383	19	1,912,689	100,667.84210

$$G T \quad 41,276 \quad 469 \quad 4,768,832.16000$$

$$G T^2 \quad 1,703,708,176$$

$$\frac{G T^2}{N} = 3,632,640$$

$$1,136,192.16 = \sum \frac{T^2}{n} - \frac{GT^2}{N}$$

$$r = 20$$

$$\frac{r \left(\sum \frac{T^2}{n} - \frac{GT^2}{N} \right)}{N} = \frac{22,723,843.20}{469} - 48,451.6912 - \sum d^2$$

$$GM = 88.0085287$$

$$\sqrt{\frac{\sum d^2}{r(r-1)}} = \sqrt{127.5044473} = 11.29$$

$$t = \frac{88.0085}{11.29} = 7.795$$

DIRECTIONS TO TEACHERS FOR GROUP TEST

This is an experiment in motivation to test how much a classroom group can improve their scores over a practice test. The purpose of the experiment is to find how much a classroom group will improve when they are motivated by being encouraged by the teacher to work harder and do better, knowing their previous results so they may improve, and offering prizes as goals for improvement in competition with another classroom group.

Pre-Test

In giving the pre-test to the class, emphasize that it is for practice only. Do not give any hint that any other tests will follow, or that prizes are to be awarded. This pre-test is to serve as a measuring stick without any motivation for pupils.

Tell the children we only want them to practice adding arithmetic problems -- this is not a test. Be careful that your manner and your voice follow the practice idea. Don't let your voice or manner put the class in a test situation. Tell them not to put their names on the papers, but you as teacher keep a seating chart and collect the papers by rows and seats so that you can put the names on the papers.

Day I

You will keep two charts during this experiment, one a class bar chart which the children see, and one an individual pupil chart with the name of each pupil on it and each pupil's improvement, which the class does not see. After the pre-test, grade the papers very carefully and put the class results on the class chart in terms of a bar graph. Tell them they are going to have a contest with prizes going to the group making the most improvement. Tell them what other group they are competing with, and that the prize will go to the group making the most improvement over the practice test. Each of the groups has a good chance to win the prize, as it will be given for improvement, and each class can improve if it works hard.

Particular Note: Do not let the pupils know that you are recording their individual scores on a separate chart. To them this is a contest of group against group, and nobody knows what the individual pupil is doing to help his group win. That is the reason you tell them not to sign their test papers. This is an experiment in group competition, so naturally the members of the group are not thought of as individuals, but their scores count toward the group score. The group sees only the class bar graph of their group and the competing group; they never see their own individual scores.

The teacher, however, will keep a separate chart with the name of each pupil on it and record the day by day progress of each pupil

in terms of daily improvement over the practice test. Directions for this chart are: first column, left, M. A. score which stands for the child's I. Q.; next column, the pupil's name, next column, the pre-test score, next to five columns, the results of each test, and last column, total amount of improvement for the entire week.

Note: Put the pupil's name each day on his test paper from your seating chart, and be very careful that you get the correct name on each paper. This is very important, as you will have to copy on the individual chart each day's improvement for each pupil.

Distribute the pupil class charts to each pupil and let the children chart the progress of the class on it. First let each child copy the class pre-test score. This will be the average score; that is, divide the total score by the number of pupils taking the test. For example, to keep the master group chart: If you have 30 pupils in the class, and the total score for all of them is 6000, then divide the 6000 by 200 to get the class score. Be careful in doing this, as you may have some children absent, and though your total score will be all right, you will divide by a smaller number of pupils to get the class score.

What we are really after on this test is what each child will do individually when he is a part of the group. This is the chart the children do not see, but which is very important to our results. You will keep this chart very carefully, and record each day each child's improvement. The chart the group will see is the class bar chart, which is a bar showing their improvement each day in relation to the other competing group. Hang this class bar chart on the bulletin board in a conspicuous place in the room, but keep the individual chart away from the children.

Check each day with the other class with whom you are competing and get their class average score, and then record their class average score and your class average score in terms of improvement on the bar chart. Do not record the actual score, but the average improvement score for each class.

Be enthusiastic in your voice and manner, while telling them about the contest and giving directions. Keep up and build up higher their enthusiasm during the entire contest. Be sure and emphasize that the "Class Certificates of Improvement" will be signed by you as teacher, the principal, and a Purdue University professor.

Always emphasize throughout the contest that you know the class can do better, encourage them to work harder, and to improve.

It is this first day that we really set the whole stage of the experiment, so be enthusiastic in telling them of the contest,

prizes, and improvement in grades. Your personal enthusiasm will do much to stimulate the class to high efforts. Display the prizes (certificates of class improvement) and the Master Class Chart in a prominent place in the room, and have pupils copy daily class improvement scores.

Days 2-3-4-5

Check very carefully to see that you have each pupil's pre-test score and the results from each day in terms of improvement copied on the individual charts. Record only the amount of improvement on the Individual Chart over the previous test. Do not record the actual test score; record the amount of improvement in terms of more problems finished. Stress before each test session that you know the class can do better. See that the class chart is accurately made and kept. Keep up the contest and prize spirit throughout all five tests. Be enthusiastic about it yourself, and encourage them to work hard for the prizes. Be sure before a test is given that they know the class score of the previous test, and that they have recorded the class scores on their charts.

When Test Is Finished

For the Individual Chart record in column at left of chart each pupil's I. Q. This goes under column headed M. A. Clip together the six papers of each child for the complete set. Do this clipping together of the six tests for each pupil in the class.

For the Individual Chart record in the column at the extreme right of chart the total number of problems more, for the five tests, that the pupil made over the pre-test. For example, if on the pre-test a pupil has 190 problems correct, and if on the Day I of the test, 200, his first score will be 10 for improvement. If on the second day he scores a 200 again, his score for improvement on Day II will be zero. If on the third day he scores 215, his improvement score on Day III will be 15. Record under Days 1-2-3-4-5 the amount of improvement made each day over the previous day. At the end of the contest, in total improvement column, add up the sum of each of the five days' individual improvement to get the entire week's improvement.

Place all your papers clipped together for each pupil, together with the Individual Master Chart, the Class Chart, and the Children's Class Charts into an envelope and mark the name of the school on the outside. Be sure each child's paper has his name on it and the name of the school.

Summary

I. First give the pre-test, without the children's knowing that you are having a contest with prizes.

II. Record the pre-test scores on the Individual Master Chart, and the group score on the Class Chart.

III. Work up contest spirit after the pre-test; tell them about prizes, and that they will be given for improvement. Tell them what class they are competing with.

IV. Give the tests for five days, following instructions.

V. Give results each day of the previous day's improvement; tell them to work hard and improve. Have child record each day on his own class chart the class daily improvement from the Class Master Chart.

VI. For Individual Chart at end of test record I. Q. in left column, and in the right column add each day's improvement for total improvement of week. Make sure each pupil has his name and the name of the school on each test. Clip the six tests of each pupil together to his own chart.

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I should like to impress upon the teachers cooperating in this experimental research the seriousness of this problem. The results of this study will be read by educators and authorities in the field, so we all need to be very careful in computing results, giving directions to the students, and in making the Individual and Class Charts. If you are members of the Saturday morning class at Purdue, we shall give you credit for your work as a term paper, instead of a final examination. The tests take five minutes a day for five days.

The following points should be especially carefully checked by you:

1. The pre-test directions
2. Making of Individual Chart and Class Chart
3. Giving of directions to pupils
4. Every day read the amount of improvement made by the two competing classes
5. Hanging chart in a conspicuous place in room
6. Have prizes prominently displayed after the pre-test; emphasize they will be given to class making most improvement in this contest. Sign the certificates and ask your principal to sign them also; put on bulletin board.
7. Keep contest always before their minds, and stress improvement. Always say before next test is given, "I know you can do much better today."

8. Be sure the class knows from day to day their progress, Never give the next test until the class sees their grade from the previous one.
9. Set up a real, lively, competitive contest for best results on this study.
10. Stress regular attendance by all the pupils throughout the contest. If a child misses a test, draw a line through his name on the individual chart, and write "absent."
11. Be careful in keeping the seating chart and in writing the pupils' names on the test papers from the seating chart. These are then recorded on the Individual Chart.

DIRECTIONS TO TEACHERS FOR INDIVIDUAL COMPETITION

This is an experiment in motivation to test how much a child can improve his score over a practice test. The purpose of the experiment is to find how much a child will improve when he is motivated by being encouraged by the teacher to work harder and do better, knowing his previous results so he may improve, and offering prizes as goals for improvement.

Pre-Test

In giving the pre-test emphasize that is for practice only. Do not give any hint that any other tests will follow, or that prizes are to be awarded. This pre-test is to serve as a measuring stick without any motivation for pupils.

Tell the children we only want them to practice adding arithmetic problems - this is not a test. Be careful that your manner and your voice follow the practice idea. Don't let your voice or manner put the class in a test situation.

Day I

After the pre-test, grade the papers very carefully, and put the names of the pupils on the chart in alphabetical order. Put beside the name the grade each pupil received on the pre-test and read off the grades to the class. Tell them they are going to have a contest with prizes going to the pupils making the most improvement. The pre-test score will not make any difference in giving prizes because they will be given for the most improvement, and all of the pupils can improve if they work hard. Emphasize that the prizes are for improvement, and that each pupil has a good chance to win a prize.

Distribute the pupil charts and let the child chart his own progress on it. First let the child copy his pre-test score from the Master Chart, and then daily copy his improvement score on to his own chart. Help the pupils and show them how to do it; this daily keeping of a chart of improvement will do much to add to the child's enthusiasm in the contest.

Be enthusiastic in your voice and manner, while telling them about the contest and giving directions. Keep and build up higher their enthusiasm during the entire contest. Be sure and emphasize that the "Certificates of Improvement" will be signed by you as teacher, the principal, and a Purdue University professor, and sent home to their parents for good work in this contest.

Always emphasize throughout the contest that you know they can do better, encourage them to work harder, and to improve.

It is this first day that we really set the whole stage of the experiment, so be enthusiastic in telling them of the contest, prizes, and improvement in grades. Your personal enthusiasm will do much to stimulate the class to high efforts. Display the prizes (certificates of improvement) and the Master Chart in a prominent place in the room, and read and have pupils copy their daily improvement scores.

Days 2-3-4-5

Check very carefully to see that your pupils have the pre-test score and the results from each day in terms of improvement copied on their own charts. They may copy their own scores from the Master Chart as you read off each child's improvement.

Record only the amount of improvement on the Master Chart and pupils' charts over the previous test. Do not record the actual test score; record the amount of improvement in terms of more problems finished. Always have before them the chart with their improvement on it and the prizes for improvement. Stress before each test session that you know they can do better. See that each pupil's chart is accurately made and kept. Keep up the contest and prize spirit throughout all five tests. Be enthusiastic about it yourself, and encourage them to work hard for the prizes. Be sure before a test is given that they know the score of the previous test, and that they have recorded their scores on their charts.

When Test Is Finished

Record in column at left of chart each pupil's I. Q. This goes under column headed M. A. Clip together the six papers of each child for the complete set. Do this clipping together of the six tests for each pupil in the class.

Record in the column at the extreme right of chart the total number of problems more, for the five tests, that the pupil made over the pre-test. For example, if on the pre-test a pupil has 190 problems correct and if on the Day I of the test, 200, his first score will be 10 for improvement. If on the second day he scores 200 again, his score for improvement on Day 2 will be zero. If on the third day he scores 215, his improvement score on Day 3 will be 15. Record under Days 1-2-3-4-5 the amount of improvement made each day over the previous day. At the end of the contest, in total improvement column, add up the sum of each of the five days' individual improvement to get the entire week's improvement.

Place all your papers clipped together for each pupil, together with the Master Chart and the Children's Charts into an envelope and mark the name of the school on the outside. Be sure each child's paper has his name on it and the name of the school.

Summary

I. First give the pre-test, without the children's knowing that you are having a contest with prizes.

II. Record the pre-test scores on the Master Chart and read to class.

III. Work up contest spirit after the pre-test; tell them about prizes, and that they will be given for improvement. Have children record their own pre-test scores on their own charts.

IV. Give the tests for five days, following instructions.

V. Give results each day of the previous day's improvement, tell them to work hard and improve. Have child record each day on his own chart his daily improvement from the Master Chart.

VI. At end of test record I. Q. in left column, and in the right column add each day's improvement for total improvement of week. Make sure each pupil has his name and the name of the school on each test. Clip the six tests of each pupil together to his own chart.

DIRECTIONS TO STUDENTS TAKING ARITHMETIC TESTSGROUP COMPETITIONPRE-TEST:

"Boys and Girls, we would like to know how well this class can add, so we are going to give this class some practice work in arithmetic. The work the class is going to do is for practice only; it is not a test. Write the word 'Practice' at the top of the paper; do not sign your name on the paper. When I say 'Go,' begin adding and work until I tell you to stop."

DAY I

"Boys and Girls, last week we gave this class some arithmetic problems to find how well this class could add. Your teacher placed a class score chart on the bulletin board this morning and read off the class grade on that test, so that you might know how well the class did. Now we are going to have a contest between this class and _____, to see which class can make the most improvement in raising its grade on these tests each day for a week. Each of you pupils is a member of this class, so if you want your class to win, each of you will have to work hard to raise the class score each day. The class score is made up of what each of you pupils do on these tests. All of your scores are added together to get the class score, so if each of you improve each day, you will raise your class score and help your class win.

"We know you, as a member of this class, can do much better than you did on that first test, and we would like to see how much this class can improve the grade. Today, and for the rest of the

week, we are going to give you tests to see how much the class can improve the grades in both accuracy and speed over the first test of last week. Every morning the amount of improvement made by the class will be posted by your teacher on the bulletin board. There will also be posted on the bulletin board the amount of improvement made by _____ (School and class to be filled in by each teacher) each day on these tests, beside the improvement of this class.

"We are going to give a prize to the class making the most improvement in raising grades. The prize will be a class certificate of improvement signed by your principal and teacher and a Purdue University professor. This class has a good chance to win the prize, as it will be given to the class improving the grades the most. Do not write your names on the tests, as this contest is for the class as a whole, and each of you is a member of this class. Write on the top of the paper your class and the name of the school. Each day this class will have its amount of improvement and _____ amount of improvement put on the bulletin board. Remember, the prize will be given to the class making the most improvement in the grades from day to day, so the harder you work, the higher will be the class score, and the better chance this class will have to win a prize. When I say 'Go,' you will start to add, and continue until I tell you to stop."

DAYS II. III. IV. V:

"Boys and Girls, this morning your teacher read from the improvement chart the grade of this class and of _____ class on the test we gave you yesterday. Now we know you, as a member of this class, can do much better on this test today and improve the class grade over that of yesterday. Remember each of your scores count in making up the class score, so if each of you improve, you will help the class to improve. The prize will be given to the class making the most improvement, so the harder you work to improve your grade, the better chance the class will have to win the prize. When I say 'Go,' you will start to add, and continue until I tell you to stop."

IMPROVEMENT CONTEST IN ARITHMETIC

Boys and girls, we are going to have an improvement contest in arithmetic to see which ones in this class can improve their grades the most during this week.

The prizes for improvement will be merit certificates signed by your teacher, your principal, and Purdue University. Each one of you has a good chance to win as the prizes will be given to those improving the most over the practice test, and we know that everyone in this class will work hard to improve his grade. So that each of you will know from day to day how much you are improving, you will keep your own improvement chart which is at the bottom of this page. Each day for the following week, write down on your chart how much you improve each day.

Remember the prizes in this contest will be given to those pupils making the most improvement, so work hard each day to improve your grade.

- - - - -

CONTEST CHART

Name _____

School _____

Daily Improvement

Name	Practice Test	Day I	Day II	Day III	Day IV	Day V	Total Improvement for Prizes

DIRECTIONS TO STUDENTS TAKING ARITHMETIC TESTSINDIVIDUAL COMPETITIONPRE-TEST:

"Boys and Girls, we would like to know how well you can add, so we are going to give you some practice work in arithmetic. The work you are going to do is for practice only; it is not a test. Write the word 'Practice' at the top of the paper and underneath it your name. When I say 'Go,' begin adding and work until I tell you to stop."

DAY I:

"Boys and Girls, last week we gave you some arithmetic problems to find how well you could add. Your teacher placed a score chart on the bulletin board this morning and read off your grades on that test, so that each of you might know how well you did.

"Now we know you can do much better than you did on that first test, and we would like to see how much you can improve your grade. Today, and for the rest of the week, we are going to give you tests to see how much you can improve your grade in both accuracy and speed over your first test of last week. Every morning the amount of improvement made by each pupil will be posted by your teacher on the bulletin board.

"We are going to give a prize to each of the pupils making the most improvement in raising their grades in this class. The prizes will be certificates of improvement signed by your principal and teacher. Each of you has a good chance to win a prize, as they

will be given to those improving their grades the most. Write your names on the top of the paper so we can score your progress on the improvement chart. Remember the prizes will be given to those making the most improvement in their grades from day to day, so the harder you work, the higher will be your own score, and the better chance you will have to win a prize. When I say 'Go,' you will start to add, and continue until I tell you to stop."

DAYS II, III, IV, V.

"Boys and Girls, this morning your teacher read from the improvement chart your grades on the test we gave you yesterday. Now we know you can do much better on this test today and improve your grade over that of yesterday. Remember the prizes will be given to those making the most improvement, so the harder you work to improve your grade, the better chance you will have of winning the prize. When I say 'Go,' you will start to add, and continue until I tell you to stop."

DIRECTIONS TO TEACHERS

I should like to impress upon the teachers cooperating in this experimental research the seriousness of this problem. The results of this study will be read by educators and authorities in the field, so we all need to be very careful in computing results, giving directions to the students, and in making the charts. If you are members of the Saturday morning class at Purdue, we shall give you credit for your work as a term paper, instead of a final examination. The tests take five minutes a day for five days.

The following points should be especially carefully checked by you:

1. The pre-test directions
2. Making of charts
3. Giving of directions to pupils
4. Every day read the amount of improvement made by each pupil in the class.
5. Hanging chart in a conspicuous place in room
6. Have prizes prominently displayed after the pre-test; emphasize they will be sent by you to child's parents for good work in this contest. Sign the certificates and ask your principal to sign them also; put on bulletin board.
7. Keep contest always before their minds, and stress improvement. Always say before next test is given, "I know you can do much better today."

8. Be sure the child knows from day to day his progress.
Never give the next test until the pupil sees his grade from the previous one.
9. Set up a real, lively, competitive contest for best results on this study.
10. Stress regular attendance by all the pupils throughout the contest. If a child misses a test, tell him he is out of the contest, and draw a line through his name on the chart, and write "absent."

INDIVIDUAL CHART OF IMPROVEMENT

SCHOOL _____

M.A. NAMES	PRE-TEST	DAY I	DAY II	DAY III	DAY IV	DAY V	TOTAL AMOUNT OF IMPROVEMENT FOR PRIZES
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							
19.							
20.							
21.							
22.							
23.							
24.							
25.							
26.							
27.							
28.							
29.							
30.							
31.							
32.							
33.							
34.							
35.							

CLASS IMPROVEMENT CONTEST

CONTEST BETWEEN 1. _____ School
 2. _____ School

CLASS IMPROVEMENT CHART IN ARITHMETICCONTEST CHART FOR BULLETINBOARD

AVERAGE DAILY CLASS IMPROVEMENT

SCHOOLS	PRACTICE TEST Average	Day 1 Average	Day 2 Average	Day 3 Average	Day 4 Average	Day 5 Average	Average Total Class Improve- ment for this prize
1.							
2.							

FIRST PRIZEIMPROVEMENT CONTEST

This is to certify that the sixth grade class of _____
School, has made the most improvement in working arithmetic problems,
and has been awarded first prize.

Signed:

_____ PRINCIPAL

_____ TEACHER

_____ PURDUE
UNIVERSITY

SECOND PRIZEIMPROVEMENT CONTEST

This is to certify that _____
has made much improvement in working arithmetic problems in the
sixth grade of _____ School, and has been awarded
second prize.

Signed:

_____ PRINCIPAL

_____ TEACHER

_____ PURDUE
UNIVERSITY

