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I hereby recommend that the thesis prepared under my supervision by Zed Houston Burns

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THE EFFECT OF PRACTICE ON INDIVIDUAL DIFFERENCES UNDER VARYING CONDITIONS OF MOTIVATION

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by

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CHAPTER I

NATURE OF THE PROBLEM

Introduction

The primary purpose of this investigation is to inquire into the cause of the disagreement which exists among those investigators who have attacked the problem of the effect of practice on changes in variability. It may be said, therefore, that this study as a whole deals with a special aspect of the general problem of the effect of practice on changes in variability.

Among the perennial questions of education few are to be found of more importance to the worker in that field than the one which asks what the effect of practice is upon a group. To state this same question in slightly different form: Do equal amounts of education, or training, tend to make people more alike or to increase the differences already existing within a group? Furthermore, are the intensely stimulating conditions of much modern education a significant factor in this connection?

For more than a quarter of a century the question of how practice affects individual differences has been debated. During this time much experimental evidence has been obtained, and yet the investigators are far from being in agreement as to the interpretation of the results of their experiments. This problem lies within the general field of nature and nurture. It deals with the question of the extent to which training can change individual differences. A

survey of the field of nature and nurture today will show a distinct tendency to arrive at a balanced position with respect to the importance of heredity and environment. There is also a tendency toward consideration of specific problems which may be attacked experimentally, rather than toward general speculation and conjecture.

This study deals with the general question: Which exerts the greater influence in learning, native capacity or environment? It does more, however, than to repeat again what has been so often done, that is, simply to study the effects of practice upon some particular function chosen to be studied.

The importance of this problem cannot be denied but the vast number of factors involved as well as their complexities defy a comprehensive answer to this important query. At present the best the investigator can do is to select some specific phase of the general problem for which an answer based upon experimental evidence can be given. Specifically, which is the more potent factor in the acquiring of a given skill, the native capacity of the individual for that skill, be it mental or physical, or the environment as made up of the learning situation, in which, and by virtue of which, the means and opportunities for acquiring the given skill are afforded? For the educator this question is vital. It means in the one case that he may expect to find the initial differences in his students perpetuated or increased with the same training. It may mean, on the other hand, that he has a right to expect those individuals who show only mediocre or poor abilities at the start, in any given skill, to approximate the standard of excellence set up for, or by, the best of the group. The

majority of those workers who attacked the problem during the first decade and a half of this century definitely favored the belief that practice served to increase individual differences in most cases. A survey of the more recent experiments made in studying this problem, such as those of Kincaid (38)*, Peterson and Barlow (50), Reed (55), and Hunter (32), show a greater amount of evidence for believing that the effect of practice is to reduce the variability, or lessen the individual differences within a group.

Statement of the Problem

This study is composed of two separate experiments each one having for its purpose the investigation of one aspect of the problem of the effect of practice on individual differences. The first experiment is by far the more extensive. Its aim was to study motivation as a factor in changes in variability. As the practice periods were rather well distributed in the first experiment the second experiment sought to determine the effect of massing practice upon changes in variability under ordinary and high motivation.

The aim of this investigation may be said to be threefold. First, it is interested in repeating what has been done many times, but under new conditions. It asks: What is the effect of practice on changes in variability? Second, it is especially interested in how motivation is involved in the changes which take place under practice. Third, this study seeks to discover what the effect of

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* A single number in parenthesis refers to the bibliographical item as a whole. A second number, where it occurs, is the page reference of that item.

distributed and massed practice is upon changes in variability under varying degrees of motivation.

In order to find out the effect of a high degree of motivation on variability it was first necessary to know what changes in variability occurred under ordinary motivation. For this purpose control groups were used. In setting up the experiments advantage was taken of upwards of seventy experiments already done. These are summarized in Table I, Chapter II, as well as being discussed there. The statistical treatment most widely used and accepted has been employed in this study. The functions studied are two in number. One, addition, used in the first experiment, has been among the most widely studied, and so yields data comparable to those obtained by many investigators over a considerable period of time. The other function studied, code writing, used in both experiments, is unique to this investigation. The materials themselves are radically different to work with. In the case of addition, every subject, as a college student, possessed some previous training in this function. The code writing, on the other hand, was entirely new to every subject who took part in the investigation. In a number of previous studies of the effect of practice upon individual differences, college studentshhave served as subjects, thus making it possible to compare the results of this experiment with results already obtained. The special motivation used in the first experiment in connection with the strongly motivated group was a combination of knowledge of results and competition. The scores for the motivated group were posted every day. Each member of the group knew his own score for the previous day, as well as the scores of the rest of the group.

The second experiment studied only the function code writing. Although it employed the same control group type of procedure, it was as a whole a much briefer experiment. It was designed to repeat part of the first experiment, the practice all took place in less than an hour while in the first experiment the practice was spread over a period of six weeks.

These experiments sought to answer a number of questions: What is the relative effect of a strong and ordinary motivation upon college students in the functions studied? Does the performance of such groups become more or less variable with practice? Will the effect of practice be the same in both functions studied? What is the effect of special motivation upon the variability of a group and is this effect constant for both functions studied? What is the effect of massed or distributed practice both on the control and strongly motivated groups? Finally, and most important, does the factor of motivation provide an adequate explanation of the present disagreement as to the effect of practice on changes in variability?

Some of these questions have been at least partially answered by previous investigators. Others of them have not been touched upon. One of the most important parts of this study is that showing the day by day change in variability of the control and motivated groups in both functions. This part of the study presents a picture of what occurs in terms of variability when a group of college students under-goes practice in the two functions studied.

It shows further a day by day record of how the special motivation influenced changes in variability. Nowhere in the extensive literature on the effects of practice is there anything which deals with this particular problem.

This question of the effect of motivation upon changes in variability is one having important implications for education. If by the use of strong motivation the lower ranking members of a group may be brought up so that their achievement will compare favorably with that of the more proficient members of the same group, education needs to know that fact. If strong motivation serves to increase variability, education also needs to know that.

CHAPTER II

ANALYSIS AND SUMMARY OF PREVIOUS EXPERIMENTATION

Status of the Field

The experiments dealt with in this chapter cover the years from 1908, when Thorndike (65) first attacked the problem of the effect of practice on individual differences, down to Ewert's (22) experiment reported in 1933. The quantity of material contained in the summary table presented in this chapter bears testimony to the lively interest the problem has aroused since Thorndike's initial work. With the exception of Whitley (78), Thorndike and most of his co-workers, among them Chapman (11) and Wells (77), have held as a result of the investigations that the effect of practice upon individual differences is to increase those already existing. In more recent years Thurstone (73), Starch (59) and Race (52) have come to that opinion through experimental work of their own. Hunter (32:620), writing in a recent publication, agrees with this point of view. At the same time he admits that the bulk of the evidence is on the other side.

Among those who early came, as a result of their experimental work, to the belief that the effect of practice is to reduce individual differences, are Whitley (78), Peterson (46), as a result of his experiment on ball tossing in 1917, Perrin (45), whose work dealt with analogies and mirror reading, and Gates (26).

More recently Reed (54) pointed out that the conclusion of leading psychologists that practice increases individual differences was false because of the measures on which it was based. He said that this conclusion was justified when gains were measured by absolute increases in amount of work per unit of time, but that an entirely opposite conclusion is reached when gains are measured by time per unit of work, and that, because of this contradiction, neither measure is valid.

In the same year, 1924, Barlow (5) reported the results of three practice experiments with card sorting, mental multiplication, and substitution tests. He found that the card sorting tests showed a decrease in variability, and that the mental multiplication and substitution tests showed an increase. He concluded that the more complex the trait learned, the stronger is the tendency for the individuals to become more unlike with equal practice, and the simpler it is, the stronger is the tendency for them to become more alike.

Kincaid (35), a year later, made an experiment in changes in variability, using Braille writing and dart throwing. She concluded that differences generally decrease with practice.

Three years later Peterson and Barlow (50) published the co-efficients of variability for most of the studies of the influence of practice on individual differences that had been published before that date, forty in all. Of these, twenty-four show a reduction in variability, five show no definite change, and eleven show an increase. They also reported three new experiments of their own. In only one of these is the change in variability great enough to give the study

any weight. In this one, which dealt with weekly tests in a psychology course, all sections showed a marked reduction in variability over a period of twelve weeks.

Reed's (55) study made in 1931 reviews all of the studies mentioned above. He criticizes many of them on the score that the measures used to determine whether variability increases or decreases are invalid. Reed tabulates the results of seventy-one experiments on changes in variability previously made and ranging over the years from 1908 to 1929. In fifty-nine of these using the ratio of the average of the three highest divided by the average of the three lowest, he found that 95 per cent showed a decrease in variability and that 5 per cent showed an increase, none showing a lack of change. Applying the measure $\frac{\text{S.D.}}{\text{Average}}$ to seventy of these experiments, he found that 77 per cent showed a decrease in variability, 19 per cent an increase, and 4 per cent no change at all. Out of fifty-eight of these studies, by using the measure, correlation of initial performance with per cent of gain, he found that 93 per cent showed a decrease in variability, 7 per cent an increase, and none a lack of change.

This work seems to show that the contradictory findings of previous workers on the question of changes in variability were due largely to lack of validity in the measures used.

Two new investigations are next reported of the influence of training on changes in variability. The first of these is Reed's experiment on motor skill using the yo-yo top. His subjects were

thirty-seven college sophomores. They were divided into three groups. One group practiced ten minutes a day for eighteen days, another, twenty minutes a day for nine days, and the third group sixty minutes once a week for three weeks. Using the measure for the index of variability $\frac{S.D.}{Average}$, he found there was a drop from 1.02 for the initial performance to .25 for the eighteenth or final trial. The correlation between initial performance and per cent of gain was found to be -.43, which would also indicate a decrease in variability. He found that the ratio of the average of the three highest scores divided by the average of the three lowest, which was 99.44 for the initial performance, became reduced to 1.31 for the final trial. These and other measures used are all in agreement in indicating a marked decrease in variability. However, this procedure might be questioned in one respect, that is, in the grouping together of distributed, less distributed, and massed practice periods, all into one table of data. He sayd, "In calculating the influence of practice on changes in variability, no account was taken of the effect of the distribution of practice." It is conceivable that enough of the low students might have been in the group where the practice was massed to affect the variability of the whole group. Reed may have controlled this factor, but the experiment as reported gives no evidence of his having done so. Pechstein (43) found learning to be considerably influenced by the distribution or massing of practice.

It may be noted that in the first experiment of the present investigation practice was distributed; in the second experiment, it was massed.

The second experiment which Reed reports is one made by J. C. Edwards (21) under his supervision. In this investigation one hundred thirty-seven pupils ranging from the second to the eighth grade were the subjects. Standard tests were used in reading, arithmetic, dictation, language usage, history and literature, nature study and science. The correlations of initial score and per cent of gain for all ten tests used in all grades were found to be negative and to range from -.42 to -.75 over the period from October to May. Using the ratio of the average of the three highest scores divided by the average of the three lowest, he found that there was convergence in 98 per cent of the cases from October to February, and convergence in 96 per cent of the cases from October to May. Using the formula $\frac{\text{S.D.}}{\text{Average}}$ as a measure, he found the percentage of convergence from October to February to be 76, while that from October to May was 85. The percentage of decrease in variability for Grade II was 63; for Grade III, 47; for Grade IV, 22; for Grade V, 24; for Grade VI, 0; for Grade VII, 33; and for Grade VIII, 12.

In his conclusions, Edwards says that the tests were made under school conditions without any special effort at individual instruction. He says, "It is possible that if every pupil had been encouraged to do a maximum amount of work, that the results would show a greater variability." He does not advocate that the best pupils be held back in any way, but he believes that the poorer pupils can be made to approach the level of the best ones by training.

Using the term homogeneity as being synonymous with the term variability, Carrol (10) sought to discover whether a group of college students would become more alike or unlike through practice on the

following: First, in the complex skill of silent reading as measured by standard tests for that purpose, and second, in the simple skill of making marks as rapidly as possible in groups of five, using the left hand (or right hand if left-handed). He found that in the case of the silent reading the coefficient of variability, which was 26 for the initial practice, became reduced to 15 for the final practice. Practice extended over twenty-eight periods. The total range of fluctuation in variability was from 28 on the seventeenth trial to 12 on the twenty-sixth trial.

In the case of the simple skill of making marks, Carrol found that there was a drop from 24 to 16 in variability between the initial and forty-fifth or final trial. He found also that the fluctuations in variability were much less marked than in the silent reading. He concluded that, in the case of either a broad or a narrow mental function, practice has the effect upon a fairly homogeneous group of retaining the homogeneity or of making the group more homogeneous. In other words, Carrol's conclusions were that, regardless of the type of mental function, the effect of practice upon a fairly homogeneous group is to make that group more alike.

Table I presents data based upon seventy-six studies which dealt with the problem of the effect of practice on individual differences. Some few of these studies, McCall's (40) for example, were not made by their authors with the purpose of studying the effect of practice on individual differences. The data have been utilized by others for this purpose, however. Sims' (58) study was primarily interested in motivation, as will be shown later. The seventy-six studies presented in summarized form in Table I are grouped under seven headings, and arranged

TABLE I

SUMMARY OF EXPERIMENTS ON THE EFFECT OF PRACTICE ON INDIVIDUAL DIFFERENCES

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			ARITHMETICAL FUNCTIONS Addition			
Thorndike '10	19 coll. students	7 periods	Time Competition with own record	Corr. initial rank with % of gain. Ind. diff. reduced	Kincaid	Variability increased .26 to .29
Wells '12	5 adults	30 periods	Work Immediate knowledge of results	Similarity in learning curves. Ind. diff. increased	Reed	Variability increased .12 to .13
Donovan & Thorndike '13	29 children grade 4	30 periods	Work Not controlled	Av. gross gains of groups of four. Ind. diff. increased	Peterson	Variability reduced .37 to .25
Kirby '13	1350 children	75 minutes	Work No mention of motivation	The higher the initial rank the more the gain		
Hahn & Thorndike '14	192 children	90 minutes	Work Comp. with own record. Encouraged to excel it	Gross gains. Ind. diff. increased	Reed	Variability reduced .59 to .53
Chapman '14	22 coll. students	10 periods	Work Subjects paid. Knowl. of results	Ind. diff. increased. (esp. in complex material)	Kincaid	Variability reduced .29 to .26
Thorndike '16	11 coll. students	10 periods	Work No mention of Mot.	Gross gain. Ind. diff. increased	Kincaid	Variability reduced .26 to .21

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			Addition (Continued)			
McCall '16	72 children	18 periods	Work Names of 3 highest announced daily	Ind. diff. not McCall's problem	Reed	Variability increased .45 to .51
Race '22	53 children	10 periods	Work No mention of motivation	Comp. av. gross gains of highest and lowest 4ths. Ind. diff. increased	Barlow	Variability increased .52 to .62
Gates '22	23 college students	29 periods	Time & work No mention of motivation	Gross & relative gain. Ratios good to poor. Ind. diff. reduced	Barlow	Variability reduced .16 to .12
Reed '24	140 college students	60 minutes	Work No mention of motivation	Variability reduced .80 to .21		
			Division			
Kirby '13	1350 children	60 minutes	Work No mention of motivation	Curve showing positive relation between initial rank and gain. Ind. diff. increased		
			Mental Multiplication			
Thorndike '08	28 adults	50-96 examples	Time corrected Knowledge of results	Ratios of worse to better records. Ind. diff. increased	Kincaid	Variability increased .37 to .42

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
Mental Multiplication (Continued)						
Whitley '11	9 college students	20 periods	Time Paid for services	Gross and relative gains. Position at finish correlated with initial rank. Ind. diff. reduced	Kincaid	Variability reduced .55 to .37
Chapman '14	22 adults	10 periods 2 daily	Work Paid for services and knowledge of results	Correlation of initial score with gross and relative gains. Ind. diff. increased	Peterson	Variability reduced .28 to .20
Thorndike '16	11 adults	10 daily pract.	Work No mention of motivation	Gross gain. Ind. diff. increased	Kincaid	Variability increased .28 to .40
Starch '19	8 college students	14 daily practices	Time Subjects told to work hard and carefully	Gross and relative gains. Ind. diff. increased	Reed	Variability reduced
Gates '22	23 college students	22 periods	Time and work No mention of motivation	Gross and relative gains. Ratios good to poor used. Ind. diff. reduced	Barlow	Variability reduced .45 to .43
Barlow '24	20 children	12-20 periods 20 min. each	Work Said to be good (by Peterson)	Variability increased	Given by Reed	Variability increased .28 to .34
Peterson and Barlow '28	96 children	882 problems 7 periods	Time Said to be high (by Barlow)	Variability reduced	Given by Reed	Variability reduced .37 to .32

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
Multiplication by Substitution						
Race '22	56 children	20 periods	Work No mention of motivation	Compared average gross gains of highest and lowest 4ths. Ind. diff. increased with practice	Barlow	Variability increased .17 to .35
DISCRIMINATIVE FUNCTIONS						
Analogies						
Perrin '19	21 college students	10 periods	Time Prize given. Knowledge of results	Curves plotted. Ind. diff. reduced	Reed	Variability reduced .53 to .41
Cancellation						
Whitley '11	9 college students	20 periods	Time Paid for services	Gross and relative gains. Ind. diff. reduced	Kincaid	Variability increased .27 to .30
Chapman '14	22 adults	10 periods	Work Paid for services. Knowledge of results	Gross and relative gains. Ind. diff. increased	Kincaid	Variability increased .12 to .14
Thorndike '16	11 college students	10 periods	Work No mention of motivation	Gross gain. Ind. diff. increased	Kincaid	Variability reduced .125 to .09
McCall '16	17 children	18 periods	Work Names of three highest announced	Ind. diff. not McCall's problem	Kincaid	Variability reduced .40 to .29

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of Measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			Cancellation (Continued)			
Race '22	59 College students	8 periods	Work: No mention of motivation	Compared average gross gains of highest and lowest 4ths. Ind. diff. reduced	Reed	Variability reduced .15 to .13
			Color Naming			
Chapman '14	22 college students	10 periods 15 min. each	Work: Paid for services. Knowledge of results	Gross and relative gains. Ind. diff. increased	Kincaid	Variability reduced .13 to .11
			Mirror Reading			
Perrin '19	21 college students	7 periods	Time: Knowledge of results	Curves plotted. Superior subjects improved less	Reed	Variability reduced .60 to .50
			Substitution			
Starch '19	20 college students	10 periods 120 minutes	Work: Subjects told to work hard and carefully	Gross gain. Ind. diff. increased	Reed	Variability reduced
Reed '24	108 college students	400 substitutions	Time: No mention of motivation	Variability increased .53 to .56		
Reed '24	59 college students	400 substitutions	Work: No mention of motivation	Variability reduced .43 to .42		
Barlow '24	20 children	12 periods	Time: Said to be good (by Peterson)	Variability increased .15 to .18		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			Substitution (Continued)			
Sims '28	36 college students	12 periods 2 minutes each	Work 1st.sec.ordinary, 2nd sec. group 3rd sec. individ.	Gain: 34.8 38.6 59.2		
Ewert '33	94 coll. students	20 periods	Work Not stated	Contradictory		
			MOTOR-DISCRIMINATIVE FUNCTIONS Cube Fitting			
Myers '18	14 adults	23 periods	Time Some knew results. Some did not	Nature of change in doubt	Reed	Variability stationary .12 - .12
			Sorting			
Woodrow (forms) '17	20 feeble minded children; 16 normal	13 periods	Work Urged while working	Normal gained 46% Feeble-minded gained 49%	Kincaid	Variability increased: Feeble-minded .14 to .18 Normal .13 to .13
Myers (cards) '18	27 adults	80 trials	Work Some knew scores Others did not	Av.Dev. Av. Ind. diff. not affected by practice	Reed	Variability increased .08 to .13
Barlow (cards) '24	20 children	6 periods 720 sortings	Time Said to be good (by Barlow)	Variability reduced .15 to .12		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			Sorting (Continued)			
Whitley (counters) '11	8 college students	20 periods	Time Paid for services	Correlation of initial and final rank. Ind. diff. reduced	Kincaid	Variability reduced .32 to .06
Brown (cards) '14	26 college students	8 periods	Time corrected Competition; Knowledge of results	Gain of lowest 4th exceeded that of highest 4th	Barlow	Variability reduced .13 to .10
			Weight Discrimination			
Whitley '11	9 college students	16 periods	Error Paid for services	Gross and relative gains. Ind. diff. reduced	Kincaid	Variability reduced .21 to .12
			MOTOR SKILL FUNCTIONS Archery			
Lashley '15	19 adults	30 periods 12 shots each	Work Prizes given. Knowledge of results	Per cent and gross gains used. Ind. diff. reduced		
			Ball Tossing			
Peterson '17	28 college students	30 periods	Time Record of performance kept by subject	Variability increased .28 to .40		
			Dart Throwing			
Kincaid '25	28 college students	40 periods	Not given Not known	Variability reduced .38 to .31		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			Javelin Throwing			
Murphy '16	30 college students	100-150 periods	Errors No mention of motivation	Standard deviation used. Ind. diff. reduced	Reed	Variability reduced .34 to .24
Johnson '23	14 adults		Work Self competition	Average of first 5 trials compared with average of last 5 trials. Nature of change in doubt	Peterson	Variability increased .16 to .19
			Making Marks			
Carrol '32	College students	45 periods	Work None stated	Variability reduced .24 to .16		
			Maze Running			
Whitley '11	9 coll. students	20 periods	Time Subjects paid	Gross and relative gains. Ind. diff. reduced	Kincaid	Variability reduced .30 to .25
			Mirror Drawing			
Reed '24	58 coll. students	15 trials	Time None mentioned	Variability reduced .32 to .24		
Ewert '33	40 coll. students	100 trials	Time corrected Cash prizes	Slight increase in variability		
			Rifle Practice			
Lashley '15	9 adults	30 periods	Work Prizes given; Knowledge of results	Per cent and relative gain used; Ind. diff. reduced		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			Tapping			
Gates '22	23 coll. students	22 periods	Time and Work None mentioned	Gross and relative gain; Ratios good to poor used; Ind. diff. reduced	Reed	Variability increased .10 to .12
			Yo-Yoing			
Reed '31	37 college students	18 periods 180 min.	Work No mention of motivation	Variability reduced 1.02 to .25		
			LANGUAGE FUNCTIONS Language Completion			
Race '22	31 children	10 periods	Work None mentioned	Lowest fourth gained more than highest fourth	Reed	Variability reduced .11 to .09
			Opposites			
Chapman '14	22 college students	10 periods	Work Subjects paid; Results known	Gross and relative gains; Slight increase of Ind. diff.	Kincaid	Variability reduced .21 to .15
Hollingworth '14	13 college students	175 trials	Time Prizes given Rank known	Author believed changes due to qualitative changes in test		
			SCHOOL ACHIEVEMENT Arithmetic			
Henmon '20	128 children	9 periods 1 per month	Work Subjects watched own improvement	Highest fourth made most gross gain		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
History						
Race '22	97 children	20 periods 800 min.	Work No mention of motivation	Lowest 4th exceeded highest 4th in gain. Ind. diff. reduced	Reed	Variability reduced .34 to .26
Reading						
Henmon '20	128 children	9 periods 1 per month	Work Subjects watched own improvement	Gross gain; Ind. diff. increased		
Sims '28	45 college students	12 periods 3 min. each	Work 1st.sec. ordinary 2nd sec. group 3rd sec. individ.	Per cent of improvement: 8.7 14.5 34.7		
Carrol '32	college students	28 periods	Work Not stated	Variability reduced .26 to .15		
Spelling						
Henmon '20	128 children	9 periods 1 per month	Work Subjects watched own improvement	Gross gain. Ind. diff. increased		
Stanford Achievement Test						
Edwards '29	Grades 2 to 8	8 months	Work Normal school conditions	Variability reduced Oct. .45 Feb. .28 May .26		
Writing						
Henmon '20	128 children	9 periods 1 per month	Work Not known	Gross gain. Ind. diff. increased		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
			MISCELLANEOUS			
			Braille Writing			
Kincaid '25	31 coll. students	47 periods	Not stated / Not stated	Variability reduced .29 to .17		
			Copying			
McCall '16	75 children	20 periods 260 minutes	Work / Names of 3 highest announced daily	Ind. diff. not McCall's problem	Reed	Variability reduced .36 to .23
			Intelligence Tests			
Race '22	38 children	15 periods 30 min. each	Work / No mention of motivation	Lowest fourth gained more than highest fourth. Ind. diff. reduced.	Reed	Variability reduced .28 to .18
			Psychology			
Peterson & Barlow '28	224 college students	8 - 10 weeks	Work / Competition; Papers scored and returned	Variability reduced .30 to .18		
			Saying Alphabet Backwards			
Reed '24	129 college students	12 trials	Time / No mention of motivation	Variability reduced .59 to .42		

TABLE I (Continued)

Investigator	Subjects	Practice	Unit of measure / Motivation	Measures used and findings of author	Recalculated by	New findings
Telegraphy						
Thurstone,[18]	165 adults	100 hours	Work No mention of motivation	Standard deviation and quartile deviation. Ind. diff. increased	Peterson	Variability reduced .74 to .52
Typing						
Thorndike '16	11 college students	10 periods	Work No mention of motivation	Ind. diff. reduced	Kincaid	Variability reduced .41 to .18
Myers '18	14 adults	25 periods	Time No mention of motivation	Av.Dev. mean used. Ind. diff. not changed by practice		
Chapman '19	19 high school students	180 periods	Work Urged to do very best	Interested in curves only	Peterson	Variability reduced .16 to .07
Sandiford	10 high school students	360 hours	Work Not known		Reed	Variability reduced .09 to .02
Color Naming						
Gates '22	23 college students	22 periods	Work and time No mention of motivation	Gross and relative gains used. Ind. diff. reduced	Reed	Variability reduced .21 to .17

alphabetically under each head. These are as follows: Arithmetical Functions, Discriminative Functions, Motor-Discriminative Functions, Motor Skill Functions, Language Functions, School Achievement, and Miscellaneous.

An examination of Table I shows that in twenty-eight of the studies tabulated the authors found that practice increased individual differences. In thirty-four of them the authors concluded that the effect of practice was to reduce individual differences. In the other fourteen studies, for various reasons, no definite conclusion was reached by the authors as to the effect of practice on changes in variability. Of forty recalculations made, seven agree with the original studies that variability or individual differences are increased by practice. There are seventeen which agree with the original findings that the effect of practice is to reduce variability. The remaining sixteen are in disagreement with the original calculations.

Motivation Used

Table I shows that in the seventy-six studies tabulated, the kind of motivation used may be grouped under ten types. In many of the studies more than one type of motivation was used. A check-up will show that in some cases the motivation was simply school conditions; in others it was reported as uncontrolled. In three experiments some subjects were motivated more than others, though just which ones these were or why this practice was followed is not made clear. In three experiments competition served as a

motivator. Four experiments are alleged to have had good motivation. In five cases prizes of varying values were offered and in five other cases the subjects were urged to do their best. Ten experimenters paid their subjects for their time. The type of motivation used most was some form of knowledge of result. This was used in twenty-three cases. In thirty-one of the experiments, or more than 40 per cent of them, the experimenter failed to mention what sort of motivation was used.

Sims' study already referred to should be noted in connection with motivation. He studied the simple function substitution and the complex one reading. In the study of both functions he used three sections of twelve subjects each equated as to initial score. One section he describes as working under normal or ordinary motivation. This is called in the experiment, the control section. One section he calls the group-motivated section. This section was divided into two parts, one part competing against the other. The third section is known as the individually motivated section. This section was divided into two groups, the members of which chose members from the other group to compete with. The relative effectiveness of the two types of motivation is shown in Table I in terms of per cent of improvement. It is unfortunate that the data from this experiment are not available, as they would probably be very valuable for the present problem.

Among the experiments which had for their major interest the effect of practice upon changes in variability, Ewert's (22) is unique as one where adequate attention was given to motivation. He used a

system of reward and penalty, together with a substantial prize, which assured a very high motivation in studying the function mirror drawing.

Summary and Need for Present Study

One thing clearly shown by Table I is lack of attention to the motivating factors involved in the studies summarized therein. The fact that in more than 40 per cent of the experiments no mention of any kind is made of motivation forcibly illustrates this fact. Various studies of motivation convince one that this is a serious oversight. Arps (3) found that knowledge of result increases speed and efficiency on the part of subjects working with ergograph. Chapman and Feder (14) found that knowledge of results in the form of publication of the previous day's work and presentation of learning curves exerted considerable effect on the amount of the produce in cancellation and substitution but not in addition. Starch (60:178) reports an experiment by L. J. Cubal using standard tests in writing, spelling, and arithmetic, where the pupils who were kept informed of their records more than doubled their gain in the school year. Ross (57) found that the gain of an informed group over a partially informed group was from 2.2 per cent to 8.5 per cent, and that the gain of an informed group over one working without knowledge of results was from 4.5 per cent to 12.6 per cent. Deputy (18) found that knowledge of results in studies may be a motivating factor with college students.[1]

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[1] For a more complete summary of experiments on motivation and of the general theory of motivation, the reader is referred to the following reference: Diserens, Chas. M., and Vaughn, James. "Experimental Psychology of Motivation", Psychological Bulletin, XXVIII (January, 1931), 15-65.

In summarizing, it may be said that Chapter II and particularly Table I shows the complete lack of agreement among trained investigators as to what the effect of practice upon changes in variability really is. It further shows a neglect of one of the most important conditions in any experiment on learning: namely, the motivation used. The present investigation, including two learning experiments, each employing two comparable groups, one working under ordinary motivation and the other under special conditions of motivation, aims at pointing out the effect upon changes in variability of that special motivation.

CHAPTER III

PROCEDURE

The First Experiment

Scope.-The subjects of the first experiment were eighty-six college students who worked on the practice materials five days a week for six weeks, or a total of thirty practice periods. The practice material was of two types. One type was designed to measure progress in addition in terms of the number of columns added in five minutes' time. The other type of material was designed to show progress in code writing. The practice period in each case was five minutes. The subjects were divided into two groups of forty-three each. These groups were equated on the basis of scores on an intelligence test, an English test, and tests for initial ability in both functions studied. One of these groups, the control group, worked under ordinary or normal motivation. This consisted of being told what to do and doing it as part of the regular school program. In addition to this form of motivation, the strongly motivated, or experimental group, had their scores presented to them each day so that their additional motivation took the form of knowledge of results and also competition with their fellows.

In order to obtain the data upon which the conclusions of this part of the report are based, it was necessary to administer, score, and record some six thousand individual tests. These tests

were distributed over a period of six weeks. About the same length of time was occupied in the preliminary part of the investigation. This consisted of collecting psychological and English scores of the subjects, developing code writing and addition testing materials, and giving preliminary tests used in equating the two groups.

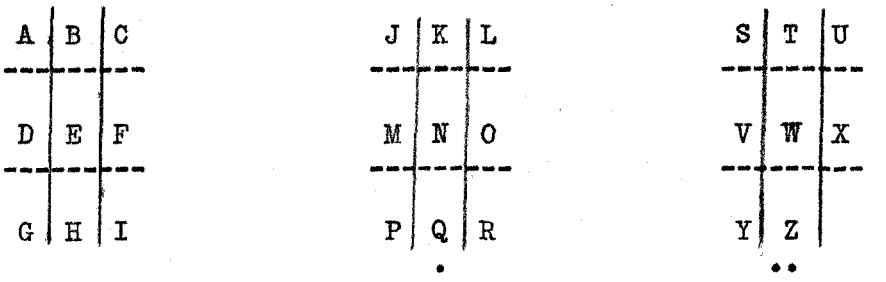
The second experiment repeated with some modifications the portion of the first experiment on code writing. Its main interest was in what effect the massing of practice would have on changes in variability under normal and accellerated motivation.

Subjects.-The subjects of the first experiment were all members of one or the other of two sections of third quarter freshman psychology at the State Teachers College, Jacksonville, Alabama. These students formed an unusually homogeneous group. Their ages ranged from 31 years to 16 years, the mean being 20.36 years. They were divided according to sex as follows: 45 per cent male and 55 per cent female. They were all American born. One hundred per cent of them were high school graduates. Their regular instructor in psychology agreed to give these students credit for participating in the experiment, as a substitution for their regular laboratory work in psychology. Thus the experiment became for them a part of their regular work. This arrangement solved one of the most pressing problems of the investigation: i.e., the problem of how motivation was to be secured for the control group.

Charts and Lists.-Two charts or graphs, measuring eighteen by twenty inches, were provided and ruled off into convenient units,

so that the average progress of the motivated group in each material could be shown each day. A list of the names of the members of the motivated group, together with their scores in both materials, was posted on the bulletin board each day between the two graphs.

Code Writing Materials.-The code writing material consisted of mimeographed sheets of thirteen lines of English which were to be put into the code as rapidly as possible. The number of lines was changed from thirteen to fifteen for the last two weeks of the experiment. All the English selections were from Bacon's Essays. This source was chosen because of the general uniformity of the work and hence the evenness of difficulty. The key to the code writing is given herewith:



The symbol for each letter consists of that portion of the figure in which the letter occurs. For example, A is written thus ⌐ and B thus ⊔. In the second group the letters are differentiated from those in the first one by placing a dot in the symbol, and in the third group two dots are used. For example, A, J, and S are all written alike except that the first is without a dot, the second has one dot, and the third has two. Thirty different specimen sheets were prepared for the code writing and a diffefent one was used every day. The score in code writing was always the number of letters correctly translated

into the symbols in five minutes. For a specimen of these practice sheets see Appendix A.

Addition Materials.-The addition material consisted of mimeographed sheets of columns of numbers. Each column was made up of ten single digits (the one's and zero's were omitted). Each sheet contained three rows of these columns, twenty-two to the row. Ten different sheets were prepared and they were rotated over a period of ten practices, i.e., a period of two weeks. The score in addition was always the number of columns added correctly in five minutes. For a specimen of these practice sheets see Appendix A.

Questionnaires.-Three different questionnaires were used during the course of the experiment. These were worded in such a way as to reveal the attitude of the subjects toward the experiment, and also obtain certain facts as to age, training, etc. For information concerning these questionnaires and the tabulation of the answers to them see Appendix C.

Physical Conditions Surrounding Experiment.-With the exception of the preliminary tests, which were given in the regular classroom and at the regular class period, all the tests of the experiment with both sections were given in the same room. This room served as a regular laboratory and was not used for any other purpose whatever during the whole experiment. This room measured twenty feet by forty feet, and accommodated fifty tablet-armed chairs, allowing them to be spaced in such a way that all subjects had ample room in which to work comfortably. The room was clean, well lighted, and cheerful, and was finished in the same manner as the other classrooms of the building. This room

was fitted with an electric wall clock which was used for timing throughout the experiment.

Every subject who took part in this experiment did so under the same conditions to the extent that all had credit to gain in psychology by so doing. This arrangement had the virtue of eliminating almost entirely the undesirable factor of having any subject simply loaf through the daily procedure without attempting to improve his score.

The students who took part in this experiment were told that the practice work which they were to do was a part of their regular course and that they were expected to carry out instructions and cooperate with the experimenter in every way, just as in any other part of their work in psychology. This was explained to them by their regular instructor. At the same time they were reminded by him that the essence of an experiment is the controlling of conditions under which it takes place and that, therefore, they were not to practice the various tasks which the experiment involved, except at the regular experiment periods. He also warned them that failure to comply with this request was easily detected by the person conducting the experiment. The subjects were told enough about the aim of the experiment to enable them to follow instructions intelligently. That is, they were told that the experiment itself was an investigation in the field of learning and that both groups would not follow identically the same procedure. In the explanation of the experiment, the point was emphasized that they were to receive credit, not for how much of each material they were able to cover in a given time, but for how well they carried out whatever instructions were given them. It was

made plain to them that differences in scores were to be expected, and that a low score was no reflection on its maker, while a high score, though desirable, was evidence of individual ability along a particular line rather than of superior intelligence, and that in any event, the thing of importance was to see how much each person could gain each day, regardless of what his original score was.

Method of Equating in First Experiment

Procedure in Securing Composite Scores.-In order to investigate the effect of motivation upon changes in variability through practice it was necessary to have two groups of subjects as nearly alike as possible. The ideal situation would have been to have two groups both with the same initial abilities in the two materials and also with the same potential abilities or capacities for gain in the two materials. This ideal could be attained only where two materials could be devised whose correlation was perfect and whose individual correlations with whatever measure of intelligence used were also perfect, and where the measure of intelligence was a true and absolute measure of capacity for gain.

There were available for the subjects of this investigation the scores made by them on the Thurstone Psychological Examination for high school graduates and college freshmen, 1931 edition, and also the scores made by them on the Columbia Research Bureau English Test, Form B, for upper high school grades and colleges. Preliminary tests in the code writing and the addition were given to eighty-three subjects. The results of these four tests were used as a basis for forming the two equal groups necessary to carry out the investigation.

In equating the two groups, one of the methods suggested by Garrett (25:279) was followed. The standard deviation for each of the

four tests was calculated and found to be as follows: Thurstone 47.50, English 26.37, code writing 13.32, addition 5.37. In order to make all the sigmas approximately equal, as there seemed to be no good reason for giving one test more importance than another, the sigma of the Thurstone Examination was multiplied by 7/12, the English by 1, the code writing by 2, and the addition by 5. These multipliers gave the following new values for sigma: Thurstone 27.72, English 26.37, code writing 26.54, addition 26.85. The actual scores of each of the eighty-three subjects were multiplied by these same multipliers and the products added to obtain a single composite score for each subject. Table II shows the process.

TABLE II

SCORES COMBINED AND WEIGHTED
ACCORDING TO VARIABILITY

	Thurstone	English	Code	Addition
Sigmas	47.50	26.37	13.32	5.37
Multipliers	7/12	1	2	5
New Sigmas	27.72	26.37	26.54	26.85
Subject c l's* score	112	115	35	22
Subject c l's weighted score (all tests equal)	65.31	115	70	110

* See page

For example, subject c 1's composite score is 360, or the sum of his weighted scores. This procedure was carried out for each subject, giving a composite or combined score for each one. The composite scores of all the subjects were then arranged in order from the largest to the smallest. This arrangement showed a range from 484 to 142. Table III shows the arrangement.

Procedure in Pairing Subjects.-Beginning at the bottom of the list, the first two scores were combined to form the first pair and the next two scores to form the second pair, and so on through the whole list until forty-one pairs had been formed. As there were eighty-three subjects in the list, it was of course necessary to omit some one. It fell to the lot of subject number 15 to be omitted, as his score was considerably lower than that of the subject above him and higher than that of the one below him. However, a partner was later found for him. Those subjects by whose designations appear stars were originally designated as m19 and m32. They are numbers 42 and 71 respectively in Table III. Subject number 42 was dropped from the experiment because her attitude and record indicated that she was not trying to improve her score. Subject number 71 was dropped from the experiment because of her irregular attendance.

Of the forty-one pairs formed in the manner just described, one member of each pair was placed in the control group and the other member in the experimental group.

Between the time that the forty-one pairs described above were formed and the actual beginning of the experiment, ten late comers were added to the two classes whose complete personnel this experiment

TABLE III

ARRANGEMENT OF SUBJECTS ACCORDING TO COMPOSITE SCORES

Number	Thurstone	English	Code	Add.	Composite	Designation
1	202	172	62	14	484	m15
2	168	179	44	20	465	c15
3	189	153	29	22	431	c29
4	147	148	68	12	430	m29
5	165	149	55	14	425	m12
6	158	161	37	19	422	c12
7	156	127	44	23	421	c 4
8	121	156	52	15	406	m 4
9	177	142	40	15	400	c42
10	140	133	34	20	394	m42
11	148	162	40	13	393	c 9
12	119	129	42	22	392	m 9
13	109	128	61	15	389	m22
14	126	126	34	24	288	c22
15	155	114	56	13	381	c28
16	155	95	33	23	366	m 1
17	112	115	35	22	360	c 1
18	76	116	27	29	359	c38
19	156	125	47	9	355	m38
20	164	115	38	13	352	c 6
21	125	132	38	13	346	m 6
22	83	106	46	18	336	c 3
23	73	165	36	10	330	m 3
24	155	115	42	8	329	m 2
25	76	108	45	17	327	c 2
26	67	119	51	13	325	m26
27	64	104	41	20	323	c26
28	119	123	38	11	323	c10
29	103	107	37	16	321	m10
30	103	157	24	13	320	m18
31	76	107	24	24	319	c18
32	84	112	40	15	316	c27
33	69	111	39	17	314	m27
34	92	150	24	12	312	m 7
35	78	100	43	16	312	c 7
36	136	76	43	13	306	c12
37	70	74	40	22	305	m21
38	80	92	45	15	304	m14
39	90	104	18	21	298	c14
40	163	80	23	15	296	m31

TABLE III (Continued)

Number	Thurstone	English	Code	Add.	Composite	Designation
41	119	82	23	19	292	c31
42	37	84	50	13	291	---*
43	84	90	40	14	289	c19
44	134	68	43	11	287	m35
45	79	132	34	8	286	c35
46	71	115	25	14	286	m41
47	75	107	19	19	284	c41
48	126	87	36	10	283	m25
49	93	113	30	11	282	c25
50	93	90	46	9	281	m43
51	90	90	36	13	280	c43
52	102	89	28	15	280	c37
53	73	115	24	14	276	m37
54	61	123	39	8	276	c40
55	95	97	24	15	275	m40
56	70	101	23	17	273	c13
57	59	95	25	17	264	m13
58	81	92	25	14	259	c11
59	87	103	12	16	258	m11
60	109	104	34	4	256	m39
61	88	107	25	9	253	c39
62	92	82	18	16	252	m17
63	41	93	34	12	245	c17
64	51	107	28	10	243	c36
65	98	83	17	12	234	m36
66	50	85	21	15	231	c24
67	34	78	18	18	224	m24
68	60	116	45	16	221	m30
69	81	86	30	4	213	c30
70	67	77	25	9	211	c32
71	44	103	11	11	206	---*
72	29	94	10	13	196	c34
73	42	91	24	6	194	m34
74	88	75	13	8	192	c20
75	67	80	27	3	188	m20
76	56	97	11	7	187	c13
77	74	87	11	6	182	m16
78	39	95	10	8	178	c 8
79	26	89	10	9	169	m 8
80	42	99	9	5	167	c 5
81	57	84	17	3	166	m 5
82	58	44	17	8	152	m23
83	18	70	18	5	142	c23

*These subjects were omitted

included. As the practice periods had been assigned as a part of the regular work in psychology for the two classes before mentioned, no one in either class could be omitted from the experiment. Furthermore, it seemed desirable to have as many subjects as possible and it was hoped that some of these ten new subjects might be used to fill the places of any of those who might, for one cause or another, be required to drop out. Such proved to be the case and five of these ten were used in the experiment. These ten subjects were, therefore, given the preliminary tests in code writing and addition before the regular practice periods began and were divided between the two groups, four of them being placed in the control group and the other six in the motivated group. Table IV shows the data for these ten members.

TABLE IV

ARRANGEMENT OF TEN ADDITIONAL SUBJECTS ACCORDING TO THEIR COMPOSITE SCORES

Number	Thurstone	English	Code	Add.	Composite	Designation
1	157	131	50	20	423	m28
2	123	142	27	12	328	m33
3	67	117	30	19	311	c33
4	96	93	35	6	291	m19
5	84	157	21	8	288	---*
6	97	85	18	13	243	---*
7	18	91	43	7	223	---*
8	71	79	20	12	220	m32*
9	20	73	22	8	168	---*
10	45	112	6	2	160	---*

*These subjects were omitted

Those subjects by whose designations appear stars were omitted because there were no partners for them. Subject number I in Table IV was matched with subject number 15 in Table III, who had lacked a partner. Subject number 4 in Table IV took the place of subject number 42 in Table III, whose record was dropped from the experiment. Subject number 8 in Table IV took the place of subject number 71 in Table III, whose record was also dropped from the experiment. The composite scores of the subjects number 2 and 3 in Table IV were close enough together to permit them to become partners, as one of them had been put in the control group and the other in the motivated group. This procedure added two pairs of matched subjects to the original forty-one pairs. This investigation is based upon the data secured from these forty-three pairs of subjects.

The subjects composing the control group were arranged in alphabetical order and numbered from 1 to 43. The small letter "c" was placed before the number of each subject in the control group. The subjects of the motivated group were given the corresponding numbers of their partners with the small letter "m" in place of "c".

These symbols, that is the numbers from 1 to 43 preceded by either "c" or "m", will be used throughout the rest of this report to designate the various subjects. Table V lists the forty-three pairs of subjects with their composite scores.

TABLE V

COMPOSITE SCORES OF FORTY-THREE PAIRS
OF SUBJECTS USED IN THIS EXPERIMENT

Subject	Comp. Score	Subject	Comp. Score	Subject	Comp. Score
c 1	360	c 8	178	c15	465
m 1	366	m 8	169	m15	484
c 2	327	c 9	393	c16	187
m 2	329	m 9	392	m16	182
c 3	336	c10	323	c17	245
m 3	330	m10	321	m17	252
c 4	421	c11	259	c18	319
m 4	406	m11	258	m18	320
c 5	167	c12	422	c19	289
m 5	166	m12	425	m19	291
c 6	352	c13	273	c20	192
m 6	346	m13	264	m20	188
c 7	312	c14	298	c21	306
m 7	312	m14	304	m21	305
c22	388	c30	213	c38	359
m22	389	m30	221	m38	355
c23	142	c31	292	c39	253
m23	152	m31	296	m39	256
c24	231	c32	211	c40	276
m24	224	m32	220	m40	275
c25	282	c33	311	c41	284
m25	283	m33	328	m41	286
c26	325	c34	196	c42	400
m26	323	m34	194	m42	394
c27	316	c35	286	c43	280
m27	314	m35	287	m43	281
c28	381	c36	243		
m28	423	m36	234		
c29	431	c37	280		
m29	430	m37	276		

This method of forming the two groups resulted in a very close resemblance between them, in terms of the distributions of composite scores in each group. A comparison of the two groups shows the mean of the control group to be 288.7 and the mean of the motivated group to be 287.3. The standard deviation of the control group is 79.7 and that of the highly motivated group is 79.1. This gave two groups with almost exactly the same index of variability. Calculation shows it to be .276 for the control group and .275 for the experimental group.

Daily Procedure in First Experiment

Daily Procedure with the Control Group.-The experimenter was permitted to use a part of the regular chapel period as the meeting time for the control group. The control group, therefore, met every morning at 10:15. Before the regular practice meetings began, two charts of the seating arrangement of the room were drawn up, one for the control group, and one for the highly motivated group. These charts permitted the checking of attendance while the tests were in progress. The names of the students who were to occupy each seat in the morning group and in the afternoon group were typed on slips of paper and pasted on the arms of the chairs. Thus each chair had two names pasted on its arm, the name of the subject who was to occupy it in the control group each morning and the name of the subject who was to occupy it in the experimental group which met in the afternoon. This procedure enables the subjects to find their places from the very start with a minimum of delay and confusion.

It was the experimenter's practice to distribute code writing and addition material each day before the door was opened and the students allowed to come in. This material was laid face down on the arms of the chairs. At 10:15 the doors of the room were opened and the subjects were permitted to enter and take their places. The subjects then turned over the two practice sheets and wrote their names on them, together with the date. The date was written daily on the blackboard at the front of the room. After the names of the subjects and the date had been written on the practice sheets, they were again turned wrong side up. When all the subjects were ready to begin, the experimenter would caution, "When the clock moves the next time we will begin." He would then watch the clock until it make the click characteristic of electric clocks. At this click he would say, "Go." At the word "go," all would turn their papers over and begin on either the code writing or the addition, depending on the instruction for that particular day. A notice telling the subjects which material to do first each day was kept on the blackboard at the front of the room, along with the date. This was changed each day, so that the code writing, which came first the first day, came second the second day, etc., throughout the whole six weeks of practice. The method for doing the code writing was explained twice to the subjects in both sections - once when the preliminary tests were given, and again at the first practice period of the regular experiment. The subjects were told at the time the preliminary tests were given that, with the addition, they were to add the columns as rapidly as they could and get the right answers,

and nothing more was ever said about it. At the end of five minutes the experimenter would say, "Begin now on the addition," or, "Begin now on the code writing," depending on which material had been used to start with. The subject would stop work only long enough to change from one material to the other, never more than a few seconds. After five more minutes had elapsed, the experimenter would say, "Time up," At the words "time up," the subjects would stop at once, no matter where they happened to be, and turn their papers over as they had been instructed to do. They had been warned beforehand that they were not to cound their scores from day to day, or to try to keep up with what they made in any way. After the papers had been turned over, the experimenter would say, "That's all for today," or, if a questionnaire was to be filled out, give the instructions for so doing. When the subjects were told that that was all for that day, they would immediately rise and leave the room. The practice sheets were always left on the arms of the chairs, collected at once by the experimenter, placed in envelopes, and labeled.

Daily Procedure with the Highly Motivated Group.-The daily procedure for the motivated group was exactly the same as that described for the control group, with a few additions. No attempt was made to keep the subjects of this group from counting their scores immediately after the tests each day. Two large charts were posted each day before the subjects of this group came into the room. These charts showed the position of the group in each material as shown by the average score. In addition to these charts, the scores of all subjects for the previous

day in both materials were typed and posted on the bulletin board each day, with the highest score and the corresponding name first, and the second highest next, on down to the lowest. When they came in to take their tests, the subjects of this group were allowed a few minutes each day to look at their scores for the previous day. The time for meeting for the motivated group was 3:30 in the afternoon.

Procedure Common to Both Groups.-The daily practices were held every school day (five days a week) over a period of six weeks, beginning April 3, 1933, and ending May 12, 1933. This particular time proved to be well chosen in that during the whole practice time of the experiment there was not a single holiday to mar the continuity of the work. The weather, which might have influenced greatly the attendance of the subjects, was very nearly ideal during the whole course of the experiment.

Whenever a questionnaire was to be answered, it was placed on the arm of the chair with the other material. It was customary to have these filled out after the regular tests had been taken. Whenever an absence occurred in the control group, the absentee was required to come in at 3:00 o'clock of the same day, if possible, and take the test he had missed. If the tests were not made up the same day, they were made up as soon as possible by appointment. Whenever an absence occurred in the motivated group, the absentee was required to make up the test he had missed at 10:00 o'clock the following day, or if this were impossible, as early as possible.

The test papers for both groups were scored each day and the

scores were entered on a large chart which was prepared in such a way as to provide a place for each score in each material every day for every subject. The scores of all subjects in both materials, as taken from this chart, are to be found in Appendix B.

A brief daily record of the routine procedure of the experiment was kept by the writer. This record showed the absences during the experiment to be less than two per cent.

The Second Experiment

Procedure.-In the second experiment a control group technique was also used. The subjects were members of eight of the regular classes in the Teachers College of the University of Cincinnati summer session. There were in all one hundred and thirty-two subjects. Only one function, code writing, was studied. The same material was used as that listed in Appendix A, page 102.

The subjects were divided into two groups, one numbering sixty-three and the other sixty-nine. The former served as the control and the latter as the experimental group.

The general procedure with these groups was similar to that described for the control and strongly motivated groups (pages to). However, in this case all the practice was given at one sitting. This practice consisted of six periods of three minutes each with intervening rest periods of two minutes. The practice material was presented to both groups in the form of six sheets stapled together. A sheet was used for each practice.

Procedure with the Control Group.-The group which served as the control group was told enough about the experiment to enable it to intelligently follow directions. The cooperation of the group as a whole was asked in the interest of education and psychology. The members of the group were requested not to try to keep track of their scores in any way, and to turn the test material wrong side up during the period of instruction and the rest periods.

Procedure with the Experimental Group.-The same procedure described above was followed with the experimental group with the following additions and exceptions. The members of this group were allowed to count their scores. It was pointed out to them that the arrangement of the practice material was such as to facilitate the knowledge of progress. After the initial practice, a prize consisting of a rather popular recent book was offered to the person who gained the most during the experiment.

Statistical Treatment of Experimental Results

Choice of Measures of Variability.-Before reasons for choosing certain measures of variability can be adequately stated, some definite statement must be made as to what is meant by variability, as used in connection with this experiment. The term may mean: (1) changes in the output of an individual from one time to another, (2) changes in the average output of a group from one time to another, (3) the amount of scatter or dispersion in the outputs of the individuals of a group, or (4) the ratio of the dispersion of a group to its average performance. It is with definition (4) that this study will be concerned. Probably

the term "variation" is a better one for the first two usages. The term "variability" will be used in this investigation as practically symonymous with "individual differences". By a reduction of variability is meant a becoming more alike on the part of the group. By an increase in variability is meant a becoming more unlike on the part of the group.

There are several measures of variability in the sense of dispersion, such as the semi-interquartile-range, the average deviation, and the standard deviation. It is true that these measures are concerned with the spread or scattering of the distribution, but it is also true that none of them has significance for this experiment when considered apart from a measure of central tendency. Not only is it possible but it often occurs that the standard deviation of a group increases from the initial to the final performance, while the index of variability, or the standard deviation divided by the mean, together with other reliable measures of variability, shows definitely that the variability of the group has actually decreased. Kincaid (35) in 1925 attempted to solve the problem of the influence of practice on individual differences by applying an unusually large number of measures to the data of most of the studies published up to that time. From this large number of measures she selected the following upon which to base her conclusions: The standard deviation in the initial performance as compared with the standard deviation in the final performance, the ratio of the worst to the best in the first performance as compared with the same ratio in the final performance, the gross gain made by the highest 25 per cent as compared with the same made by the lowest 25 per cent, the correlation between initial ability and gross gain, the correlation between initial

ability and per cent of gain, the standard deviation divided by the average in the initial performance, and the same in the final performance.

Two measures employed by Kincaid are probably reliable measures of variability, as the term is used in this present experiment. They are: the index of variability and the correlation between initial ability and per cent of gain. The others are at least questionable as to their reliability.

It seems probable that no judgment can be made on the change in variability of a group by a simple comparison of the standard deviations alone. A standard deviation has meaning only in relation to the average of the group from which it is computed, and states the range from the average within which 68.26 per cent of the cases fall, but it has no meaning in relation to another standard deviation when the averages are disregarded. Its size is dependent on the sizes of the average and of the cases from which it is computed. An increase in the size of the standard deviation, from the beginning to the end of practice, does not necessarily mean that the variability of the group has increased, because the average of the group may have increased relatively more than the standard deviation.

The correlation between initial performance and gross gain is not a reliable measure of the variability of the group from one stage of practice to another. Table VI illustrates this fact. The pupils with high initial scores may make larger absolute gains than the pupils with low initial scores, but their relative gains may be much smaller. If so, there will be a positive correlation between initial

TABLE VI

ARRANGEMENT OF THEORETICAL SCORES TO SHOW THAT GROSS GAINS MAY CONFLICT WITH RELATIVE GAINS

Subject	Initial Score	Final Score	Gross Gain	Relative Gain in Per Cent
A	14	19	5	36
B	10	14	4	40
C	6	9	3	50
D	2	4	2	100

performance and gross gain, and also a positive correlation between initial and final performance, but a negative correlation between initial performance and relative gain. By relative gain is meant gain in relation to initial score, often called per cent of gain. If two individuals are far apart at the beginning of practice, and the high one makes a smaller relative gain than the low one, the two will eventually come together. If their rates of relative gain remain constant, the low one will overtake the high one.

The coming together, through practice, of a group of individuals who are far apart at the beginning means that their variability has been reduced. Negative correlations between initial performance and gross gain or negative correlations between initial performance and relative gain would be indications of reduced variability, but a positive correlation between initial and final performance may mean either an increase or a decrease in variability. However, a positive correlation between initial performance and relative gain would be a reliable indication of an increase in variability. From what has already been said about gross gains, it follows that calculations based upon this measure are not reliable measures of changes in variability from one stage of practice to another. An individual with a high initial score often gains more absolutely during a given period than one with a low initial score, but less relatively.

The ratios of best to worst or of next best to next worst, etc., are not reliable measures of changes in variability from one stage of practice to another. They compare only the extremes of the group; and what is true of the extremes of the group may not be true of the group as a whole. But the most serious error is that it rarely happens that the worst and best or next worst and next best at the beginning of practice continue to occupy the same positions at the end of practice. Consequently the ratio of worst to best at the end of practice usually represents a comparison of different individuals from those at the beginning of practice, and tells nothing about the convergence or divergence of the initially lowest and the initially

highest individuals. If, however, the ratio of the worst to the best at the beginning of practice is calculated and then the ratio for these same individuals at the end of practice is calculated, it will at least show whether these particular individuals have a tendency to converge or diverge during the course of practice. If this is done, it will yield valuable information, for it may very well be that those who are at the extremes of the distribution at the beginning of practice converge or diverge a great deal more during the course of practice than those near the average. Even when used in this way, the ratio of worst to best has the limitation of not measuring the variability of the group as a whole. However, the ratios of worst to best, next worst to next best, etc., at the beginning and the end of practice, when taken regardless of the same individuals, mean very little.

The percentage of gain by the highest 25 per cent of the group as compared with that of the lowest 25 per cent of the group is subject to some of the same criticisms as the ratio of worst to best. Not all the individuals in these groups at the end of practice will be the same as those at the beginning of practice. However, many of the shifts in rank that occur do not change groups or divisions. Hence this measure is far superior to the ratio of worst to best; for in the latter, as has been stated, the same individuals rarely occupy these positions at the beginning and the end of practice. If the percentage of gain by the highest 25 per cent is smaller than that of the lowest 25 per cent, it is almost sure to be an indication of reduced variability, and the opposite, if it is larger. It may,

therefore, be accepted as one measure of change in variability.

An ideal measure of variability would be calculated as follows: First, the ratios of the best to worst, second best to second worst, third best to third worst, and so on, would be calculated until the ratios of all those above and below the average of the first practice had been found. Second, the ratios of the members of each pair at the end of practice would be calculated. Third, the average of all the ratios at the beginning of practice would be calculated. Fourth, the same would be done for the final practice. If the average for the fourth step was lower than the average for the third step, the variability of the group would have been reduced, while, if this ratio was larger, the variability would have been increased. The objection to this method of calculation is that it is too long and tedious. Practically the same result is obtained if the correlation between initial performance and relative gain if found. For example, if the ratio of best to worst is taken at the beginning of practice, and it is found that the ratio for the same individuals at the end of practice has decreased, it means that the worst individual made a larger relative gain than the best. On the other hand, if the ratio has increased, it would mean that the best individual made a larger relative gain than the worst. The same reasoning applies to the ratio of second best to second worst, third best to third worst, etc. In other words, a decrease in the ratios would mean a negative correlation between initial performance and relative gain. Consequently, correlation between initial performance and relative gain is a reliable measure of changes in variability in

the course of practice. The coefficient of variability $\frac{\text{S.D.}}{\text{Average}}$ is also a valid measure because it is an approximation to the ideal measure. This measure is referred to as V_1 in this experiment. Instead of being an average of the ratios of pairs of individuals above and below the mean, it is the ratio of their deviations to the mean. This ratio, however, has a disadvantage in that the numerator of the formula represents only that distance on either side of the mean within which the middle 68.26 per cent of the cases fall. It therefore does not adequately represent the whole group, particularly the lowest and highest sixths. If this reasoning is correct, it follows that Kelley's measure of variability obtained by dividing the difference between the ninetieth and tenth percentiles by the median, $\frac{90\% - 10\%}{\text{median}}$ is a better measure than $\frac{\text{S.D.}}{\text{Average}}$ for the reason that the numerator includes the middle 80 per cent of the cases. This measure is referred to in this report as V_2.

When it is asked whether practice increases or decreases the variability of a group, what is meant is, does practice increase or decrease the ratio of dispersion to central tendency? When it is asked whether practice increases or decreases the variability between the highest and lowest individuals of a group, what is meant is, does practice increase or decrease the ratio of their output? And when it is asked whether practice increases or reduces the variability of certain sections of a group, what is meant is, does practice increase or decrease the ratio of the average output of those sections. In determining changes in variability, ratios are more properly dealt

with than direct scores because of their comparability.

Measures of Variability Used in this Investigation.-From what has been said, it follows that reliable results in changes in variability may be obtained by the use of the following four measures: The ratio of the best to the worst at the beginning of practice compared with the ratio of the same individuals at the end of practice, the coefficient of variability, $\frac{S.D.}{Average}$, or V_1, also $\frac{90\% - 10\%}{median}$, or V_2, and the correlation between initial performance and relative gain.

The following measures have a fair reliability: Correlation between initial performance and gross gain, the percentage of gain in the upper fourth as compared with that in the lower fourth when the individuals in the two sections are kept the same, the ratio of the average of the highest to the lowest fourths, or of the seventh to the first octiles at the beginning of practice compared with the ratio of the same individuals at the end of practice. The following measures have little or no validity as measures of changes in variability during the course of practice: Correlation between initial and final performance; correlation between initial performance and gross gain; ratio of best to worst, next best to next worst, etc., at the beginning of practice compared with the ratios of best to worst, next best to next worst, etc., at the end of practice; gross gains in amount of time per unit of work of the initially high individuals as compared with the initially low individuals; standard deviation and other like measures, when taken apart from their measures of central tendencies.

The measures which have been adopted for use in this experiment are as follows: The index of variability as measured by the formula, $\frac{S.D.}{Average}$, and the formula, $\frac{90\% - 10\%}{median}$; the ratio of the average of the initially three lowest to the initially three highest at the beginning of practice as compared with the ratio of the averages of the same individuals at the end of practice; and the correlation between initial ability and relative gain. Other measures will be used, but those given above are the ones upon which the conclusions reached in this study are chiefly based.*

*The arguments and conclusions presented in this section are largely taken from Reed (55:19-28). The wording is not identical; hence quotation marks are not used, but the writer makes full acknowledgment to him for having borrowed them. Some of the conclusions are similar to those reached by Peterson and Barlow (50).

CHAPTER IV

RESULTS

Organization of Data

Arrangement of Findings.- This chapter is divided into three sections. The first section deals with the effect of practice upon changes in variability, in the first experiment. In this section tables and calculations are presented to show the effect of practice on variability in four different instances in the following order: The control group in the function code writing, the control group in the function addition, the strongly motivated group in code writing, and the strongly motivated group in addition. Data are next presented to show the daily fluctuations in variability for both the control and experimental groups in both functions.

The second section is concerned with the effect of motivation on changes in variability, also in the first experiment. In this section of the chapter many of the tables already presented in the first section are referred to in presenting the further data which show the effect of motivation, first on achievement, in the case of both functions, and then on variability. Data are first presented and comparisons made which point out the effects of variance in motivation on the function code writing. The same thing is then done for addition. Data from a recalculation comparing the sixth and twenty-first practices instead of the initial and final ones are next presented in order to show more clearly how the additional motivation

of the experimental group affected variability. Next the data showing the day by day fluctuations in variability for both groups in both functions are referred to and re-stated to show how the additional motivation of the experimental group affected the day by day changes in variability.

The third section deals with the second experiment and is concerned with the effect of massing the practice time. In this section are presented tables and figures dealing with this phase of the investigation.

Effect of Practice on Changes in Variability

The Control Group in Code Writing.- In Table VII data are presented for the individual members of the control group in code writing.

TABLE VII

INDIVIDUAL SCORES AND GAINS FOR THE CONTROL GROUP IN CODE WRITING FOR INITIAL AND FINAL PRACTICES

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
c24	91	180	89	98
c35	87	265	178	205
c28	83	233	150	181
c29	77	281	204	265
c 6	70	207	137	196
c 2	68	140	72	106
c25	65	235	170	262
c40	65	303	238	366
c 9	59	243	184	312
c22	58	287	229	395
c39	57	221	164	288
c 4	56	195	139	248
c19	54	287	233	431
c 3	53	110	57	108
c10	53	200	147	277
c27	52	204	152	292

TABLE VII (Continued)

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
c14	50	228	178	356
c13	48	247	199	416
c15	48	183	135	281
c34	48	226	178	371
c12	47	177	130	277
c42	47	213	156	353
c43	47	207	160	340
c33	45	246	201	447
c32	41	193	152	371
c38	41	169	128	312
c11	35	184	149	426
c37	35	185	150	429
c41	34	239	205	603
c 8	33	204	171	518
c31	33	224	191	579
c16	32	185	153	475
c18	31	246	215	694
c36	30	203	173	577
c17	28	203	175	625
c21	28	252	224	800
c23	27	83	56	207
c 5	23	201	178	774
c 7	21	220	199	948
c20	17	140	123	724
c26	16	147	131	819
c30	14	306	292	2086
c 1	11	249	328	2164

Computation, based upon the data presented in Table VII, shows that the standard deviation increased from 19.44, for the initial practice, to 46.5 for the final practice. However, owing to the fact that the average of the group increased in a much greater ratio, from 45.5 for the initial to 212.8 for the final practice, the variability of the group actually was reduced by practice. The formula $\frac{S.D}{Average}$, or V_1, shows this decfease to be from .42 to .21, while the formula $\frac{90\% - 10\%}{median,}$ or V_2, shows that the reduction was from 1.10 to .66.

The ratio of the average of the three initially lowest scores to the average of the three initially highest scores is 5.68. The corresponding ratio of the averages of these same groups of subjects for the final practice is .87, a reduction of 4.81. These ratios indicate that, for the extremes of the group, the effect of practice was to decrease markedly individual differences.

The correlation between initial scores and per cent of gain was found to be -.69, P.E. .054. Between initial score and gross gain there was a correlation of -.23, P.E. .048. Initial and final scores, however, gave a correlation of .22, P.E. .098. The Pearson product moment method was used in calculating all correlations in this experiment.

The negative correlation between initial score and per cent of gain shows that the variability of the group has been reduced as explained in Chapter III, page 49. This would have held true even if the correlation between initial score and gross gain had been positive instead of negative as it was. In this case, however, the two measures were in agreement.

All these measures of variability - V_1, V_2, the ratio of the average of the three highest to the average of the three lowest of the initial performance compared with the ratios of the averages of the same groups of subjects for the final performance, the correlation of initial scores and per cent of gain - are in agreement in showing that the variability of the group has been reduced. It may safely be said that the control group became more alike in code writing through practice.

The Control Group in Addition.- Data from the control group in the function addition are presented in Table VIII.

TABLE VIII

INDIVIDUAL SCORES AND GAINS FOR THE CONTROL GROUP IN ADDITION FOR INITIAL AND FINAL PRACTICES

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
c18	23	36	13	57
c33	23	36	13	57
c38	23	35	12	52
c 4	20	30	10	50
c22	19	33	14	74
c14	18	29	11	61
c 1	17	35	18	106
c12	17	26	9	53
c15	17	31	14	82
c 3	16	19	3	18
c26	16	26	10	63
c31	16	26	10	63
c34	16	25	9	56
c37	15	20	55	33
c42	15	21	6	40
c 9	14	17	3	21
c28	14	27	13	93
c 2	13	12	-1	-7
c29	13	28	15	115
c36	13	25	12	92
c19	12	16	4	33
c40	12	27	15	125
c10	11	18	7	64
c11	11	19	8	73
c24	11	21	10	91
c 6	10	19	9	90
c 7	10	17	7	70
c17	10	27	17	170
c21	10	27	19	190
c41	10	17	7	70
c25	9	20	11	122
c27	9	23	14	156
c35	8	25	17	213
c 8	7	18	11	157
c16	7	19	12	171
c20	7	13	6	86
c43	7	17	10	141
c13	6	27	21	350

TABLE VIII (Continued)

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
c32	6	10	4	67
c23	4	6	2	50
c39	4	10	6	150
c 5	3	15	12	400
c30	3	12	9	300

From the data shown in Table VIII it was found that what had occurred in the case of the code writing had also occurred with the addition: e.g., that though the standard deviation of the group in addition had increased from 5.27 for the initial practice to 7.14 for the final practice, the corresponding averages of the group had increased from 12.2 to 22.4.

The variability of the group, using the formula for V_1, became reduced from .43 to .32. The formula for V_2 showed a reduction in variability from 1.10 to .97, a two point greater reduction than V_1 had shown.

The ratio of the average of the three initially lowest scores to the average of the three initially highest scores (including, in both cases, ties for these positions where they occurred) is 5.02. The ratio of the averages of the scores of these same groups of individuals for the final practice is 2.53, a difference in favor of reduced variability of 2.49.

There was found to be a correlation of -.61, P.E., .065 between initial scores and relative gain. The correlation between initial score and gross gain was found to be .10, P.E. .092, while

the correlation between initial and final score was found to be .79, P.E. .038.

As has been pointed out, the correlations between initial standing and gross gain, initial and final standing, when positive, are not reliable measures of changes in variability. It therefore is practically certain that, as both formulae for the index of variability, i.e., V_1 and V_2, the ratio of the average of the three lowest to the average of the three highest, and the negative correlation between initial score and per cent of gain, all show that variability became reduced through practice, such was actually the case. This means that the control group in addition became more alike with practice.

The Experimental Group in Code Writing.- The data presented in Table IX are from the group in code writing which worked under special motivation. The concern here is not with the motivation, which will be treated in the second section of this chapter, but with the effect of practice on variability.

TABLE IX

INDIVIDUAL SCORES AND GAINS FOR THE MOTIVATED GROUP IN CODE WRITING FOR INITIAL AND FINAL PRACTICE

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per Cent
m29	86	382	295	344
m15	83	325	242	292
m22	77	289	212	275
m14	65	195	130	200

TABLE IX (Continued)

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
m 1	65	229	164	344
m 4	64	242	178	263
m28	62	180	118	190
m26	56	248	192	343
m38	54	233	179	331
m 9	51	260	209	410
m27	50	217	167	334
m10	49	353	304	620
m25	49	196	147	300
m12	46	265	219	476
m30	45	151	106	236
m 6	45	339	294	653
m39	43	223	180	419
m11	43	252	209	486
m35	41	174	133	324
m 2	39	189	150	385
m41	38	205	167	439
m19	37	282	245	662
m33	37	235	198	535
m37	36	183	147	408
m18	36	295	259	719
m31	33	224	191	579
m17	32	251	219	684
m 5	32	175	143	447
m43	30	184	154	513
m21	29	243	214	738
m23	29	139	110	379
m36	28	121	93	332
m40	28	136	108	386
m 7	24	168	144	600
m20	24	127	103	429
m42	23	289	266	1157
m32	22	269	247	1214
m 8	22	187	165	750
m13	22	165	143	650
m24	19	233	224	1179
m34	17	127	110	647
m 3	14	152	138	986
m16	4	147	143	3575

The standard deviation of the motivated group in code writing increased from 17.92 for the initial practice to 61 for the final one.

The average score for these same practices increased from 40.2 to 220.4. The formula for V_1 showed a reduction in variability during practice from .44 to .27. The formula for V_2, when applied to the same data, showed a reduction from 1.22 to .72.

The ratio of the average of the three initially lowest scores to the average of the three initially highest scores is 7.07. The ratio of the averages of the scores of these same groups of subjects at the end of practice is 2.34.

The correlation between initial score and per cent of gain was found to be -.58, P.E. .068. The correlation between initial score and gross gain was found to be .29, P.E. .094, while the correlation between initial and final scores was .57, P.E. .079.

The measures applied to the motivated group in code writing are the same as those used with the control group in both functions. These measures are all in agreement in showing that the effect of practice on the motivated group in code writing is to decrease variability, or make the group more alike.

The Experimental Group in Addition.- In Table X data are presented from the motivated group in addition.

TABLE X

INDIVIDUAL SCORES AND GAINS FOR THE MOTIVATED GROUP IN ADDITION FOR INITIAL AND FINAL PRACTICES

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
m 1	23	43	20	87
m21	19	31	12	63
m42	19	31	12	63

TABLE X (Continued)

Subjects	Scores		Gains	
	Initial practice	Final practice	Gross	Per cent
m 9	18	35	17	94
m28	17	39	22	129
m24	17	27	10	59
m26	17	26	9	53
m30	16	31	15	94
m29	16	22	6	38
m 8	16	22	6	38
m 4	15	28	13	87
m17	14	35	21	150
m32	14	33	19	136
m11	14	30	16	115
m22	13	35	22	169
m36	13	21	8	62
m33	13	25	12	92
m10	13	26	13	100
m41	13	21	8	62
m14	13	19	6	46
m31	12	20	8	67
m37	12	21	9	75
m13	12	25	13	108
m 7	11	17	6	55
m27	11	25	14	127
m15	11	34	23	209
m35	11	27	16	145
m12	10	23	13	130
m 3	10	16	6	60
m43	9	17	8	89
m40	9	20	11	122
m19	8	24	16	200
m18	8	29	21	263
m39	7	17	10	143
m16	7	17	10	143
m38	7	23	16	229
m20	6	14	8	133
m 2	5	16	11	220
m25	5	13	8	160
m 6	4	16	12	300
m23	4	13	9	225
m34	3	13	10	333
m 5	1	8	7	700

Calculations based upon Table X show that, though the average of the group increased during the practice from 11.5 at the start to 23.9 for the final trial, and the standard deviation increased from 4.81 for the first trial to 7.6 for the last one, the index of variability, or V_1 showed that the variability of the group became reduced from .42 to .31. The formula for V_2 showed a decrease from 1.02 to .88 of the group during practice.

The ratio of the average of the three initially lowest to the average of the three initially highest at the beginning of practice was 6.58. The ratio of these same groups of subjects at the end of practice was 2.80.

The correlation of initial score and per cent of gain was found to be -.65, P.E. .061. The correlation between initial score and gross gain was .32, P.E. .090, and the correlation between initial and final scores was .79, P. E. .028.

All the data presented thus far are in agreement that the effect of practice is to reduce individual differences. This holds true in this experiment regardless of which of the four measures - V_1, V_2, ratio of highest to lowest at beginning and end of practice, correlation of initial score and per cent of gain - is used. It also holds true with both groups studied in both functions studied.

In the second section of this chapter the day by day fluctuations in variability (V_1) are shown. These data are presented graphically in Figure 3. Reference to them will show that except for the fourth and fifth days' practice of the control group in

addition, the variability at no time, regardless of group or function studied, ever reached the initial point.

Effect of Motivation on Changes in Variability

Attention has been called earlier to the differences between the conditions of motivation under which the control and motivated groups worked. This highly motivated or experimental group was given special stimulation as described in Chapter III, pages to .

It is the purpose of this section of the chapter to show first that the special motivation given the experimental group produced a differential effect upon achievement. Its next object is to show what the effect of this motivation was upon changes in variability.

Effect of Motivation on Achievement.- Figures 1 and 2 are graphic records of the progress made from day to day in achievement, as measured in terms of the daily average of the group, by both groups in code writing and in addition. These records show that, although the motivated group made a lower average score in both cases to start with, the average score of that group in code writing caught up with and exceeded that of the control group for the sixth practice. The same thing occurred in addition for the ninth practice. From the sixth practice in code writing, the motivated group maintained its lead through the thirtieth meeting. From the ninth practice in addition, the motivated group held its lead through the thirtieth practice, in spite of the irregularity in the progress of both groups.

In interpreting Figures 1 and 2, it should be remembered that what is shown is not the difference in daily progress between a motivated

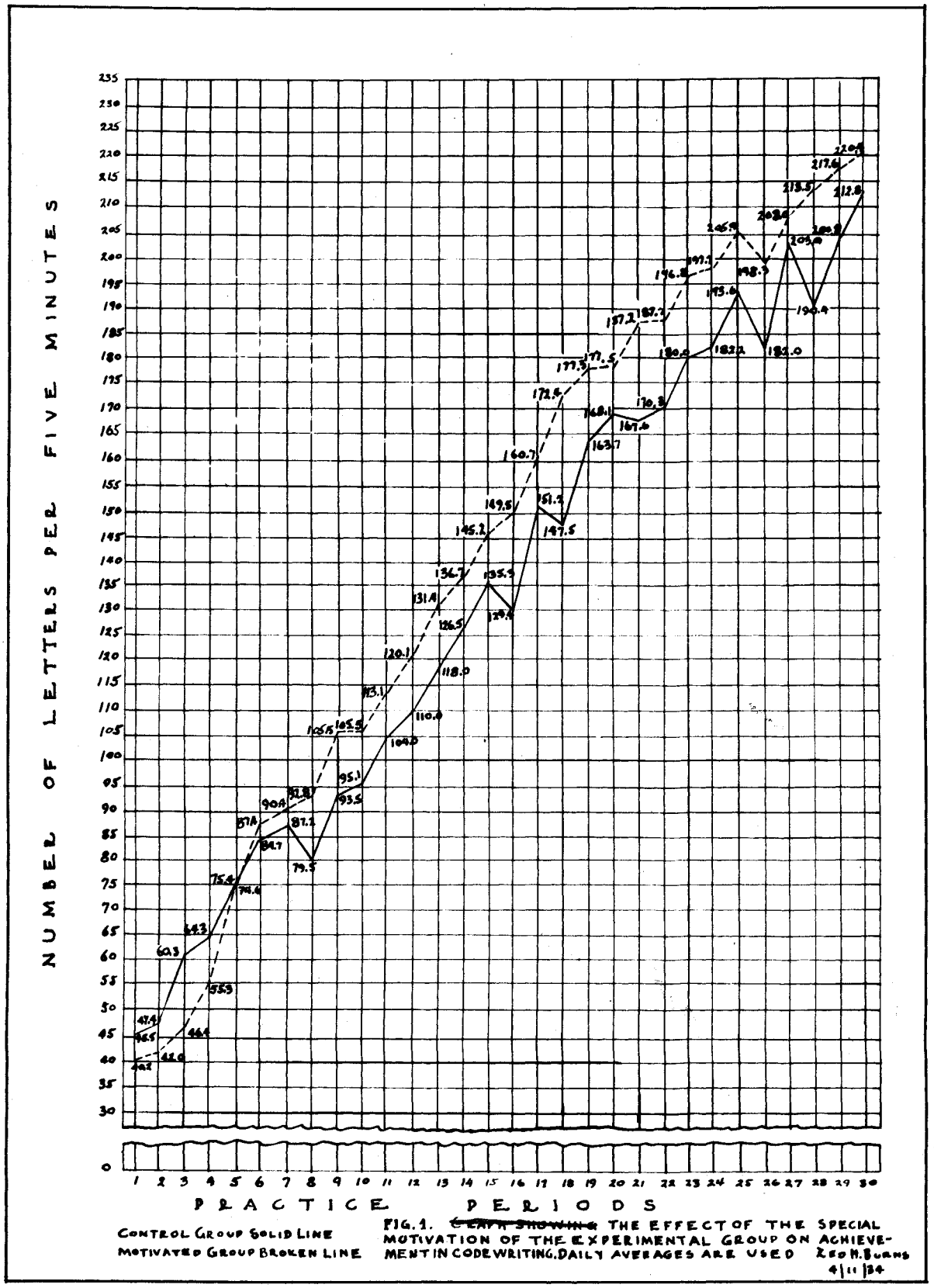


FIG. 1. ~~CLEAR SHOWING~~ THE EFFECT OF THE SPECIAL MOTIVATION OF THE EXPERIMENTAL GROUP ON ACHIEVEMENT IN CODEWRITING. DAILY AVERAGES ARE USED

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4/11/34

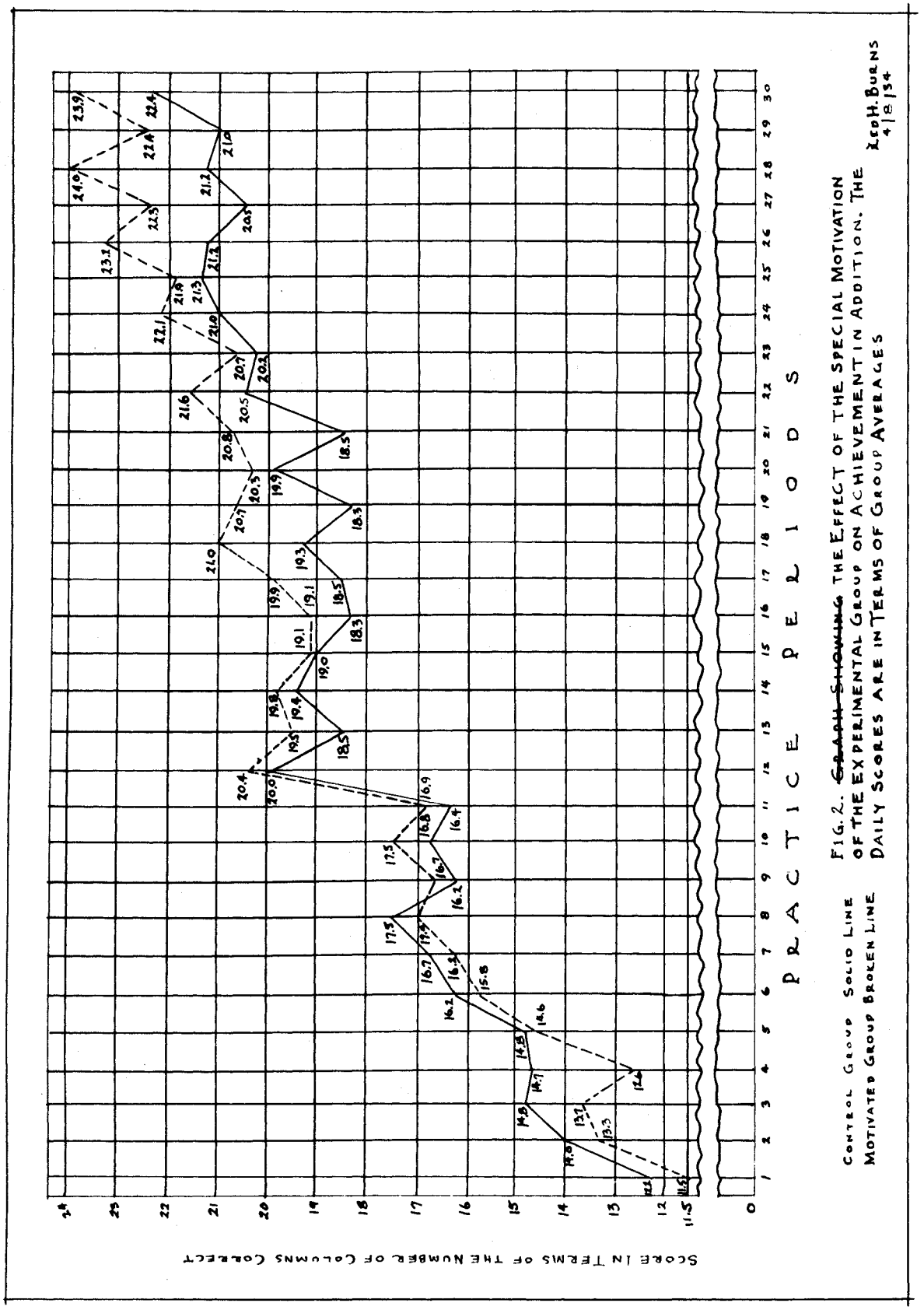

FIG. 2. ~~GRAPH SHOWING~~ THE EFFECT OF THE SPECIAL MOTIVATION OF THE EXPERIMENTAL GROUP ON ACHIEVEMENT IN ADDITION. THE DAILY SCORES ARE IN TERMS OF GROUP AVERAGES

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group and a non-motivated group, but the difference in progress between a control group rather well motivated and an unusually well motivated group. All subjects of both groups had credit to gain in psychology by complying with the conditions of the experiment; the main one of these conditions was to try to improve their scores as much as possible each day. This was a strong motivating factor. In addition to this the experimental group was motivated by a knowledge of results and competition. What is shown in Figures 1 and 2, therefore, is a graphic representation of the effect of a strong motivation as compared with normal motivation in code writing and addition, in terms of the daily averages of the groups.

The Effect of Motivation on Changes in Variability in the Case of Code Writing.- Reference to the data presented in the first section of this chapter will show that certain differences occurred in variability between the control and motivated groups in code writing. As these groups had been carefully equated, and all conditions controlled during the experiment to a very high degree, it seems quite legitimate to attribute this difference in change in variability to the difference in conditions of motivation under which the two groups worked.

These differences are as follows: The measure V_1 showed that the variability of the control group was reduced from .42 to .21 through practice - a change of .21 in variability. The formula for V_2 showed this change to be from 1.10 to .66 - a difference of .44. The ratio of the three highest to the three lowest was 5.68 for the

initial practice and the ratio for the final practice of the same individuals was .87 - a change of 4.81. The correlation between initial score and per cent of gain was found to be -.69.

The corresponding changes in variability for the highly motivated group are as follows: For V_1 a change from .44 to .27, or a difference of .17; for V_2 a change from 1.22 to .72 - a difference of .50; for the ratio of the three highest to the three lowest a change from 7.07 to 2.34, or a difference of 4.73. Initial score correlated with per cent of gain -.58.

These data are presented in Table XI in a compact form so that comparisons may be readily made.

TABLE XI

SUMMARY OF DIFFERENCES IN CHANGES IN VARIABILITY FOR THE CONTROL AND MOTIVATED GROUPS IN CODE WRITING

Measure	Group	Practice		Amount of Change		Greater Decrease
		Initial	Final	Increase	Decrease	
V_1	Control	.42	.21		.21	Control
	Motivated	.44	.27		.17	
V_2	Control	1.10	.66		.44	
	Motivated	1.22	.72		.50	Motivated
Av.3 high / Av.3 low	Control	5.68	.87		4.81	Control
	Motivated	7.07	2.34		4.73	
Correlation of initial score and per cent of gain		Control group		-.69		
		Motivated group		-.58		

It would be difficult, if not impossible, to draw a definite conclusion from Table XI concerning the effect of motivation on changes in variability in code writing. The three measures which are in

agreement indicate that the effect of the motivation was to prevent the variability from being decreased in the motivated group to the same extent that it was in the control group.

Reference to Figure I will show that in code writing the motivated group crosses over the control group in achievement on the sixth day of practice and maintains its lead from there on. Further examination of the same graph will show that at the twenty-first practice the control and motivated groups in code writing were further apart than at any other point during the whole thirty practice periods.

It seemed reasonable to suppose that, provided the effect of motivation upon variability was to cause it not to decrease as much as it normally would in the control group, measures applied at these two new points (the sixth and twenty-first practices) would show this tendency clearly.

Accordingly complete recalculation of the data on dode writing was made at these new points in practice rather than at the initial and final points of practice. Table XII contains these new data.

Calculation based upon the data presented in Table XII shows that the average for the sixth practice was 84.7 and that it increased to 167.6 for the twenty-first practice. The standard deviation also increased over the same period from 22.7 to 33.7. The formula for V_1 showed that the variability decreased from .27 to .20. The formula for V_2 showed a decrease from .70 to .49.

The ratio of the average of the three lowest for the sixth practice to the average of the three highest for the same practice was 3.17, while the ratio of the averages of the same individuals for the twenty-first practice was 1.10.

TABLE XII

INDIVIDUAL SCORES AND GAINS FOR THE CONTROL GROUP IN CODE WRITING FOR THE SIXTH AND TWENTY-FIRST PRACTICES

Subjects	Scores		Gains	
	Sixth practice	Twenty-first practice	Gross	Per cent
c 9	138	188	50	36
c25	120	204	84	70
c28	120	221	101	83
c29	119	257	138	116
c35	114	197	83	73
c41	111	187	76	68
c21	110	188	78	71
c40	110	200	90	82
c24	108	184	76	70
c 6	101	181	80	79
c 4	99	150	51	52
c33	96	194	98	102
c14	92	178	86	93
c27	92	177	85	92
c19	91	191	100	109
c11	90	180	90	100
c22	88	212	124	141
c12	87	150	63	72
c13	86	185	99	115
c32	85	151	66	78
c42	85	131	46	54
c 7	84	151	67	80
c10	84	172	88	105
c17	84	175	91	108
c37	83	135	52	63
c36	82	157	75	91
c30	81	215	134	165
c38	80	158	78	98
c 2	78	123	45	58
c 3	76	110	34	45
c26	75	89	14	19
c 8	74	166	92	124
c43	74	123	49	66
c31	73	156	83	114
c 1	69	155	68	125
c23	59	85	26	44
c34	59	152	93	158
c16	57	168	111	195
c20	56	99	43	77
c 5	52	154	102	196
c18	43	200	157	365
c15	40	158	118	295
c39	36	199	163	453

The correlation between scores for the sixth practice and per cent of gain was found to be -.62, P.E. .063.

Table XIII gives the results for the motivated group in code writing from the sixth to the twenty-first practice.

Computation based upon the data presented in Table XIII shows that the standard deviation, which was 28.6 for the sixth practice, increased to 54.4 for the twenty-first practice. The V_1 calculated for these two points was found to have changed from .33 to .29. The formula for V_2 shows an increase from .79 for the sixth practice to .86 for the twenty-first practice.

The ratio of the average of the three lowest for the sixth practice to the average of the three highest for the same practice was 3.86, while the ratio of the averages of the same individuals for the twenty-first practice was 2.05.

The correlation between scores for the sixth practice and per cent of gain up to the twenty-first practice was found to be -.44, P.E. .083.

Table XIV presents the results in compact form for the code writing from the sixth to the twenty-first practice.

Table XIV shows definitely that, in the case of the code writing, the effect of motivation was to prevent the variability from decreasing to the same extent as it did in the control group.

In this instance all four of the measures are in agreement and the effect found here is the same as that indicated by Table X. It may safely be said that the effect of special motivation on

TABLE XIII

INDIVIDUAL SCORES AND GAINS FOR THE MOTIVATED GROUP IN CODE WRITING FOR THE SIXTH AND TWENTY-FIRST PRACTICES

Subjects	Sixth practice	Twenty-first practice	Gross	Per cent
m29	158	336	178	113
m10	156	270	114	73
m15	153	272	119	78
m22	135	277	142	105
m19	124	244	120	97
m 9	124	221	97	78
m12	116	249	133	115
m 4	106	214	108	102
m 1	104	195	91	88
m33	101	211	110	109
m35	100	167	67	67
m31	98	205	107	109
m26	98	194	96	98
m 5	97	177	80	82
m 6	95	273	178	187
m14	95	182	87	92
m18	95	235	140	147
m32	89	210	121	136
m41	89	156	67	75
m28	88	188	100	114
m 2	86	170	84	95
m39	84	160	76	90
m21	83	187	104	125
m38	82	192	110	134
m37	81	150	69	85
m11	79	232	153	194
m42	79	222	143	181
m30	78	132	54	69
m27	74	208	134	181
m24	74	183	109	147
m25	69	173	104	151
m23	67	137	70	104
m 7	64	146	82	128
m20	64	114	50	78
m40	62	96	34	55
m13	62	102	40	65
m17	61	207	146	239
m16	58	125	67	116
m 3	56	102	46	82
m36	52	110	58	112
m34	51	103	52	102
m 8	47	183	136	290
m43	23	142	121	526

TABLE XIV

SUMMARY OF DIFFERENCES IN CHANGES IN VARIABILITY FOR THE CONTROL AND MOTIVATED GROUPS IN CODE WRITING FROM THE SIXTH TO THE TWENTY-FIRST PRACTICE

Measure	Group	Practice		Amount of change		Greater decrease
		Sixth	Twenty-first	Increase	Decrease	
V_1	Control	.27	.20		.07	Control
	Motivated	.33	.29		.04	
V_2	Control	.70	.49		.21	Control
	Motivated	.79	.86	.07		
Av.3 high	Control	3.17	1.10		2.07	Control
Av.3 low	Motivated	3.86	2.05		1.81	
Correlation of sixth score and per cent of gain		Control group -.62 Motivated group -.44				Control

variability in the case of code writing is to cause it to increase or, if a reduction takes place to prevent that reduction from being as great as it would normally be without the special motivation.

Effect of Motivation on Changes in Variability in the Case of Addition.-Reference again to data presented in the first section of this chapter will show that certain differences also occurred in variability between the control and motivated groups in addition. The conditions surrounding the two groups in code writing, referred to on page , were the same for the two groups in addition.

These differences in variability between the two groups are as follows: The measure V_1 showed that the variability of the control

group became reduced from .43 to .32. The corresponding change in the motivated group was from .42 to .31; that is, both groups showed a reduction of .11. The formula for V_2 showed that the variability became reduced from 1.10 to .97 for the control group and from 1.02 to .88 for the motivated group, or a difference in reduction of .01 in the direction of less decrease in variability for the motivated group. The ratio of the average of the three initially highest to the average of the three initially lowest for the control group was 5.02. The ratio of the averages of the same groups of individuals at the end of practice was 2.53, a reduction of 2.49. The corresponding ratios for the strongly motivated group was 6.58 to 2.80, a reduction of 3.78, which was 1.29 greater than the control group. The correlation between initial score and per cent of gain for the control group was found to be -.61, P.E. .065, while the corresponding correlation for the motivated group was -.65, P.E. .061. This showed a difference of .04 in favor of reduced variability for the motivated group.

Table XV presents these facts in compact form and indicates that the effect of motivation on addition was to cause the variability to become further decreased than was the case with the control group. It is to be noted, however, that in spite of the fact that three of the measures of variability are in agreement, the differences in some cases are very small. It would probably be more accurate to say that the effect of motivation, as used in this experiment, upon changes in variability is negligible, than to say, on the basis of Table XV, that it serves further to decrease variability.

TABLE XV
SUMMARY OF DIFFERENCES IN CHANGES IN VARIABILITY FOR THE CONTROL AND MOTIVATED GROUPS IN ADDITION

Measure	Group	Practice		Amount of change		Greater decrease
		Initial	Final	Increase	Decrease	
V 1	Control	.43	.32		.11	Equal
	Motivated	.42	.31		.11	change
V 2	Control	1.10	.97		.13	
	Motivated	1.02	.88		.14	Motivated
Av.3 high	Control	5.02	2.53		2.49	
Av.3 low	Motivated	6.58	2.80		3.78	Motivated
Correlation of initial score and per cent of gain			Control group -.61			
			Motivated group -.65			Motivated

Since the results for the effect of motivation on variability for addition contradict, to some extent, those for code writing, it was believed that the only solution to the problem was to calculate the variability for every day using the formula $\frac{S.D.}{Average}$ for V_1. This measure was chosen as it has been used by more investigators in the past than any other, and has thus become a sort of standard measure.

Daily Fluctuations in Variability Showing the Effect of Motivation on Code Writing and Addition.-The calculation of V_1 for every day gave a complete picture of what occurred during the whole experiment with both groups in both functions in terms of the index of variability. Tables XVI and XVII contain all the data of this calculation.

TABLE XVI

DAILY AVERAGES, STANDARD DEVIATIONS, AND COEFFICIENTS OF VARIABILITY FOR THE CONTROL AND MOTIVATED GROUPS IN CODE WRITING

C O N T R O L G R O U P

Practice	Average	Sigma	V_1
1	45.5	19.1	.424
2	47.4	14.8	.314
3	60.3	18.4	.301
4	64.3	18.8	.292
5	75.4	23.6	.312
6	84.7	22.7	.268
7	87.2	21.5	.247
8	79.5	21.3	.268
9	93.5	21.5	.230
10	95.1	24.1	.253
11	104.0	25.5	.245
12	110.0	24.7	.224
13	118.0	29.2	.248
14	126.5	31.8	.250
15	135.3	31.4	.233
16	129.4	30.6	.236
17	151.2	31.7	.210
18	147.5	32.6	.220
19	163.7	32.1	.196
20	168.1	36.6	.218
21	167.6	33.2	.198
22	170.3	37.1	.218
23	180.0	39.3	.218
24	182.2	37.9	.209
25	193.6	40.7	.210
26	182.0	40.3	.220
27	203.0	43.6	.214
28	190.4	42.2	.220
29	204.8	38.6	.188
30	212.8	46.4	.200

M O T I V A T E D G R O U P

Practice	Average	Sigma	V_1
1	40.2	17.0	.423
2	42.0	16.2	.386
3	46.4	16.4	.353
4	55.3	20.3	.371
5	74.6	28.2	.378

TABLE XVI (Continued)

M O T I V A T E D G R O U P			
Practice	Average	Sigma	V_1
6	87.4	28.6	.327
7	90.4	32.7	.362
8	92.8	34.3	.369
9	105.5	36.5	.346
10	105.5	42.1	.399
11	113.1	45.7	.404
12	120.1	46.0	.383
13	131.4	44.1	.336
14	136.7	51.0	.373
15	145.2	53.1	.366
16	149.5	54.6	.365
17	160.7	52.8	.329
18	172.4	55.9	.325
19	177.3	57.7	.325
20	177.5	56.0	.315
21	187.2	54.4	.290
22	187.7	59.9	.320
23	196.8	56.0	.284
24	197.7	56.8	.288
25	205.9	60.6	.294
26	198.3	58.0	.292
27	208.0	64.7	.310
28	213.5	55.7	.260
29	217.6	60.4	.277
30	220.4	64.2	.290

TABLE XVII

DAILY AVERAGES, STANDARD DEVIATIONS, AND COEFFICIENTS OF VARIABILITY FOR THE CONTROL AND MOTIVATED GROUPS IN ADDITION

C O N T R O L G R O U P			
Practice	Average	Sigma	V_1
1	12.2	5.27	.431
2	14.0	5.56	.397
3	14.9	5.79	.389
4	14.7	6.76	.460
5	14.8	6.86	.464
6	16.2	6.04	.372
7	16.7	6.16	.369
8	17.5	6.14	.350

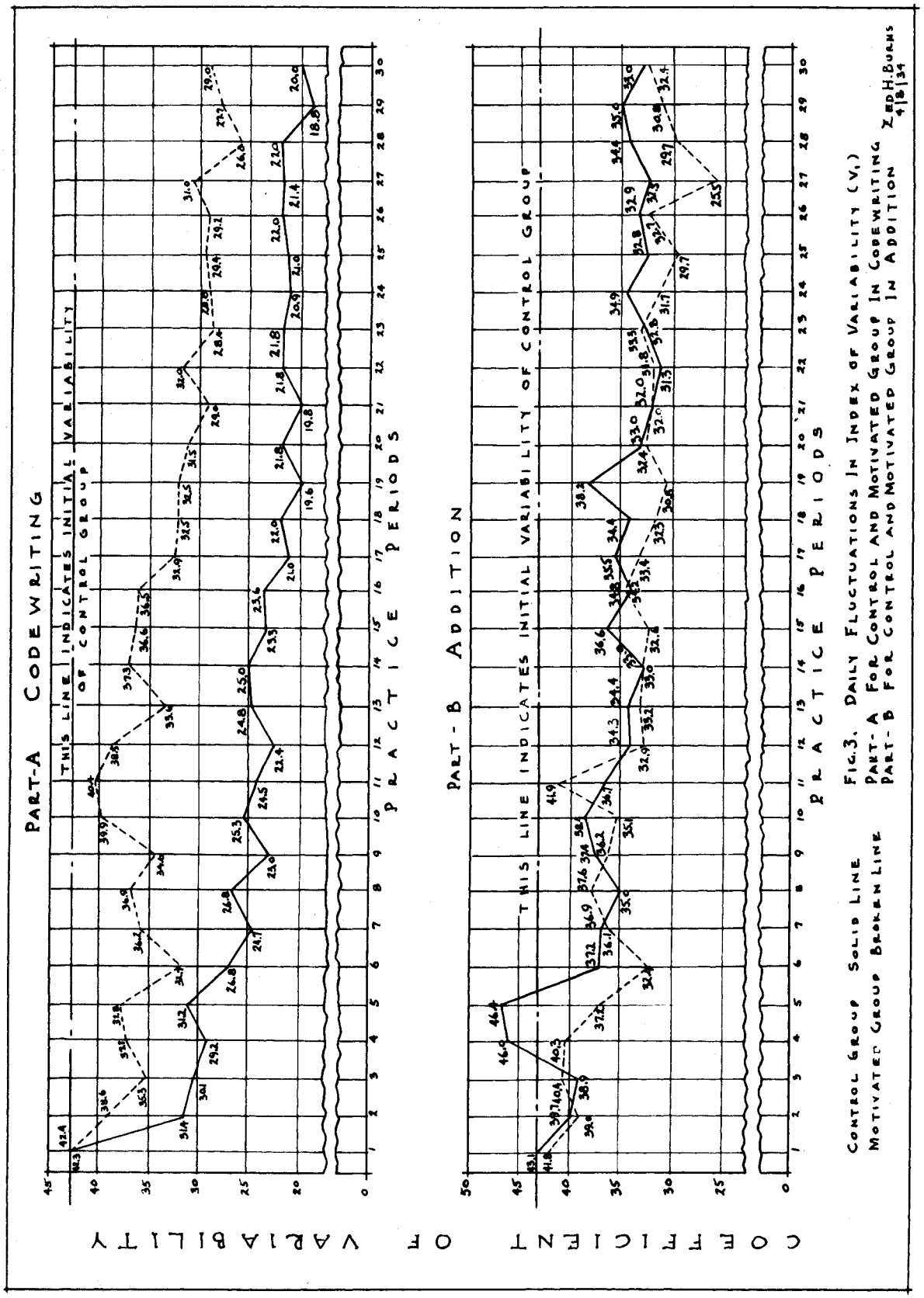
TABLE XVII (Continued)

C O N T R O L G R O U P			
Practice	Average	Sigma	V_1
9	16.2	6.05	.374
10	16.8	6.47	.384
11	16.4	6.02	.367
12	20.0	6.87	.343
13	18.5	6.37	.344
14	19.4	6.32	.330
15	19.0	6.97	.366
16	18.3	6.27	.342
17	18.5	6.57	.355
18	19.3	6.65	.344
19	18.3	7.05	.382
20	19.9	6.58	.330
21	18.5	5.93	.320
22	20.5	6.42	.313
23	20.2	6.64	.328
24	21.0	7.32	.349
25	21.3	6.98	.328
26	21.2	6.98	.329
27	20.5	6.66	.325
28	21.2	7.25	.344
29	21.0	7.37	.350
30	22.4	7.41	.330
M O T I V A T E D G R O U P			
Practice	Average	Sigma	V_1
1	11.5	4.81	.418
2	13.3	5.19	.490
3	13.7	5.54	.404
4	12.6	5.08	.403
5	14.6	5.43	.372
6	15.8	5.12	.324
7	16.2	5.86	.361
8	17.0	6.38	.376
9	16.7	6.04	.362
10	17.5	6.15	.351
11	16.9	7.12	.419
12	20.4	6.72	.329
13	19.5	6.48	.332
14	19.8	6.53	.330
15	19.1	6.23	.326
16	19.1	6.65	.348
17	19.9	6.66	.334
18	21.0	6.80	.323
19	20.7	6.38	.308
20	20.3	6.58	.324

TABLE XVII (Continued)

M O T I V A T E D G R O U P			
Practice	Average	Sigma	V_1
21	20.8	6.64	.320
22	21.6	6.87	.318
23	20.7	6.92	.333
24	22.1	7.02	.317
25	21.9	6.50	.297
26	23.2	7.60	.327
27	22.3	5.69	.255
28	24.0	7.13	.297
29	22.4	6.92	.308
30	23.9	7.74	.324

Figure 3 presents a graph of the daily fluctuations in the index of variability (V_1) for the control and motivated groups in code writing and addition. Part "A" of this figure shows the index of variability as calculated for each day for the code writing. Part "B" shows the same thing for the addition. This graph shows clearly that in the case of the code writing the variability of the motivated group did not decrease nearly so much as was the case with the control group. This picture of what happened agrees with the result obtained from a comparison of the initial and final, as well as the sixth and twenty-first practices. In the case of the addition, a comparison of the initial and final practices had led to the belief that the effect of the motivation was to cause the variability to decrease to a greater extent than was the case with the control group. This is borne out by the graph in part "B" of Figure 3. An examination of the graph of the two groups in addition will reveal the fact that out of thirty practice periods there are twenty times when the variability



CONTROL GROUP SOLID LINE
MOTIVATED GROUP BROKEN LINE

FIG.3. DAILY FLUCTUATIONS IN INDEX OF VARIABILITY (V,)
PART-A FOR CONTROL AND MOTIVATED GROUP IN CODEWRITING
PART-B FOR CONTROL AND MOTIVATED GROUP IN ADDITION

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of the motivated group is below that of the control group, that there are two times when it is the same, and that it is above the control group eight times.

Upon the basis of all the calculations made so far in this report, it may be said that the effect of special motivation on the group in code writing was to prevent the variability of that group from becoming reduced as much as it normally would have been under ordinary motivation.

Probably the effect of special motivation on addition should be considered negligible.

Effects of Massing Practice

Results in Second Experiment.- When the practice material for the second experiment had been scored it was found that fifty-seven pairs of subjects could be chosen with very close initial scores. A maximum difference of two letters in initial scores was allowed. This gave two groups with mean scores of 21.45 and 21.17 and with standard deviations of 11.12 and 11.19. The data from subjects who could not be paired were ignored.

Table 18 presents initial scores, final scores, gross and relative gains of the individual members of the control and experimental groups.

TABLE XVIII

INITIAL AND FINAL SCORES WITH GROSS AND RELATIVE GAINS FOR THE SUPPLEMENTARY EXPERIMENT

Control				Experimental			
Initial Score	Final Score	Gross Gain	Relative Gain	Initial Score	Final Score	Gross Gain	Relative Gain
4	10	6	150	5	11	6	120
4	7	3	75	6	10	4	67
5	15	10	200	7	15	8	114
5	15	10	200	7	18	11	157
6	9	3	50	8	16	8	100
7	19	12	171	8	33	25	312
7	46	39	557	8	40	32	400
9	42	33	366	9	21	12	134
10	19	9	90	10	42	32	320
10	33	23	230	10	19	9	90
10	17	7	70	10	34	24	240
10	31	21	210	10	31	21	210
10	23	13	130	11	34	23	209
10	13	3	30	11	29	18	163
11	34	24	218	11	48	37	336
11	33	22	200	12	49	37	308
13	40	27	207	12	28	16	125
13	48	35	269	13	26	13	100
14	31	17	121	13	48	25	192
14	28	14	100	13	36	23	177
14	25	11	78	14	63	49	350
15	28	13	86	14	30	16	114
15	33	18	120	14	29	15	107
16	29	13	81	14	20	16	114
16	74	58	362	14	46	32	229
16	45	29	181	15	39	24	160
18	29	11	61	16	42	26	163
18	40	22	122	17	49	32	188
18	21	2	10	18	54	36	200
21	53	32	152	19	45	26	142
22	46	24	109	20	24	4	20
22	33	11	50	21	56	35	167
22	33	11	50	22	35	13	59
23	54	31	135	22	67	35	155
23	57	34	148	22	35	13	59
23	42	19	83	22	52	30	136
23	33	10	44	22	35	13	59
24	52	28	117	24	62	18	75
24	68	44	183	25	62	17	68
26	51	25	96	25	48	23	92
27	35	8	29	26	69	43	165
27	29	2	7	26	38	12	46

TABLE XVIII (Continued)

Control				Experimental			
Initial Score	Final Score	Gross Gain	Relative Gain	Initial Score	Final Score	Gross Gain	Relative Gain
27	46	19	70	26	36	10	38
29	34	5	19	27	50	23	85
31	51	20	65	29	53	24	83
32	45	13	41	30	38	8	27
34	57	23	68	33	48	15	45
34	57	23	68	34	43	9	26
36	76	40	111	37	61	24	65
38	48	10	26	37	70	33	89
38	51	13	34	38	46	13	34
39	86	47	121	38	51	13	34
40	59	19	48	40	56	16	40
40	68	28	70	41	74	33	80
41	62	21	51	43	86	43	100
49	54	5	10	51	77	26	41
54	64	10	19	52	60	8	15

The same statistical measures of variability were used in the second experiment as in the first experiment. These were: (1) the index of variability as measured by the formula, $\frac{SD}{mean}$; (2) the index of variability as measured by the formula, $\frac{90-10}{med.}$; that is, the ninetieth minus the tenth percentile divided by the median; (3) the ratio of the average of the three lowest scores to the average of the three highest scores at the beginning of practice compared to the ratio of the averages of the same groups of individuals at the end of practice; (4) the correlation between initial score and relative gain.

The question as to whether or not the experimental group really is more highly motivated than the control group seems to be answered by the data presented in Figure 4, where it is shown that, in spite of the fact that the average score for the experimental group at the first practice was slightly below the control group, from that point on the experimental group maintained a steady lead in terms of the average score for each practice period.

Computation shows that in both the control and experimental groups the effect of practice was to reduce variability. The variability of the control group as measured by the formula, $\frac{SD}{Mean}$ or V_1, for the initial practice is .518 and for the experimental group .529. The mean score of the initial practice for the control group is 21.45 and for the experimental group 21.17, with a standard deviation for the control group of 11.12 and of 11.19 for the experimental group. These figures show the two groups to be very close together at the start of practice. For the final practice period the variability of the control group as measured by the above formula becomes .444 and that of the experimental group becomes .389. In other words, the effect of the special motivation is to cause the variability to become reduced by .140 rather than by .074, as was the case with the control group.

Using the formula $\frac{90-10}{med.}$ for finding the index of variability or what is known in the first experiment as V_2, it is found that the variability of the control group becomes reduced through practice from 1.58 for the initial to 1.15 for the final practice - a change of .43. In the case of the motivated group, the reduction is from 1.65 to 1.07, or a change of .58.

A comparison of ratios of the average of the three highest to the average of the three lowest at the beginning of practice with the ratio of the averages of the same individuals at the end of practice shows that in the control group this ratio dropped from 11.08 to 5.62 - a change of 5.46, and in the experimental group this fatio is reduced from 7.79 for the initial to 5.28 for the final practice - a change of 2.51 due to practice. This indicates that the reduction in

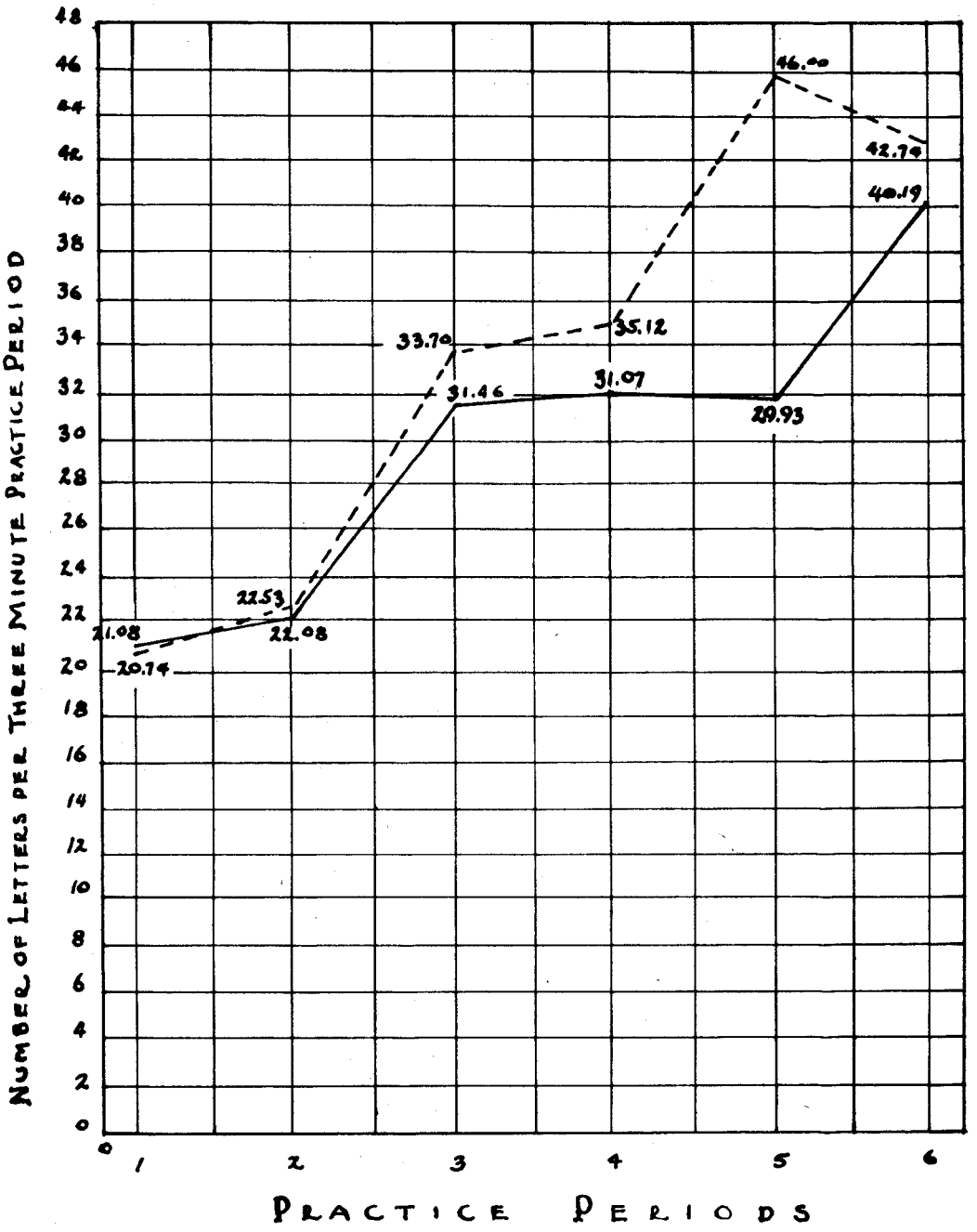

FIG. 4. - A COMPARISON OF THE PROGRESS OF THE CONTROL AND EXPERIMENTAL GROUPS OF THE ~~SECOND~~ second EXPERIMENT IN TERMS OF AVERAGE SCORES DURING THREE-MINUTE PRACTICE PERIODS.

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variability wh oh took place during practice due to motivation did not affect the extreme cases but rather the central portion of the distribution.

The fourth measure of changes in variability, the correlation between initial score and relative gain, shows that in the control group this relationship is $-.562 \pm .061$ and that for the experimental group the correlation is $-.592 \pm .059$

Table XIX presents the above results in compact form.

TABLE XIX

SUMMARY OF DIFFERENCES IN CHANGES IN VARIABILITY FOR THE CONTROL AND EXPERIMENTAL GROUPS IN THE SECOND EXPERIMENT FROM THE INITIAL TO THE FINAL PRACTICE

Measure	Group	Practice		Amount of Change		Greater Decrease
		Initial	Final	Increase	Decrease	
V_1	Control	.518	.444		.074	
	Experimental	.529	.389		.140	Experimental
V_2	Control	1.58	1.15		.43	
	Experimental	1.65	1.07		.58	Experimental
Av. 3 high Av. 3 low	Control	11.08	5.62		5.46	Control
	Experimental	7.79	5.28		2.51	
Correlation of Initial Score and Per Cent of Gain		Control group $-.562 \pm .061$ Experimental group $-.592 \pm .059$				Experimental

CHAPTER V

CONCLUSIONS

General Summary.-This investigation was concerned with three aspects of the general problem: What is the effect of practice on changes in variability, In the first place, it sought to determine the effect of practice on variability in the two functions studied, and under normal conditions of motivation. In the second place, using the same two functions, addition and code writing, it aimed to discover the effect of unusually high motivation by setting up an experiment in such a way that this factor with its effect might be singled out. In the third place, it endeavored to reveal the part played by massing the practice instead of distributing it.

Two experiments were performed. In both of them the control type of technique was used. In each experiment the control and highly motivated groups were chosen and equated in such a manner as to give as nearly as possible groups of equal ability. Statistical measures applied to scores made at the beginning of each experiment indicate that this aim was largely achieved.

In the first experiment two types of practice material was used: code writing and addition. Addition has often been used by those who have investigated the effects of practice on changes in variability. On the other hand, code writing does not appear in the literature of this topic at all. In the second experiment only one type of material-code writing was used.

The subjects of the first experiment were college students of the State Teachers College, Jacksonville, Alabama. In the second experiment the subjects were summer students at the University of Cincinnati and were somewhat more mature.

Table XX summarizes the statistical results of the investigation as a whole.

TABLE XX

SUMMARY OF STATISTICAL RESULTS OF THE INVESTIGATION

Measure	Practice				Amount of change		Greater decrease	r
	Init.	6th	21st	Final	Incr.	Decr.		
RESULTS FOR THE CONTROL GROUP OF THE FIRST EXPERIMENT IN CODE WRITING								
V_1	.42			.21		.21	Control	
V_2	1.10			.66		.44	Experi-mental	
$\frac{\text{Av. 3 high}}{\text{Av. 3 low}}$	5.68			.87		4.81	Control	
$\frac{\text{of init. score}}{\text{\% of gain}}$							Control	-.69
V_1		.27	.20			.07	Control	
V_2		.70	.49			.21	Control	
$\frac{\text{Av. 3 high}}{\text{Av. 3 low}}$		3.17	1.10			2.07	Control	
$\frac{\text{of init. score}}{\text{\% of gain}}$							Control	-.62

TABLE XX (Continued)

Measure	Practice				Amount of change		Greater decrease	r
	Init.	6th	21st	Final	Incr.	Decr.		
RESULTS FOR THE EXPERIMENTAL GROUP OF THE FIRST EXPERIMENT IN CODE WRITING								
V_1	.44			.27		.17	Control	
V_2	1.22			.72		.50	Experimental	
Av. 3 high / Av. 3 low	7.07			2.34		4.73	Control	
init. score / % of gain							Control	-.58
V_1		.33	.29			.04	Control	
V_2		.79	.86		.07		Control	
Av. 3 high / Av. 3 low		3.66	2.05			1.81	Control	
init. score / % of gain								-.44
RESULTS FOR THE CONTROL GROUP OF THE FIRST EXPERIMENT IN ADDITION								
V_1	.43			.32		.11	Equal	
V_2	1.10			.97		.13	Experimental	
Av. 3 high / Av. 3 low	5.02			2.53		2.49	Experimental	
init. score / % of gain								-.61

TABLE XX (Continued)

Measure	Practice: Init.	6th	21st	Final	Amount of change: Incr.	Decr.	Greater decrease	r
RESULTS FOR THE EXPERIMENTAL GROUP OF THE FIRST EXPERIMENT IN ADDITION								
V_1	.42		.31			.11	Equal	
V_2	1.02		.88			.14	Experimental	
Av. 3 high / Av. 3 low	6.58		2.80			3.78	Experimental	
init. score / % of gain							Experimental	-.65
RESULTS FOR THE CONTROL GROUP OF THE SECOND EXPERIMENT IN CODE WRITING								
V_1	.518		.444			.074	Experimental	
V_2	1.58		1.15			.43	Experimental	
Av. 3 high / Av. 3 low	11.08		5.62			5.46	Control	
init. score / % of gain							Experimental	-.562
RESULTS FOR THE EXPERIMENTAL GROUP OF THE SECOND EXPERIMENT IN CODE WRITING								
V_1	.599		.389			.140	Experimental	
V_2	1.65		1.07			.58	Experimental	
Av. 3 high / Av. 3 low	7.79		5.28			2.51	Control	
Init. score / % of gain							Experimental	+.592

A careful consideration of the results of this investigation leads one to the belief that in them is to be found an explanation of why disagreement has so long existed among previous investigators as to the effect of practice on changes in variability. These may be said to form the major conclusions of this investigation.

1. The results of the first experiment show that with practice material of a fairly intellectual nature, such as code writing, the changes in variability during practice are very definitely influenced by an increase of motivation.

2. The results of the first experiment show further that with practice material, such as addition, the changes in variability during practice are only slightly if at all affected by an increase in motivation.

3. The results of the second experiment indicate that with practice material, such as code writing, the massing of the practice has a very decided effect.

The following are further detailed conclusions of the study.

1. Where variability in the functions of code writing and addition is measured by any of the four measures used in this study with college students as subjects, practice does reduce variability.

2. This decrease in variability is fairly constant throughout practice.

3. The effect of increasing motivation with a college group in the above mentioned practice materials is not constant but varies with the function studied.

4. The effect of an unusually high degree of motivation in the case of code writing is in the direction of increasing the variability of the group where the practice is distributed.

5. Where practice is massed the effect of high motivation in code writing may be toward furthering the decrease in variability of the group.

This study is admittedly a laboratory one dealing entirely with a laboratory set up in so far as it studies the effects of practice. It is not claimed, even by implication, that its results

are directly applicable to school-room situations even with college students, and far less with pupils of a different age and educational level.

However, it does seem reasonable to infer that its results have some educational importance. The study as a whole indicates the prime importance of the factor of motivation in the learning situation. It shows this factor to have a great deal of importance even in learning situations which are more formal than those of the most conventional school. If, therefore, the successful progressive school is by definition one with an activity program which offers to its pupils far more individual opportunity and hence far greater motivation in school work than the conventional school offers it is to be expected that much more learning will take place.

If this study tends to increase interest in the effects of practice, it will have served a purpose.

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APPENDIX - A

PRACTICE MATERIAL

A sample of the practice sheet for code writing used in this experiment:

Name _____ Date _____

I CANNOT CALL RICHES BETTER THAN
THE BAGGAGE OF VIRTUE THE ROMAN
WORD IS BETTER IMPEDIMENTA FOR
AS THE BAGGAGE IS TO THE ARMY SO
IS RICHES TO VIRTUE IT CANNOT BE
SPARED NOR LEFT BEHIND BUT IT
HINDERETH THE MARCH YEA AND THE
CARE OF IT SOMETIMES LOSETH OR
DISTURBETH THE VICTORY OF GREAT
RICHES THERE IS NO REAL USE EXCEPT
IT BE IN THE DISTRIBUTION THE
REST IS BUT CONCEIT SO SAITH
SOLOMON WHERE MUCH IS THERE MANY

A sample of the practice sheet for addition used in this experiment:

Name _____ Date _____

8	7	9	5	6	3	4	2	9	8	6	4	3	5	7	8	9	6	7	8	5	4
6	5	4	3	2	9	8	7	6	5	7	8	8	8	6	6	6	5	2	6	7	7
3	4	5	6	7	8	9	9	9	9	9	9	5	6	7	8	9	9	9	8	5	4
9	8	7	5	4	3	2	3	4	5	6	7	8	9	9	7	7	6	5	4	3	9
5	6	3	3	9	8	5	5	7	7	8	9	3	4	5	6	8	3	4	5	6	7
8	8	8	6	5	4	6	7	4	5	6	7	5	7	8	3	3	8	8	9	5	8
5	4	3	3	6	7	8	9	9	8	7	8	7	6	5	4	9	4	7	8	9	6
8	9	9	8	7	8	7	4	3	3	2	2	5	4	4	7	6	5	8	7	6	5
4	5	6	7	8	9	8	7	6	5	4	3	2	3	5	4	5	6	7	8	9	9
9	8	7	6	5	4	3	2	3	4	5	6	7	8	9	9	9	9	9	9	7	6

7	8	9	4	3	5	4	9	7	5	3	2	4	8	9	8	2	3	4	5	6	8
8	3	4	5	6	7	8	8	9	8	6	7	7	6	5	4	9	8	7	6	7	7
5	6	7	8	9	9	9	7	7	6	5	4	2	3	6	7	6	5	5	7	8	9
9	8	6	5	4	3	2	5	6	7	8	9	9	8	7	6	5	4	3	2	3	4
2	3	5	6	7	8	9	9	9	8	7	6	5	4	4	3	2	9	8	7	6	5
6	8	7	9	8	6	7	5	6	4	5	3	4	2	8	9	7	8	6	8	7	8
7	6	8	5	9	5	8	4	8	3	7	9	7	5	3	2	4	6	8	3	5	7
8	7	6	6	5	4	3	5	6	8	6	5	5	4	8	7	9	8	7	6	7	6
3	4	5	7	8	9	9	8	7	6	5	4	3	2	3	4	5	6	5	5	6	8
9	8	7	6	5	4	3	3	4	5	6	7	8	9	9	9	9	9	9	8	8	4

3	5	7	9	8	6	4	2	9	8	6	4	8	7	5	3	7	6	4	2	6	5
8	6	4	2	3	5	7	9	6	4	5	3	3	5	7	9	6	5	7	8	8	8
5	5	7	7	8	8	6	6	9	9	8	8	7	7	6	6	8	8	5	5	4	3
8	7	6	5	4	3	2	3	4	5	6	7	8	9	9	8	7	6	7	6	5	6
6	5	7	6	8	8	9	9	8	7	8	9	7	8	6	7	5	5	4	8	9	8
8	9	8	7	7	9	7	6	6	8	6	5	5	6	5	4	4	6	5	3	4	5
5	6	7	8	9	8	6	5	4	3	2	3	4	5	6	7	8	9	9	8	7	6
8	7	6	7	8	7	8	7	7	6	7	8	9	6	8	5	7	4	6	3	5	8
6	5	6	4	6	3	6	2	9	8	9	7	8	7	9	4	9	5	9	8	9	9
9	8	7	6	5	4	3	9	2	3	4	5	6	8	8	9	4	6	5	6	5	4

APPENDIX - B

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS FOR THE FIRST FIFTEEN PRACTICES IN CODE WRITING

Subject	PRACTICE PERIOD														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c 1	11	21	41	52	42	69	65	65	92	103	112	112	98	117	128
m 1	65	44	51	66	87	104	87	85	95	107	128	124	141	133	155
c 2	68	65	66	71	66	78	82	70	80	67	86	89	93	97	97
m 2	39	61	45	34	77	86	96	77	111	103	124	96	111	124	109
c 3	53	47	49	53	55	76	77	67	67	71	80	90	84	96	105
m 3	14	14	35	36	36	56	35	51	56	63	59	73	62	75	69
c 4	56	56	73	78	104	99	125	122	124	107	137	134	119	151	144
m 4	64	65	61	73	100	106	110	121	133	143	152	164	175	181	181
c 5	23	32	23	27	43	52	56	66	75	88	94	92	114	112	117
m 5	32	24	38	53	72	97	95	90	123	104	110	113	121	118	130
c 6	70	69	69	89	82	101	109	114	100	126	121	124	186	138	159
m 6	45	31	44	32	80	95	100	115	137	142	129	173	179	200	214
c 7	21	47	39	64	78	84	81	78	103	107	88	117	126	129	144
m 7	24	20	26	38	35	64	47	63	65	68	74	76	77	76	78
c 8	33	33	45	46	70	74	71	76	81	88	101	102	114	141	131
m 8	22	41	29	42	44	47	45	62	63	55	61	82	83	65	86
c 9	59	60	70	101	111	138	139	97	119	151	158	170	159	164	187
m 9	51	66	67	87	111	124	139	141	150	159	183	170	192	182	177
c10	53	59	70	66	83	84	91	81	100	97	97	104	116	125	131
m10	49	53	69	97	134	156	156	161	181	185	199	206	212	210	233
c11	35	28	44	62	82	90	93	81	105	102	104	109	133	131	140
m11	43	24	46	45	64	79	82	93	111	124	120	129	169	154	183
c12	47	55	62	71	85	87	73	76	95	83	99	80	93	112	125
m12	46	59	51	73	100	116	126	139	149	157	177	179	173	207	198
c13	48	58	60	63	82	86	98	86	67	71	116	132	145	126	131
m13	22	24	26	34	30	62	73	70	96	52	53	97	86	72	69
c14	50	44	76	61	82	92	85	85	104	83	109	109	117	133	134
m14	65	52	66	71	95	95	109	112	105	94	96	127	129	152	167
c15	48	52	77	74	80	40	101	80	101	108	119	115	121	136	146
m15	83	68	80	101	130	153	146	154	167	173	203	197	206	223	237

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE FIRST FIFTEEN PRACTICES IN CODE WRITING

Subject	PRACTICE PERIOD														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c16	32	27	40	34	35	57	73	59	82	84	93	86	92	111	129
m16	4	16	27	17	38	58	58	57	56	73	58	58	77	82	78
c17	28	33	27	34	71	84	107	102	110	113	126	128	140	137	146
m17	32	38	33	21	33	61	66	64	64	63	68	93	123	124	145
c18	31	54	61	45	43	43	54	53	77	67	79	79	111	115	127
m18	36	46	44	55	71	95	83	93	112	93	119	118	145	141	152
c19	54	59	62	63	88	91	72	86	100	99	103	109	120	120	137
m19	37	18	53	74	88	124	122	131	137	138	166	169	182	198	197
c20	17	22	43	43	44	56	54	37	58	67	59	65	79	77	72
m20	24	28	35	49	63	64	64	68	69	71	75	64	91	80	77
c21	28	60	84	91	111	110	115	92	118	119	111	136	138	142	152
m21	29	35	22	38	69	83	69	87	101	113	99	107	141	139	147
c22	58	66	92	84	113	88	95	112	120	110	114	141	127	136	168
m22	77	69	67	91	119	135	142	152	150	160	163	177	195	219	240
c23	27	37	24	25	40	59	91	46	51	50	45	60	49	53	68
m23	29	31	28	27	47	67	66	64	90	84	103	97	109	113	143
c24	91	63	91	106	100	108	93	67	118	150	134	122	169	153	154
m24	19	42	52	49	70	74	81	82	95	89	78	106	117	122	146
c25	65	74	79	92	101	120	113	132	128	137	128	145	146	187	184
m25	49	49	54	40	73	69	91	93	109	108	118	103	116	130	130
c26	16	25	52	39	51	75	53	59	49	71	69	68	79	73	88
m26	56	62	56	57	97	98	113	108	112	159	144	165	195	193	190
c27	52	64	78	81	85	92	111	93	106	112	128	123	128	133	149
m27	50	54	50	73	96	74	85	84	106	120	134	160	150	160	183
c28	83	68	89	87	118	120	115	96	119	113	133	137	150	166	174
m28	62	50	50	55	94	88	100	102	128	105	133	129	139	151	147
c29	77	64	77	89	105	119	112	104	140	139	180	158	184	219	220
m29	86	86	97	98	152	158	197	206	212	234	250	256	264	278	293
c30	14	29	55	53	48	81	86	88	110	94	119	120	147	189	185
m30	45	44	47	57	66	78	82	62	75	80	79	82	100	81	94

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE FIRST FIFTEEN PRACTICES IN CODE WRITING

Subject	PRACTICE PERIOD														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c31	33	56	60	59	61	73	89	90	93	70	111	120	123	141	156
m31	33	35	44	64	89	98	106	111	123	123	146	156	159	186	177
c32	41	30	46	59	80	85	61	77	91	88	96	117	113	131	137
m32	22	34	33	58	66	89	73	72	90	84	86	79	100	87	121
c33	45	31	49	68	83	96	101	76	91	85	118	123	132	145	157
m33	37	38	47	52	84	101	108	101	111	128	129	138	126	139	154
c34	48	47	44	66	45	59	73	68	74	79	93	106	105	112	109
m34	17	27	30	41	42	51	44	51	61	19	56	44	57	69	76
c35	87	71	87	83	122	114	110	103	105	107	117	135	144	147	152
m35	41	62	64	65	79	100	94	99	105	97	98	113	101	125	122
c36	30	40	56	66	75	82	84	69	82	69	91	98	118	110	136
m36	28	25	42	30	51	52	44	51	46	41	56	30	65	66	84
c37	35	44	62	49	72	83	84	66	68	90	97	89	96	106	125
m37	36	34	18	41	66	81	78	80	88	96	90	100	98	104	114
c38	41	47	66	68	63	80	74	54	85	63	68	88	85	103	106
m38	54	44	45	60	57	82	90	77	90	95	81	105	113	119	123
c39	57	31	51	64	50	36	46	51	61	88	76	77	86	65	94
m39	43	40	49	64	63	84	88	83	105	68	94	95	107	102	118
c40	65	64	91	60	65	110	118	60	119	135	108	149	124	165	160
m40	28	34	31	52	44	62	64	59	58	54	73	71	77	77	84
c41	34	35	47	65	93	111	90	96	81	80	93	96	87	94	104
m41	38	40	53	68	71	89	82	82	108	101	111	114	128	137	148
c42	47	41	65	68	79	85	95	73	86	88	82	100	98	99	105
m42	23	34	40	51	72	79	100	91	137	139	124	158	173	179	170
c43	47	32	52	46	58	74	84	67	84	70	81	77	88	102	103
m43	30	44	50	48	52	23	53	45	55	71	62	71	86	104	105

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE LAST FIFTEEN PRACTICES IN CODE WRITING

Subject	PRACTICE PERIOD														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
c 1	136	153	147	155	149	155	154	196	201	210	203	206	218	226	249
m 1	166	169	190	180	180	195	197	193	196	193	201	198	216	215	229
c 2	102	108	103	120	122	123	103	129	133	162	129	128	131	153	140
m 2	126	158	180	182	194	170	186	189	190	218	169	196	203	157	189
c 3	84	104	99	103	108	110	104	114	121	107	119	133	108	127	110
m 3	71	83	95	85	92	102	109	110	126	120	130	137	148	139	152
c 4	149	144	140	147	155	150	164	159	162	200	170	182	181	187	195
m 4	187	200	199	211	213	214	224	223	218	221	209	229	227	254	242
c 5	110	136	147	180	161	154	166	183	168	184	183	204	183	203	201
m 5	140	135	159	171	164	177	177	164	174	196	157	188	179	191	175
c 6	157	170	177	188	203	181	178	203	187	220	188	199	186	224	207
m 6	205	226	252	267	268	273	274	273	288	315	305	332	322	349	339
c 7	137	151	170	168	150	151	152	171	170	189	184	192	190	187	220
m 7	95	98	105	136	103	146	140	153	180	175	174	195	199	200	168
c 8	135	170	178	201	189	166	176	196	192	195	182	184	184	192	204
m 8	93	131	131	123	141	183	125	167	157	161	136	165	179	166	187
c 9	172	175	151	189	199	188	195	181	207	209	203	233	217	214	243
m 9	203	217	243	247	227	221	242	276	248	279	250	259	259	251	260
c10	121	138	131	157	158	172	173	188	184	181	186	195	197	204	200
m10	226	249	261	271	272	270	286	299	315	333	286	322	335	337	353
c11	130	151	158	169	174	180	165	184	177	176	172	178	167	194	184
m11	180	185	222	221	215	232	235	240	234	235	227	243	216	248	252
c12	119	134	130	152	158	150	148	166	156	174	146	172	156	191	177
m12	206	234	243	252	243	249	266	262	257	262	258	262	264	267	265
c13	104	168	165	183	196	185	200	226	215	256	238	245	226	245	247
m13	58	74	96	84	96	102	102	128	125	117	133	156	144	165	165
c14	121	133	132	159	160	178	162	178	185	212	193	207	206	203	228
m14	175	175	171	148	189	182	194	196	207	173	204	217	228	231	295
c15	146	162	152	167	157	158	164	154	167	189	185	207	177	173	183
m15	256	254	272	263	272	272	287	294	295	307	308	330	297	305	325

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE LAST FIFTEEN PRACTICES IN CODE WRITING

Subject	PRACTICE PERIOD														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
c16	145	145	142	155	141	168	162	177	165	196	136	197	173	182	185
m16	93	100	106	105	101	125	105	121	116	113	129	115	138	151	147
c17	147	168	143	152	177	175	183	181	177	182	179	199	119	212	203
m17	146	149	188	193	203	207	206	202	202	209	207	212	242	200	251
c18	142	164	168	170	188	200	187	212	209	221	153	246	219	221	246
m18	169	170	185	199	206	235	239	236	257	254	257	272	283	283	295
c19	133	158	164	180	212	191	199	209	203	260	217	225	252	220	287
m19	195	222	226	251	283	244	260	274	262	281	259	269	268	279	282
c20	77	87	85	104	76	99	97	108	97	142	102	107	117	144	140
m20	79	93	94	93	104	114	107	112	122	120	106	119	122	121	127
c21	151	180	195	183	206	188	207	243	216	240	222	233	229	226	252
m21	147	169	183	189	191	187	191	201	205	237	223	239	227	254	243
c22	160	166	181	201	205	212	204	245	242	248	233	275	258	274	287
m22	222	237	266	267	265	277	271	266	266	286	271	288	304	323	289
c23	60	93	67	70	106	85	82	65	82	76	61	63	62	81	83
m23	114	140	143	155	133	137	141	176	155	168	163	154	156	150	139
c24	132	153	168	167	185	184	199	185	169	201	176	188	165	186	180
m24	141	146	151	167	168	183	196	198	190	223	210	213	218	214	233
c25	163	192	189	205	204	204	206	205	210	209	205	230	217	227	235
m25	143	152	172	178	160	173	155	163	171	199	196	187	177	207	196
c26	69	86	78	110	72	89	83	123	125	111	126	166	163	177	147
m26	196	209	210	207	199	194	228	222	215	216	226	234	232	248	248
c27	150	164	149	173	174	177	175	190	179	196	182	192	188	200	204
m27	184	185	173	177	202	208	220	194	221	204	214	222	209	198	217
c28	166	188	189	216	227	221	230	208	229	244	228	269	243	249	233
m28	153	176	162	175	156	188	171	198	174	173	185	215	179	183	180
c29	148	230	209	212	231	257	230	239	289	262	251	255	256	262	281
m29	293	300	304	324	323	336	323	343	346	355	349	371	324	358	382
c30	182	228	193	224	246	215	223	250	267	257	271	294	278	274	306
m30	86	102	102	117	135	132	119	128	132	143	100	135	155	167	151

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE LAST FIFTEEN PRACTICES IN CODE WRITING

Subject	PRACTICE PERIOD														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
c31	165	173	152	180	171	156	187	198	191	221	212	224	201	218	224
m31	176	190	202	210	206	205	203	216	210	230	221	223	230	223	224
c32	139	134	138	152	141	151	169	160	142	166	155	178	158	177	193
m32	137	157	172	192	204	210	210	214	197	209	232	257	246	243	269
c33	164	181	166	189	192	194	179	212	212	196	197	225	222	240	246
m33	178	180	187	181	173	211	209	218	207	232	233	240	227	236	235
c34	115	127	126	150	166	152	163	143	187	173	166	196	194	203	226
m34	80	70	84	92	87	103	102	114	116	128	118	118	140	110	127
c35	157	161	173	188	201	197	230	220	216	228	212	247	244	275	265
m35	118	147	154	143	145	167	138	173	156	186	170	174	183	178	174
c36	132	150	141	165	168	157	176	180	178	183	176	214	177	186	203
m36	81	82	98	82	101	110	94	103	114	117	112	97	119	135	121
c37	104	128	135	153	141	135	147	147	156	168	173	170	172	199	185
m37	125	123	127	157	152	150	146	157	151	171	169	183	181	181	183
c38	78	136	100	138	159	158	137	135	151	165	156	176	175	179	169
m38	133	153	155	162	161	192	179	197	189	211	195	205	235	240	233
c39	73	152	127	154	165	199	178	191	206	191	216	215	199	174	221
m39	106	120	150	155	152	160	166	176	198	172	156	205	217	222	223
c40	177	179	194	202	165	200	219	200	204	210	229	234	227	267	303
m40	77	82	86	107	89	96	101	125	108	111	105	113	125	132	136
c41	110	149	119	142	182	187	192	190	208	212	199	253	212	232	239
m41	150	156	170	146	173	156	164	167	175	182	185	202	194	183	205
c42	92	111	115	115	133	131	136	131	145	164	151	180	170	190	213
m42	188	194	212	214	194	222	245	228	271	251	252	177	249	278	289
c43	104	121	137	151	154	123	140	159	156	139	163	213	179	207	207
m43	132	119	134	143	144	142	139	175	164	169	137	174	187	184	184

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE FIRST FIFTEEN PRACTICES IN ADDITION

Subject	PRACTICE PERIOD														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c 1	17	18	23	27	27	26	27	26	27	29	26	29	27	29	25
m 1	23	26	27	21	27	26	31	31	26	33	36	33	36	38	36
c 2	13	15	12	16	15	12	14	15	13	13	16	16	13	16	15
m 2	5	12	8	3	9	11	8	9	7	9	12	11	14	18	10
c 3	16	18	16	18	19	21	24	18	18	15	17	26	20	21	21
m 3	10	13	11	11	7	9	14	8	11	12	11	15	15	12	11
c 4	20	19	22	22	24	21	20	25	22	23	22	31	25	29	28
m 4	15	16	17	11	19	18	15	17	18	18	22	23	22	17	21
c 5	3	3	2	1	1	6	4	7	6	7	8	5	7	7	7
m 5	1	6	8	1	6	15	11	9	8	9	10	20	13	10	16
c 6	10	12	15	14	14	14	14	15	15	17	15	16	16	15	17
m 6	4	8	7	8	5	10	11	14	14	16	10	15	13	16	11
c 7	10	10	12	13	11	10	15	13	16	17	12	19	14	16	11
m 7	11	12	9	9	14	15	15	12	17	19	9	17	19	14	17
c 8	7	10	10	10	10	8	12	14	10	11	12	13	11	14	9
m 8	16	8	19	12	12	20	10	15	15	18	13	23	15	17	20
c 9	14	15	12	13	16	16	17	19	17	18	14	23	15	19	17
m 9	18	23	23	23	25	25	26	32	23	27	28	31	29	29	27
c10	11	12	12	11	13	14	12	11	14	13	11	17	16	15	16
m10	13	10	15	14	14	14	19	17	17	18	16	18	20	18	20
c11	11	13	16	11	15	15	18	16	17	20	17	17	15	19	19
m11	14	20	14	20	20	20	19	23	18	24	25	26	26	26	23
c12	17	21	20	17	17	21	18	17	19	21	24	28	22	25	23
m12	10	16	12	13	16	18	19	15	17	19	17	19	19	23	23
c13	6	12	13	9	7	14	16	12	17	14	15	23	21	19	16
m13	12	15	9	14	16	17	19	14	23	17	13	26	20	23	25
c14	18	20	16	24	23	25	25	23	22	25	22	24	22	25	30
m14	13	14	14	14	15	16	15	18	16	16	12	16	15	17	19
c15	17	23	19	26	24	24	28	23	25	27	23	28	29	28	30
m15	11	17	16	18	20	22	25	23	26	26	23	28	26	33	27

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE FIRST FIFTEEN PRACTICES IN ADDITION

Subject	PRACTICE PERIOD 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c16	7	7	11	9	7	12	12	10	10	13	9	14	12	10	10
m16	7	8	7	6	6	6	8	11	11	10	10	11	11	13	12
c17	10	12	12	14	11	16	17	13	8	21	13	18	18	18	18
m17	14	18	20	18	12	15	20	20	22	20	26	25	23	29	22
c18	23	20	21	24	28	29	25	26	29	23	32	33	31	29	29
m18	8	17	12	10	19	19	20	22	23	18	26	28	23	26	27
c19	12	16	12	12	13	15	15	16	12	15	15	15	16	16	19
m19	8	6	8	8	10	11	8	11	9	12	8	9	7	13	12
c20	7	10	9	12	9	9	14	14	11	6	11	11	11	13	15
m20	6	8	8	8	6	9	11	9	7	10	6	13	9	12	12
c21	10	15	14	12	17	14	16	16	14	11	15	21	18	22	21
m21	19	19	19	20	22	23	25	25	24	26	24	28	26	25	22
c22	19	21	23	24	23	26	24	25	16	25	18	28	24	29	24
m22	13	15	18	16	19	19	20	23	16	17	18	21	23	23	29
c23	4	4	7	4	5	3	5	4	3	7	3	9	5	10	4
m23	4	2	4	8	4	7	8	7	5	7	4	6	9	9	7
c24	11	10	11	7	11	6	13	14	11	15	16	15	15	14	20
m24	17	13	18	13	18	14	16	17	16	19	14	26	21	22	22
c25	9	9	8	13	12	13	13	12	12	9	10	15	13	16	15
m25	5	8	9	6	8	8	4	12	16	13	9	13	12	12	15
c26	16	23	21	21	21	25	24	24	20	20	22	27	26	25	26
m26	17	19	21	16	20	18	17	25	20	26	24	27	28	26	17
c27	9	16	17	13	15	17	19	18	15	18	15	19	17	16	20
m27	11	19	21	16	20	22	22	18	23	19	21	30	27	23	23
c28	14	17	16	16	17	17	16	21	16	20	20	23	19	21	22
m28	17	20	21	23	23	25	23	26	31	26	25	31	27	28	29
c29	13	20	27	25	19	20	23	26	23	24	18	29	24	22	22
m29	16	19	16	13	16	19	23	21	21	21	20	20	21	20	16
c30	3	4	17	3	0	18	14	8	11	7	18	9	15	21	5
m30	16	11	22	16	20	17	21	22	18	22	23	18	28	26	23

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE FIRST FIFTEEN PRACTICES IN ADDITION

Subject	PRACTICE PERIOD														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c31	16	17	20	18	21	19	26	25	19	23	21	23	24	24	26
m31	12	15	14	13	18	18	17	19	20	15	21	23	21	17	18
c32	6	4	4	5	4	6	6	7	7	6	8	10	8	8	9
m32	14	18	14	13	16	16	16	21	19	20	22	24	26	26	24
c33	23	21	26	24	24	24	25	25	25	26	27	17	29	27	29
m33	13	9	15	15	16	17	20	17	10	22	17	22	23	19	21
c34	16	16	17	17	21	18	14	22	17	22	20	21	18	21	20
m34	3	6	6	7	3	8	7	8	5	9	10	9	12	10	5
c35	8	11	14	11	10	13	12	21	19	21	13	22	20	20	19
m35	11	14	11	12	16	16	15	18	22	14	14	22	17	20	20
c36	13	12	18	13	15	17	15	22	19	16	19	18	19	17	16
m36	13	15	15	13	14	15	16	13	12	19	16	20	20	18	16
c37	15	13	12	16	11	11	12	15	15	17	14	15	17	19	18
m37	12	14	10	12	13	15	16	15	20	18	16	21	16	16	16
c38	23	24	28	31	27	30	29	32	31	26	30	35	36	34	36
m38	7	8	6	13	14	15	14	17	15	18	15	18	13	19	18
c39	4	8	8	13	7	11	11	13	8	10	11	16	14	11	13
m39	7	9	10	6	10	9	10	12	12	12	9	16	14	14	15
c40	12	12	13	12	17	15	11	21	21	18	14	26	20	22	24
m40	9	6	8	10	13	15	15	15	13	13	15	16	12	16	18
c41	10	6	9	11	11	17	11	16	15	4	16	14	17	10	18
m41	13	9	18	10	15	9	12	9	17	14	19	14	14	17	19
c42	15	19	15	12	15	20	21	19	19	18	16	26	20	25	22
m42	19	19	20	20	19	24	23	30	24	27	30	30	31	27	24
c43	7	12	11	9	11	9	12	15	14	11	8	15	17	19	15
m43	9	10	8	7	11	15	11	11	12	4	9	13	14	14	14

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE LAST FIFTEEN PRACTICES IN ADDITION

Subject	PRACTICE PERIOD														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
c 1	24	22	21	24	27	25	32	12	30	30	31	31	34	30	35
m 1	36	35	37	38	39	40	40	41	40	39	42	38	44	37	43
c 2	14	14	11	16	16	15	14	15	15	17	14	15	16	14	12
m 2	13	13	13	13	13	14	14	16	15	12	17	18	19	17	16
c 3	20	19	20	16	18	17	19	17	19	21	22	21	23	18	19
m 3	9	14	13	13	10	14	13	16	16	18	13	18	13	16	16
c 4	28	16	30	23	26	24	29	26	33	30	27	25	30	32	30
m 4	20	19	27	18	21	19	22	26	22	22	28	23	27	24	28
c 5	9	8	15	7	11	11	13	11	15	14	18	10	20	15	15
m 5	13	13	12	17	16	13	12	12	16	13	14	13	20	14	8
c 6	21	19	21	26	22	20	18	20	22	26	18	24	21	17	19
m 6	12	14	14	16	12	12	14	10	18	15	17	12	16	13	16
c 7	17	16	15	19	17	19	21	18	17	23	16	21	18	19	17
m 7	14	18	20	19	20	14	18	19	19	15	19	19	20	16	17
c 8	12	11	17	9	17	15	13	14	16	18	11	15	16	21	18
m 8	14	16	19	18	22	18	20	13	23	25	19	23	24	24	22
c 9	18	13	19	14	18	19	20	19	21	18	21	20	17	18	17
m 9	28	29	32	29	29	25	30	36	31	33	32	27	33	29	35
c10	16	14	16	17	16	15	18	18	16	16	18	18	17	15	18
m10	18	24	25	24	20	23	18	22	24	26	25	20	21	23	26
c11	18	20	20	20	21	18	20	19	22	20	22	21	20	23	19
m11	20	24	28	26	22	25	25	27	28	30	30	23	27	25	30
c12	22	23	27	26	28	24	21	26	31	27	25	25	29	28	26
m12	21	22	24	25	24	26	25	20	25	23	24	23	20	23	23
c13	17	21	23	19	24	20	19	25	23	27	24	20	25	21	27
m13	11	21	23	19	20	18	25	21	24	22	25	23	25	22	25
c14	23	24	31	29	25	26	28	31	30	30	27	26	24	25	29
m14	18	18	19	16	19	17	16	18	14	16	17	18	20	19	19
c15	30	30	28	31	27	25	32	29	24	34	29	28	26	27	31
m15	29	29	27	32	29	30	28	28	35	23	32	31	31	25	34

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE LAST FIFTEEN PRACTICES IN ADDITION

Subject	PRACTICE PERIOD														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
c16	7	12	14	13	16	15	16	14	14	17	19	17	17	16	19
m16	7	10	9	11	14	13	11	14	13	14	12	14	15	14	17
c17	21	18	22	19	22	18	18	22	24	19	17	21	23	24	27
m17	31	27	29	27	33	25	32	30	32	30	31	33	37	33	35
c18	28	33	27	29	29	28	33	35	33	36	37	32	38	35	36
m18	22	25	22	23	25	26	26	23	30	26	30	28	23	31	29
c19	14	14	19	12	17	16	17	19	17	23	19	15	17	14	16
m19	15	11	17	16	14	11	20	12	16	11	19	19	23	22	24
c20	13	14	14	10	13	13	14	13	10	11	12	17	17	11	13
m20	11	13	13	12	15	12	14	13	13	19	14	14	16	13	14
c21	18	21	17	18	21	22	19	18	28	24	22	25	27	25	29
m21	20	24	28	27	26	28	26	25	29	28	27	28	29	25	31
c22	26	27	26	27	29	25	28	27	28	32	31	31	31	29	33
m22	25	24	33	22	30	29	31	24	27	27	35	31	41	32	35
c23	7	6	8	8	8	5	5	3	6	6	4	6	7	5	6
m23	8	8	9	9	11	12	9	14	11	12	12	17	15	12	13
c24	17	13	15	16	14	14	17	21	12	19	18	19	14	21	21
m24	22	19	25	25	20	26	26	27	27	27	30	28	28	25	27
c25	16	16	15	17	16	11	17	20	17	13	18	16	15	17	20
m25	18	17	16	10	10	17	17	11	15	14	18	16	15	14	13
c26	26	20	23	25	23	22	31	27	28	23	27	24	27	21	26
m26	32	31	28	31	25	25	29	23	26	27	29	28	28	30	26
c27	18	19	21	19	20	18	20	20	21	18	22	19	21	20	23
m27	20	23	17	25	21	25	30	15	23	20	22	24	23	21	25
c28	22	21	20	20	24	19	20	22	23	22	22	23	22	24	27
m28	27	27	31	26	25	31	33	33	32	33	35	34	37	38	39
c29	23	24	30	22	28	25	28	24	26	25	30	26	28	33	28
m29	22	22	23	17	22	20	25	22	22	24	28	18	19	23	22
c30	9	10	8	7	9	18	9	11	12	13	17	9	8	6	12
m30	26	27	22	25	29	23	24	29	25	27	27	27	26	29	31

DAILY SCORES OF CONTROL AND MOTIVATED GROUPS
FOR THE LAST FIFTEEN PRACTICES IN ADDITION

Subject	PRACTICE PERIOD														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
c31	23	27	20	22	20	19	25	24	25	27	24	24	25	25	26
m31	21	18	21	22	21	24	22	25	26	22	24	22	21	22	20
c32	9	5	7	5	9	7	10	10	8	8	9	7	11	9	10
m32	24	23	26	26	21	25	25	24	25	27	30	33	29	28	33
c33	25	30	33	28	33	30	31	30	34	32	32	32	34	29	36
m33	20	19	23	20	23	23	17	20	23	22	24	20	25	23	25
c34	21	20	26	25	25	25	18	25	23	21	24	26	25	27	25
m34	7	7	12	12	9	11	14	12	12	14	12	13	14	7	13
c35	14	19	25	18	22	19	22	22	24	20	20	22	21	23	25
m35	21	23	18	24	19	27	21	25	28	27	28	25	27	26	27
c36	19	20	24	17	15	15	23	19	21	22	22	22	21	20	25
m36	18	18	20	20	20	20	21	22	21	21	20	18	24	23	21
c37	17	19	14	18	22	18	19	20	17	18	22	15	18	14	20
m37	21	20	19	22	18	21	19	18	21	22	21	19	21	21	21
c38	36	34	31	32	36	32	36	34	34	35	35	33	35	37	35
m38	19	20	15	16	24	15	20	18	18	19	20	22	27	21	23
c39	13	12	12	6	9	9	14	13	12	12	12	10	11	9	10
m39	14	15	17	15	13	16	16	19	15	16	15	19	21	18	17
c40	14	18	15	16	18	16	21	25	17	19	24	18	13	26	27
m40	18	18	15	22	17	14	17	13	16	16	17	18	17	14	20
c41	17	19	12	9	12	10	18	14	8	13	18	12	11	19	17
m41	17	20	21	20	14	19	20	17	16	19	21	23	22	22	21
c42	23	23	23	19	17	21	20	19	25	23	22	22	23	23	21
m42	29	25	28	27	27	32	31	22	29	29	33	28	32	33	31
c43	14	13	13	12	15	14	14	17	20	15	9	20	17	17	17
m43	14	14	14	14	13	18	13	16	9	17	8	11	15	17	17

APPENDIX - C

TABULATION OF THE ANSWERS TO THREE QUESTIONNAIRES USED IN THIS EXPERIMENT

During the course of the experiment these three questionnaires were used to find out the attitude held by the subjects toward the experiment. A small amount of other information was also solicited. Because some of the questions in the first questionnaire were of a personal nature, in that they asked for information as to whether certain directions had been followed, it was thought best to omit the names of the subjects. The other two questionnaires had the names of the subjects on them. The information which the first questionnaire requested was obtained at the eighth practice with both groups. The first questionnaire follows.

QUESTIONNAIRE NUMBER 1

What is your sex? MALE - FEMALE What is your age? _____yrs.

1. With which material do you prefer to work? CODE WRITING - ADDITION - NO PREFERENCE

2. How have you felt toward the experiment so far? INTERESTED - BORED - NEITHER

3. How do you think you will feel when the experiment is over? GLAD - RELIEVED - SORRY

4. Would you be willing to continue the experiment even if you were not getting credit in your psychology? YES - NO

5. Have you really tried hard to improve your score from day to day? YES - NO

6. Have you simply followed directions without much interest as to whether your score was good or bad? YES - NO

QUESTIONNAIRE NUMBER 1 (Continued)

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7. Since the beginning of the experiment has your interest - INCREASED - DECREASED - REMAINED THE SAME

8. Have you practiced the code writing at all? YES - NO

9. Have you practiced the addition at all? YES - NO

The answers to the question regarding sex showed that 51 per cent of the control group were men and 49 per cent were women. In the motivated group 62 per cent were women and 38 per cent were men.

Answers to the question regarding age showed that in the control group the ages ranged from 28 to 16 years and that the average age for the group was 20.53 years. In the motivated group the ages ranged from 31 to 16 years with the average at 20.18 years.

In answering this questionnaire both groups were urged to be perfectly frank and honest. It was explained to both groups that questions 9 and 10 referred to practice outside the regular practice periods. Analysis of the answers to questions 1 to 9 follows.

Question Number

1. With which material do you prefer to work?

	Code writing	Addition	No preference
Control	31	12	2
Motivated	26	11	4

2. How have you felt toward the experiment so far?

	Interested	Bored	Neither
Control	26	5	15
Motivated	31	4	6

3. How do you think you will feel when the experiment is over?

	Glad	Relieved	Sorry
Control	12	29	4
Motivated	17	18	6

4. Would you be willing to continue the experiment even if you were not getting credit in your psychology?

	Yes	No
Control	32	11
Motivated	32	9

5. Have you really tried hard to improve your score from day to day?

	Yes	No
Control	40	5
Motivated	37	4

6. Have you simply followed directions without much interest as to whether your score was good or bad?

	Yes	No
Control	27	16
Motivated	17	24

7. Since the beginning of the experiment has your interest -

	Increased	Decreased	Remained same
Control	39	0	10
Motivated	34	0	7

8. Have you practiced the code writing at all?

	Yes	No
Control	3	42
Motivated	4	37

9. Have you practiced the addition at all?

	Yes	No
Control	0	45
Motivated	0	41

It is to be noted that with the first questionnaire the sum of the answers to all questions asked does not always equal eighty-six. This is due to the omission of names from the questionnaires and hence the impossibility of separating the questionnaires of those who were later dropped from the experiment. It was impossible to make up this particular part of the experiment if any subject were absent, as the

identity of the subject in this case would have become known. The answers to the second and third questionnaires always total forty-three for each group except where the subject failed to answer a question. Although the questionnaires carried no written instructions as to answering, they were fully explained in each case, and the answer which the subject wished to make was always underlined by him. The second questionnaire was distributed at the eighteenth practice. This questionnaire appears below.

QUESTIONNAIRE NUMBER 2

Name _____ Date _____

1. With which material do you prefer to work? ADDITION - CODE WRITING - NO PREFERENCE

2. Do you think your attitude toward the experiment has changed since you filled out the last blank like this? YES - NO

3. If your attitude has changed are you MORE or LESS interested in it than you were then?

4. Can you honestly say that you have tried to improve your score in code writing from day to day? YES - NO

5. Can you honestly say that you have tried to improve your score in addition from day to day? YES - NO

6. Have you ever had any training that would tend to make you good in addition? YES - NO

7. Have you ever worked with anything similar to the code writing which might help your score? YES - NO

Analysis of the answers to questionnaire number 2 follows.

Question Number

1. With which material do you prefer to work?

	Code writing	Addition	No preference
Control	34	5	4
Motivated	25	10	7

2. Do you think your attitude toward the experiment has changed since you filled out the last blank like this?

	Yes	No	No answer
Control	23	20	0
Motivated	18	23	2

3. If your attitude has changed are you more or less interested in it than you were then?

	More	Less	No answer
Control	17	5	21
Motivated	18	0	25

4. Can you honestly say that you have tried to improve your score in code writing from day to day?

	Yes	No	No answer
Control	40	2	1
Motivated	42	1	0

5. Can you honestly say that you have tried to improve your score in addition from day to day?

	Yes	No	No answer
Control	38	4	1
Motivated	43	0	0

6. Have you ever had any training that would tend to make you good in addition?

	Yes	No
Control	7	36
Motivated	9	34

7. Have you ever worked with anything similar to the code writing which might help your score?

	Yes	No
Control	2	41
Motivated	0	43

QUESTIONNAIRE NUMBER 3

Name _____ Date _____

Place of birth: Town _____ State _____

Did you graduate from high school? YES - NO

What was the name of the high school? _____

1. Have you taught? YES - NO How long _____ years

2. Do you especially like mathematics? YES - NO

3. Do you especially like English? YES - NO

4. Are you GREATLY - MODERATELY - SLIGHTLY interested in psychology?

5. What is your favorite subject or study? _____

The answers to the question "Place of birth" showed that forty-one of the members of the control group were born in the state of Alabama, that one member was born in Georgia, and one member omitted the question. In the motivated group, forty-two members were born in the state of Alabama, and the other member in Tennessee. All members of both groups were high-school graduates. The schools from which they were graduated were for the most part small town high schools or county and consolidated schools. A very small number were from larger city high schools. Tabulation of the answers to questionnaire number 3 follows.

Question Number

1. Have you taught?				How long?	
	Yes	No	No answer	1 year	2 years
Control	3	39	1	2	1
Motivated	2	41	0	1	1 (3 years)

2. Do you especially like mathematics?

	Yes	No
Control	21	22
Motivated	22	21

3. Do you especially like English?

	Yes	No
Control	28	14
Motivated	32	11

4. Are you greatly, moderately, slightly interested in psychology?

	Greatly	Moderately	Slightly
Control	15	23	5
Motivated	16	20	6

(1 No answer)

5. What is your favorite subject or study?

	Geography	History	English	Biology
Control	8	3	12	3
Motivated	3	5	15	1

	Mathematics	Science	Home Economics	Physical Ed.
Control	7	1	1	1
Motivated	7	1	1	1

	Psychology	Music	Chemistry	Foreign Lang.
Control	1	1	0	0
Motivated	4	0	1	1

	No answer
Control	1
Motivated	2

These three questionnaires and their tabulated answers yield information concerning the attitudes of the two groups which seems desirable. The most outstanding thing shown by them is the fact that both groups are so close together in almost every respect.