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TRANSFER OF FATIGUE BETWEEN THE SAME AND DIFFERENT MENTAL FACTORS

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by

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Introduction

The present study is a comparative investigation of transfer of fatigue between mental tasks involving the same and different factors. It is an examination of the relative functional independence, as measured by the criterion of transfer of mental fatigue, of certain mental abilities whose statistical autonomy has already been demonstrated. The topic, then, is intimately concerned with the field of mental fatigue and with the somewhat more limited field of factor analysis, specifically as the latter is applied to psychological factors.

Mental Fatigue. So tenuous and debatable has been the distinction between mental and physical work, that no exact date can be found in the literature where mental work was initially studied for its own sake. Kronecker, in 1870, studied the fatiguability of the gastrocnemius muscle of the frog. In about 1906, Mosso invented the erogograph by means of which the amount of work done by an intact human muscle can be calculated and recorded. Mosso concluded that mental work fatigues the muscles. This point of view was upheld by Maggiora, who was able to do considerably less muscular work after having delivered a lecture than before. Any such conclusion resting on a supposedly clear-cut boundary between the mental and physical aspects of the body is a result of dangerous and unwarranted abstraction, when actually the

organism functions as a whole though specific sensory-neuro-muscular arcs are necessarily involved.

Theories aiming to distinguish between mental and muscular work have flourished. Thorndike defines mental work as work of the nervous system, as distinct from physical work involving the muscles and sense organs. Watson holds that mental work is implicit behavior involving the functioning of the finer skeletal musculature, while physical work is overt behavior calling into play the gross musculature. The conclusion of Bills, and that accepted herein, is that "The distinction between physical work and mental is purely one of degree; the former involving relatively more use of gross muscles and the latter involving relatively more use of the nervous system."[1.]

Only a few studies have been made on the transfer of fatigue from one mental task to another. As was already stated, the organism functions as a unit though one part is of necessity predominant in any given act. It is logical, then, that the fatigue developing from one act should transfer to another act to the extent that the two acts involve the same or related parts of the body. As Bills points out, quantifying the amount of transfer of fatigue between mental processes is more complex than quantifying the amount of

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1. Bills, A. G., General Experimental Psychology, New York, Longmans, Green, 1937, p. 414.

transfer of fatigue between muscles, because of the difficulty inherent in isolating particular mental functions.[1.]

Arai used mental multiplication and word memorization, and found that 9.4 hours of the former caused a 21.4 percent increase in time needed to memorize the word lists. An experiment with her subjects substantiated this transfer, but addition and free association showed no such relationship. She concludes that the amount of transferred fatigue is directly proportional to the amount of fatigue developed in the first task.

Chapman had subjects work as follows: one condition alternated half-minute intervals between addition and cancellation; a second condition alternated addition with rest; in a third condition the subjects worked continuously on one task. He found the greatest fatigue transfer between successive half-minutes occurring in the continuous work condition. The next greatest transfer occurred in the change of task condition, and the least in the condition alternating work with rest.

Bills and McTeer designed an experiment to test directly Robinson's seventh principle of work decrement which states that "the work decrement of a given stimulus-response connection is relative to the decrements which have developed in other stimulus-response connections." Theirs was the first attempt

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1. Bills, A. G., General Experimental Psychology, New York, Longmans, Green, 1937, p. 469.

to employ materials whose mutual similarity could be quantitatively determined. Thus, of the two theories regarding the conditions for transfer of fatigue, the 'common elements' theory and the 'difficulty' theory, their experiment dealt with the former. The task used was the continuous writing of alphabetical sequences differing in the number of identical elements contained therein. The conclusion drawn is that in "alternating between tasks, the general level of performance in each task, as well as the fatigue decrement developing in each task, will be proportional to the number of identical elements in the two tasks."[1.] When the number of identical elements was reduced, the decrease in the transfer was proportional to the reduction in similarity of the elements.

Vickeray, using equations and cancellation tests, found that change of work is almost as effective in reducing the work decrement in the more complex types of mental activity as is a complete rest, if the interpolated task is quite dissimilar to the original one.

In studying the influence of physical fatigue upon immediately subsequent mental work, Dockeray tested the efficiency of subjects in mental work after they had been fatigued physically either by gymnastic exercises involving

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1. Bills, A. G., and McTeer, W. "Transfer of Fatigue and Identical Elements", J. Exper. Psychol. 1932, 15, pp. 23-36.

the whole body or by exercises involving only certain groups of muscles. The mental work consisted of an addition test, a multiplication test, a sound discrimination test, and an association test in which the subjects had to memorize ten pairs of nonsense syllables. The results were inconsistent. The effects of the physical fatigue upon the addition and multiplication varied with the subject and with the amount of physical work done. Some subjects were more efficient after the physical work than after a period of rest. One subject performed poorly after rest, improved after running eighteen laps, and improved still more after twenty-seven and thirty-six laps. The physical work had a negative influence in most cases upon the sound discrimination and association tests.

Fernberger studied the influence of mental and physical work on the formation of judgments in lifted weights. Dynamometric and ergographic work had an adverse effect on the ability of the subject subsequently to form judgments on lifted weights. The physical work had the effect of causing the second weight of each comparison pair to be overestimated, and there was over a thirty percent increase in the interval of uncertainty.

In summarizing the studies made on the effects of muscular on mental fatigue, Bills states that mild amounts of physical fatigue are without marked influence upon mental efficiency, but that some influence should be expected since

the fatigue products of physical exercise are circulated throughout the whole organism via the blood stream.[1.]

As stated previously, Mosso and Maggiora investigated the influence of mental work upon physical work and found that their ergograms were reduced in height and total duration as a result of mental effort. The decreased efficiency appeared not only in the voluntary curve, but also when direct electrical stimulation was applied to the finger muscles. This would indicate that mental fatigue has a direct influence upon the voluntary muscles. It must be mentioned that one of the mental work tasks used, that of delivering a lecture, might be criticized on the basis that it is not essentially mental, since the gross musculature of the body is involved in the task probably as much as is the finer musculature. In contrast to these results, Bolton found that two-hours of addition considerably increased his performance with the ergograph, though the performances were decreased after two-hour walks, and remained unchanged after two-hour rest periods.

Fernberger, in the study mentioned above, reported that intensive mental work, consisting of reading a passage of difficult German for thirty minutes, had no influence upon the formation of judgments in lifted weight experiments. One questions, however, the extent to which mental fatigue

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1. Bills, A. G., General Experimental Psychology, New York, Longmans, Green, 1937, p. 469.

developed in the reading task used.

The somewhat disputed relation of physical and mental fatigue, as revealed in the aforementioned studies, can perhaps be explained in part in terms of the results of the present investigation. Where the predominant factor involved in the first task is entirely or relatively absent, i.e., not called into use, in the subsequent task, we would expect little influence to be exerted by the first task on the performance of the second task. Some transfer of fatigue would be expected because of the general circulation of fatigue products, while the presence or absence of any marked transferred effects may be a function of the factors involved in the work, whether it be physical, mental, both, or a change from one to the other.

Special mention should be made of a study by Cohen which bears a significant relation to the present investigation. Three experiments were conducted to ascertain whether the locus of fatigue from mental work is sensory, motor, or central. The mental work consisted of discriminatory reactions to electrically presented color and form stimuli. The subject had to touch the key corresponding to the stimulus on the glass screen before the next stimulus was automatically presented. To find whether the source of fatigue is sensory or motor, respectively, the transfer of fatigue was measured by comparing the criteria of rate of response, blocks, and inaccuracy in an unworked eye or hand with those

criteria in the same eye or hand after an intervening work period with the corresponding contralateral organ. Over one-hundred percent transfer of fatigue was found from the worked eye to the unworked eye, and from the worked hand to the unworked hand. These facts are taken to mean that the source of fatigue from mental work is neither sensory nor motor, since the inactive organ in each case was apparently as much affected by continued mental work as was the active one. The central-cognitive group of subjects used both eyes and the index finger of one hand, and the shift in work was from color stimuli, to form stimuli, and back to color stimuli. Since there was markedly less transfer of fatigue from the intervening task using one cognitive element to a task with a different cognitive element than there was in the conditions involving the transfer between two sensory or two motor organs, Cohen concluded that the source of fatigue from mental work is central-cognitive. Changing from stimuli of one cognitive aspect to stimuli of another cognitive aspect did relieve the fatigue that had developed from continuous work with the first type of stimuli.

At the same time as the aforementioned study offers proof of the central-cognitive locus of fatigue, it raises the important question of what sorts of change in mental tasks will bring the greatest relief from mental fatigue. The present study seeks a possible answer to this question in terms of factors in mental endowment. Since it has been

proved that mental fatigue is largely central-cognitive, if it can be established that this central-cognitive aspect is composed of certain factors capable of relatively independent functioning and fatiguability, an enormous gain will have been made toward analyzing mental equipment and toward fixing additional valuable principles of mental hygiene.

Factor Analysis. The faculty theory of mental organization is eminent today, as such, largely because of its disrepute. It was the first definite theory concerning the arrangement of abilities, and held that ability in general is made of separate abilities, such as memory, reasoning, etc., looked upon as independent powers.[1] On the physiological side, the corollary to faculty psychology was phrenology, the doctrine developed by Gall and Spurzheim, which assumed that the specific mental faculties can be localized in separate cerebral regions. Thorndike attacked the faculty point of view with his atomistic theory of connectionism, defining abilities in terms of specific stimulus-response units. A person's intelligence, according to Thorndike, is the sum total of these separate elements. The second outstanding attack on the faculty theory has originated in statistical analysis, carried on mainly by Spearman, Holzinger, Kelley, and Thurstone. These factor analysts attempt to

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1. Freeman, F. N., Mental Tests, Riverside Press, 1939, Chpt. XVI.

isolate statistically various abilities, to define them, and to develop tests for them.

Spearman's work with factor analysis resulted in his two-factor theory which grew directly out of the discovery of the hierarchy or degree of intercorrelation existing between tests. He locates a central factor, 'g', which all traits possess to some degree, but with which some capacities or traits are more highly saturated than are others. The second factor, 's', is the specific factor in an activity. Since his original presentation of the theory, Spearman has had to postulate additional factors less broad than 'g', but more broad than 's'.

Thurstone, with whose theory we are most directly concerned, believes that the correlations between tests are accounted for by assuming the existence of certain factors or "primary abilities". Thurstone states, with regard to factor analysis, that "This process will continue for some time until we shall be able to prepare psychological tests that involve only one or two factors instead of three, four, or five, as is the case with most of the tests in current use."[1] He goes on to say that the tests will look entirely different, superficially, from the traits that they may be found to signify. Factor analysis, as applied by Thurstone,

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1. Thurstone, L. L., Primary Mental Abilities, Psychometric Monog., 1, Univ. of Chicago, 1938, p. vi.

hopes to accomplish three ends: (1) the determination of the smallest number of independent abilities that must be postulated in order to account for the table of intercorrelations; (2) the determination of how much of each independent ability is represented by each test; (3) the setting up of regression equations by which an individual's amount of any primary ability can be estimated from tests that depend upon that ability.[1.] The following primary factors, three of which are employed in the present study, have been clearly defined by the configuration of test vectors and given a psychological interpretation by Thurstone as applied to school children: Number, Verbal Meaning, Space, Word Fluency, Induction or Reasoning, and Rote Memory. The factors not yet sufficiently clear for general application are the Perceptual factor and the Deductive factor.[2.]

A simple explanation of factor analysis and the basic assumptions involved will be attempted to acquaint the reader with the nature of the term 'factor', as employed by the factor analysts. Factor analysis is, first of all, a statistical method used to isolate separate aspects or kinds of intelligence. In other words, mental endowment is investigated to find whether or not there exist various

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1. Guilford, J. P., Psychometric Methods, McGraw-Hill, 1936, p. 472.

2. Thurstone, L.L., and Thurstone, T.G., Manual, The Chicago Tests of Primary Mental Abilities, Am. Council on Ed., 1941, p.5.

dimensions or axes of intelligence, rather than simply a composite ability commonly referred to as general intelligence. The assumption of the procedure is that if there are several or more distinct sorts of ability, then those tests that involve one type of ability will correlate fairly highly with each other and not so highly with tests that involve a different sort of ability. In line with this premise, a number of different tests are constructed which are thought to represent these different abilities suspected of independent existence. Verbal ability, memory, reasoning, and the ability to abstract are examples of types of mental ability which factor analysts have had in mind even before any results were achieved statistically.

The factorial analysis begins with the record of objective performances of subjects on the various tests. The correlation between each test and every other individual test is computed, thus indicating the degree of similarity of every test with every other test in the battery. Next, the correlations are carefully studied by the methods of factor analysis in a search for constellations of those tests which correlate highly with each other.[1.] Finally, the the tests making up each constellation are investigated to find what characteristic they have in common -- the common factor -- which of course is taken to account for the high

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1. Seashore, R. H., Fields of Psychology, New York, Henry Holt, 1942, Chpt. XX.

intercorrelations of the tests of a particular cluster. Once a fundamental ability is isolated, then, its psychological significance is determined by inspecting the tests which are known to require that primary ability and by inspecting, as well, those tests in which the primary is known to be absent. Not only is this final step of the psychological interpretation of the factors perhaps the most interesting part of factor analysis, it is the real goal of the whole procedure. The aim, after all, of trying to identify separate and unique mental abilities is to describe the mental make-up of individuals in terms of each of the abilities. Then, by means of a mental ability profile showing a person's level of performance in several primary abilities, the factor analyst hopes to predict with encouraging accuracy one's success in certain fields of endeavor requiring predominantly different types of mental ability.

Definitions

Certain definitions, especially as they relate to the procedure followed, are helpful in clarifying terminology and concepts.

Mental Work is implicit behavior involving little or no gross muscular effort.

Mental Fatigue is a measurable decrement in either output or organic state or subjective feeling-tone resulting from the continuous performance of intellectual work involving implicit behavior, and which disappears with rest from the

work which produced it.

Measurement of Fatigue. The three aspects of mental fatigue, namely, the subjective, the organic, and the objective, represent three variables each of which must be measured independently. For the present purposes only the output or product definition of fatigue is employed. The measurement of this aspect of fatigue is the decrement in the quantity or quality of the product which results from the continuity of the work.

Trait, Ability, Factor. Thurstone makes no clear-cut rhetorical distinction between a trait, ability, or factor. The terms are closely allied. He defines a trait as any attribute of an individual. He views an ability as "a trait which is defined by what an individual can do...Two abilities are statistically independent in a population if their correlation is zero in that population."[1] A trait which corresponds to a primary vector is called a primary trait or a primary factor. Finally, a factor is used to mean the type of ability that appears to be involved in a test. It is important to note that Thurstone's definitions are derived from factor analysis, the statistical approach he uses to analyze the relations in mental make-up. In contrast, the parallel definitions employed in the present study toward the same ultimate goal of analysis of human psychological

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1. Thurstone, L. L., The Vectors of Mind, Univ. of Chicago, 1935, p. 50.

make-up, are based on the transfer of mental fatigue approach. Consequently, our purposes require different distinctions among terms. The above definition of a trait is acceptable. The differences in usage lie with the terms ability and factor.

In the present study, an ability is taken as actual or potential performance, i.e., what a person can do at a particular moment in time. It is dependent upon the presence in the individual of a corresponding factor. The factor, on the other hand, is a stable mechanism which, according to our hypothesis, will behave, as regards fatiguability, as a unit variable. The factor is taken to be a permanent component of the individual's mental equipment; it is assumed to be some sort of physiological mechanism representing an ability and directly evidenced in performance by its characteristic of being separately fatiguable.

Statement of Problem

The purpose of this experiment is to determine the relative degree of transfer of fatigue between tasks involving the same mental factor as compared with the transfer of fatigue, if any, between tasks involving different mental factors. Transfer of fatigue will be the methodological approach toward revealing both the extent to which fatigue carries over intra-and inter-factorially, and, on that basis, the extent to which such tasks are functionally isolable --

the logic being that if statistically distinct factors are functional realities as well, the fatigue transfer between factors will be less than that occurring within the same factor.

Subjects and Conditions of the Experiment

The one hundred college students at the University of Cincinnati serving as subjects were divided into four groups of twenty-five persons each. The subjects were arbitrarily assigned, except that the groups were kept approximately equally divided as to sex. No effort was made to equate the groups in intelligence, but the disparity in intelligence quotients, as determined by the Otis S-A Test of Mental Ability (Higher Examination: Forms A and B), was small. See Table I for the average intelligence quotients for the four experimental groups. The subjects in Groups I, II, and III participated on five different days; the subjects in Group IV participated on only three days. Every appointment with each person was made for a full sixty minutes to preclude his feeling rushed or anxious about another obligation. The first day's appointment for all groups consisted in practice only, and in the administering of the Otis Test. In addition to the five minutes of practice in each task on the first day, the counterbalanced order was followed as further precaution against practice effect, half the subjects in each group starting with the first condition of the group

TABLE I

AVERAGE INTELLIGENCE QUOTIENTS FOR THE FOUR EXPERIMENTAL GROUPS

Group	Averages	Standard Deviations	Standard Errors
I - Verbal	118.6	9.77	1.95
II - Spatial	123.	7.85	1.57
III - Numerical	124.	9.45	1.89
IV - Spatial-Numerical	119.8	7.60	1.52

and going straight through, while the other half started with the third condition of the group and proceeded to the fourth, first, and second conditions. The members of Group IV were equally divided between the two conditions in that group as to starting position.

The reader is referred to the Appendix, Section E, for tables of percentile ranks corresponding to the linguistic (L) and the quantitative (Q) scores in the American Council on Education Psychological examination for the subjects in each group. The significance of this particular examination to the present study is that the two tests, linguistic and quantitative, are designed by L.L. and Thelma Gwinn Thurstone to measure distinct verbal and numerical factors. This American Council test is administered to the incoming Freshmen at the University of Cincinnati, but for various reasons, not every student at the University takes the test. Consequently, the data are given on the tables in every case where the subject took the examination. The tables of percentile ranks, based on national norms, are arranged so that a comparison can be made between a subject's performance on the L and Q material on the American Council test and his performance as regards units of work and errors in the present investigation. See the Appendix, Sections C and D, for the individual results on amount and errors, respectively, for the fourteen experimental conditions. In general, the subjects show higher percentile ranks in linguistic ability than in

quantitative ability on the American Council test. In some individual cases, the discrepancies between percentile ranks are great.[1] A careful examination of the individual records reveals no consistent relationship between the L and Q percentile ranks on the American Council test and the amount of objective decrement in performance found in the present study after tasks of varying degrees of factorial and operational similarity have intervened between a non-fatigue task. However, the extent to which such discrepancies between L and Q ranks may have affected the results cannot be estimated by this study. The two types of information suggest, in fact, the value of another investigation on the relationship between absolute level of performance of a factor and the behavior of that factor in terms of transfer of mental fatigue within and between factors. Furthermore, there is the possibility that a subject who possesses only a small amount of a factor would show fatigue decrement and transferred fatigue in proportion, direct or inverse, to his possession of the factor. Again, a description of the sort of relationship that would exist between the functional excellence of a factor and its fatiguability cannot be

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1. When all the subjects from the four groups are considered together, as in Table XXXIII of the Appendix, Section E, the average percentile ranks in L and Q are fairly close together, but the real interest in the percentile ranks is in the difference in percentile ranking of a single individual in the two tests.

attempted at this juncture.

The fourteen conditions of the experiment are given below. The explanation of the meaning of the names applied to the groups, and the alphabetical symbols, follows subsequently.

Condition	Group
	I - Verbal
I BAB	
II ABA	
V BCB	
VI CBC	
	II - Spatial
III CDC	
IV DCD	
VII ADA	
VIII DAD	
	III - Numerical
IX EFE	
X FEF	
XI BEB	
XII EBE	
	IV - Spatial-Numerical
XIII DED	
XIV EDE	

Preliminary Procedure

Selection of Materials. Before the experiment could be undertaken, tasks had to be located which had already been found to be statistically independent of one another through factor analysis. An examination of the Chicago Tests of Primary Mental Abilities revealed a battery of six primary mental abilities, namely, Number, Verbal Meaning, Space, Word Fluency, Reasoning, and Memory. Of these, three of the abilities -- Number, Verbal Meaning, and Space -- lend themselves to the present purpose, fulfilling the requirements

of being fatiguable, as will be explained, and capable of being objectively measured. A further choice had to be made of the best tests within an ability, since more than one test is given in the original battery for each primary factor.

Research, notably by Bills and Robinson, reveals the amount of decrement in mental work to vary with the nature and difficulty of the task. In testing the principles of homogeneity and continuity with letter sequences differing in similarity, fatigue decrement was found to be proportional to the degree of homogeneity in the tasks. This conclusion was later verified by Poffenberger who used continuous addition, judgment of composition, and intelligence test material. The greatest decrement occurred in the continuous addition. The two laws thus affirmed are the law of homogeneity which states that the more homogeneous the task, the greater the decrement; and the law of continuity, the more continuous the task -- the more rapidly the successive stimulations follow one another -- the greater the decrement. A further point to be considered was the fourth principle of the work decrement which refers to state of practice, and states that mental work involving the operation of firmly established habit systems suffers less fatigue decrement than work involving unpracticed habits.

With these characteristics of a fatigue-producing task in mind, the following factors with the tests of each were chosen for use in the present experiment:

Factor	Letter Symbol	Nature of Task
Verbal Meaning	A	Completion
	B	Vocabulary
Number	E	Addition
	F	Multiplication
Space	C	Cards
	D	Figures

Inasmuch as the published tests are material enough for only five and six minutes each of work, it was necessary to expand them to provide work for from thirty-nine minutes to seventy-three minutes per task, depending upon the number of times that task was to appear in conditions involving the same subjects. In lengthening the tests, the same principles exactly were embodied as in the original Thurstone material. The materials are the same in appearance, principle, and difficulty. See Appendix, Section B, for one sheet from each of the six tasks used.

Use of Objective Fatigue. Of the three approaches to the study of fatigue, the subjective, the organic, and the decrement in output, the latter was found best for the present hypothesis and materials to be used. Objective fatigue has been studied by two main methods, the continuous work method, and the interpolated task method. In the continuous work method, a continuous record of the subject is kept per unit of time throughout the period of uninterrupted work. The task used must be highly homogeneous and the quality of output is measured usually by the criterion of

accuracy, while quantity of performance is measured by units of work done per interval of time. The interpolated task method is based on the theory that an interpolated task is a better test of fatigue than the work task itself, so a task is introduced at intervals of time, the level of performance of which is taken as the measure of fatigue in the original task. The continuous work method, preferred by most recent investigators, is the one employed in this study.

A slight variation on the continuous work method is made in that every condition in the present experiment contains two minutes of one task, called the non-fatigue task, immediately followed by thirty minutes of another task in the same or a different primary ability, called the fatigue task, and then there follows two minutes more of the original non-fatigue task. The time intervals of two minutes before and after the thirty minute fatigue task were considered, in the case of the non-fatigue task, to be long enough to be an adequate measure of original performance and transferred decrement without being so long as to produce marked fatigue from the task itself.

The thirty-second interval of time is used in every task and condition in order to furnish small enough units, as Chapman and Nolan suggest, to reveal fine characteristics of the work curve.[1]

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1. Chapman, J.C., and Nolan, W.J., "Initial Spurt in a Simple Mental Function," Amer. J. Psycho., 1916, 27, 256-259.

Measuring Objective Fatigue. As already stated, objective fatigue is measured in terms of the decrement in quantity and quality of performance. The curve of work resulting from the continuous work method and employing these criteria is often complicated by certain factors, especially practice, which frequently make it unreliable to estimate the degree of fatigue entirely from the first and last points of the work curve. There are two tendencies in the work curve, one toward a rise due to practice, the other toward a drop due to fatigue. The fatigue may be entirely masked by practice, and vice versa. Several methods, some of which attempt to obviate this practice effect, have been used.

Oehrn, for work curves for one hour's continuous mental work on such tasks as memorizing, addition, controlled association, applied the following formulas:

$$\text{Practice} = \frac{(M-m_1) \times 100}{M}$$

$$\text{Fatigue} = \frac{(M-m_2) \times 100}{M}$$

where M represents the point of maximum efficiency, m_1 represents the first point of minimum efficiency, and m_2, the second point of minimum efficiency. This method is unsatisfactory for use in the present study since it assumes that the work curve shows an invariable drop in performance.

The Thorndike method of measuring objective fatigue is to subtract the subject's level of performance at the end of

a work period from his level of performance as tested after a period of rest sufficiently long to have removed the temporary effects of fatigue, but short enough to have allowed retention of the relatively permanent effects of practice. This method could not be used with the present data because not every task was tested a second time at the conclusion of a rest period, thus providing no basis for the comparison of performance before and after rest which is a fundamental step in Thorndike's procedure.

Cohen, in a study of transfer of fatigue which closely parallels the present one in arrangement of the tasks, used a direct measure of transfer by obtaining the percentage decrement in the non-fatigue task from the first two-minutes performance to the final two-minutes performance, and by then comparing this decrement with the loss in efficiency in the fifteen-minute fatigue task. The ratio of the percentage decrement of the non-fatigue task to the percentage decrement of the fatigue task yielded a percentage representing the transfer of fatigue from the fatigue to the non-fatigue task. For Cohen's purposes, such a ratio was satisfactory because the fatigue and the non-fatigue tasks were essentially the same. In the present study, however, the fatigue and the non-fatigue tasks differ always, either in type of test or in primary factor, or both. Consequently, it would not be justified to compare and employ in a formula these decrements, developing as they do in entirely different

kinds of materials. No basis is afforded for comparison of such decrements.

In view of the foregoing, two methods of dealing with the data were adopted, a statistical approach dealing with a direct comparison of the units of work done during the first two minutes of the non-fatigue task compared with the units of work done during the second two minutes of the non-fatigue task, and a comparison of increase in errors in the same two periods. This yielded percent decrement for units, percent increment for errors, and percentage of cases showing decrements and increments, respectively, in the second two minutes of the non-fatigue task over the first two minutes of the non-fatigue task. Because of the frequency of minus signs in the individual data, the comparisons between conditions were made in terms of critical ratios based on the standard errors of the percentage of cases in each condition showing decrements in units completed and increments in errors made between, as stated above, the first and second two minutes of the non-fatigue task.

Secondly, a graphical study of the group work curve was made for units of work completed per thirty-second interval for the first two minutes and second two minutes of the non-fatigue task, and including the average number of units of work done during the first and last two minutes of the thirty minute fatigue task for each experimental condition. No graphical examination for errors was warranted because of

the small number of errors per thirty-second interval. The graphical presentation of the level of performance was expected to reveal changes in level of performance not shown by a purely statistical comparison of data. The logic in both approaches, however, is that any difference in performance in the second two minutes of the non-fatigue task as compared with the first two minutes is due to the intervening thirty-minute fatigue task. The first two minutes of the non-fatigue task is used as its normal level of efficiency to be compared with the level attained after the fatigue task has intervened.

Apparatus and Procedure

The task material was enlarged upon so as to provide enough work for the time the subject was to be engaged in the particular task. The sheets of the task which a subject was to use were clipped together and put in a folder marked with subject's name, group and counterbalanced order, along with the other one or two tasks which he would use. The subjects in Group IV used only two tasks, while the other seventy-five persons worked on three tasks in the course of their participation.

A stop-watch and pencils completed the apparatus. A reflector lamp, in addition to ceiling illumination, was kept burning throughout the work period for each subject.

The subject was seated at the end of a table at

right-angles to the experimenter. The shift in sheets of work was handled by the experimenter in such a swift and calm manner as to result in no apparent interruption or disturbance to the subject.

Experimental Procedure

Each subject had a day of practice, on which he was urged to ask as many questions as necessary to assure his complete understanding of each task. Both oral and written instructions were given. See the Appendix, Section A, for the directions for each task and for each day of participation. The subject was given five minutes of practice in every task under the same conditions as in the experiment proper, i.e., no talking, except for the experimenter's word "Mark!" every thirty seconds, at which signal the subject put a vertical line after whatever he had just completed and went right on with the work. No verbal sign was given when the subject was to switch tasks. The experimenter merely removed the one sheet, slid the new one before the subject and indicated, by pointing, where the subject should begin. Before work on each day, the subject was asked whether he had any questions regarding the tasks, to preclude delay due to lack of understanding once the work was to begin.

The following list of conditions will clarify the factors, the tasks, and the two-minute - thirty-minute - two-minute time relationships. Obviously, in order to test our hypothesis

of whether fatigue developing from continuous mental work in one task will transfer to a greater extent to immediately subsequent mental work in the same primary factor than it will to immediately subsequent mental work in a different primary factor, it is necessary to set up conditions both in which the same and different primary factors are involved.

Condition and Factors	Time and Tasks 2"	30"	2"	Group
I BAB:Verbal-Verbal-Verbal	B-vocab.	A-comp.	B-vocab.	I
II ABA:Verbal-Verbal-Verbal	A-comp.	B-vocab.	A-comp.	
V BCB:Verbal-Spatial-Verbal	B-vocab.	C-cards	B-vocab.	
VI CBC:Spatial-Verbal-Spatial	C-cards	B-vocab.	C-cards	
III CDC:Spatial-Spatial-Spatial	C-cards	D-figs.	C-cards	II
IV DCD:Spatial-Spatial-Spatial	D-figs.	C-cards	D-figs.	
VII ADA:Verbal-Spatial-Verbal	A-comp.	D-figs.	A-comp.	
VIII DAD:Spatial-Verbal-Spatial	D-figs.	A-comp.	D-figs.	
IX EFE:Numer.-Numer.-Numer.	E-addit.	F-mult.	E-addit.	III
X FEF:Numer.-Numer.-Numer.	F-mult.	E-addit.	F-mult.	
XI BEB:Verbal-Numer.-Verbal	B-vocab.	E-addit.	B-vocab.	
XII EBE:Numer.-Verbal-Numer.	E-addit.	B-vocab.	E-addit.	
XIII DED:Spatial-Numer.-Spatial	D-figs.	E-addit.	D-figs.	IV
XIV EDE:Numer.-Spatial-Numer.	E-addit.	D-figs.	A-addit.	

Insofar as possible, the appointments with each subject were made at the same hour on consecutive days. No participant had any idea of the purpose of the experiment, and it was explained to him that his performance would, voluntarily or involuntarily, be affected were he to be aware of the purpose. The temperature of the room, illumination, and attitude of the experimenter were kept as constant as possible. Because of the complexity of changing sheets, each subject participated individually so the experimenter could most carefully watch his progress and be ready with a new sheet of the same task,

or with a new sheet of a different task at the end of the requisite time intervals.

Since each work sheet was marked off in thirty-second intervals by the subject, the experimenter had only to count the number of units of work completed within each interval and to hand-score the work for errors by means of a key. A separate page was kept for each subject, showing the number of units of work done and the errors per thirty seconds of the non-fatigue task, and showing the same information for the first and last two minutes of the fatigue task. See the Appendix, Sections C and D, respectively, for the average number of units of work completed and the percent decrement, and the average number of errors and percent increment during the first and second two minutes of each non-fatigue task for each subject.

Results

The treatment of results is divided into two parts. Experiment I deals with the transfer of fatigue within and between the numerical and verbal factors only. This involves Conditions I BAB, II ABA, IX EFE, X FEF, XI BEB, and XII EBE. Experiment II deals with transfer of fatigue within and between the spatial and verbal, and spatial and numerical factors. This involves the remaining eight conditions, V BCB, VI CBC, III CDC, IV DCD, VII ADA, VIII DAD, XIII DED, and XIV EDE. The final conclusions and interpretations will

be based on a composite consideration of all the results obtained.

A minus sign in the data indicates an increase in units of work completed during the second two minutes of the non-fatigue task as compared with the first two minutes, or a decrease in errors. That is, a positive number is used where the criteria indicate fatigue, which is looked upon as the expected or normal. The same use of signs is made with the data for the fatigue tasks.

Experiment I

This experiment is a comparison of the transfer of fatigue between two verbal tasks or two numerical tasks as opposed to the transfer of fatigue between tasks involving both the verbal and numerical factors. The two objective criteria of percent of cases showing decrement in performance in the second two minutes of the non-fatigue task as compared with the first two minutes, and the percent of cases showing an increase in errors during the second two minutes of the non-fatigue task over the first, are used in the statistical treatment. In tables giving composite data, total percent decrements and increments for units and errors, respectively, are given also. The graphical treatment deals with units of work completed only.

Results for Amount. Table II shows that under Condition IX EFE, of continuous performance in the same primary

ability, 72% of the subjects showed a fatigue decrement, as opposed to 44% of the subjects who showed a decrement in Condition XII EBE, where the tasks switched from numerical to verbal, back to numerical. The critical ratio, 2.09, is interpreted as meaning that the chances are 98 in 100 that the obtained difference between the percent of cases showing decrement under the two conditions is significant. Tables III and Tables XXXIV and XXXV in the Appendix, Section F, give an even fuller picture in considering,as they do,more and more of the conditions which involve the two factors. Where Conditions XI BEB and XII EBE are considered compositely in contrast to Conditions IX EFE and X FEF, the total percent decrement for the between factors conditions is 6.07%, while the total percent decrement within the numerical factor is 20.81%. The critical ratio of the percent of cases showing decrement is 3.44. The same trend is upheld in Tables XXXIV and XXXV in the Appendix, Section F, which deal with the combined results from five and six conditions, respectively. The critical ratio, Appendix, Section F, Table XXXV, where all the intra-factor and inter-factor conditions of the verbal and numerical factors are considered, is 2., again indicating 98 chances in 100 that the obtained difference between the percent of cases showing decrement is significant.

Results for Accuracy. Tables IV and V, and the two tables XXXVI and XXXVII in the Appendix, Section F, present the data in similar fashion for percentage increase in errors

TABLE II

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	%Cases Showing Decrement	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma Dp$
XII EBE	44%	9.9%	28.%	13.4%	2.09
XIX EFE	72%	9.%			

TABLE III

A COMPOSITE COMPARISON OF PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XI BEB, XII EBE	6.07%	.121%	44.%	7.0%	32.%	9.3%	3.44
IX EFE,	20.81%	.416%	76.%	6.0%			

and the percentage of cases showing an increase in errors. In every instance the evidence is in the direction of a smaller percentage of cases showing increase in errors in the conditions in which the thirty-minute fatigue task is of a different factor from the non-fatigue task.

Graphical Analysis.

In addition to the work curves themselves, the data for the initial and final thirty second intervals of the first two minutes of the non-fatigue task, and for the initial thirty-second interval of the second two minutes of the non-fatigue task are presented in tabular form in Tables VI and VII, with the percentage decrement occurring between the final one-half minute of the first two minutes and the initial one-half minute of the second two minutes, and between the initial half minutes of both the first and second two minutes of the non-fatigue task. Table VIII presents the decrements in units of work between the initial and final one-half minute of the first and second two minutes of the non-fatigue task, while Table IX presents the corresponding data for the first and last two minutes of the thirty-minute fatigue tasks.

The above evidence for accuracy is well-supported by the graphical and tabular presentation of the average number of units of work completed in the initial one-half minute of the first two minutes of the non-fatigue task compared with the average number of units of work completed in the initial one-half minute of the second two minutes. Equally convincing is the comparison of the average number of units

of work completed in the final one-half minute of the first two minutes of the non-fatigue task against the average number of units of work completed in the initial one-half minute of the second two minutes of the non-fatigue task.

This graphical material must be studied not only in the light of the actual differences in performance between the two half-minutes of the non-fatigue task compared, but in relation also to the nature of the intervening task and the influence of that task upon other tasks between which it has intervened. For example, a comparison of the percent decrement between the initial half-minutes of the non-fatigue task of Concition I BAB and that of Condition XI BEB, shows that the former has a smaller percent decrement than the latter. Were this absolute difference considered alone, the trend would point toward greater decrement between factors. This half-picture would lead to an erroneous conclusion. Referring to Table VII, rows 1 and 9, it is seen that Task A as a fatigue task produces more transferred decrement to a task in its own factor than it does to a task in a different primary factor. In the same way, the fatigue transfer in Condition XI BEB is markedly less than the fatigue which Task E transfers to a task within the same ability, namely numerical. The relationship of the thirty-minute fatigue task to the two-minute non-fatigue task is in every condition involving just the numerical and verbal factors, that of transferring more decrement to a task involving the same

TABLE IV

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	%Cases Showing Increase in Errors	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
XII EBE	28%	9.%	12.%	13.3%	.902
XIX EPE	40%	9.8%			

TABLE V

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase In Errors	Av. % Increase in Errors	%Cases Showing Increase in Errors	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XI BEB, XII EBE	9.7%	.194%	32.%	6.6%	2.%	9.4%	.213
IX EFE, X FEF	28.5%	.57%	34.%	6.6%			

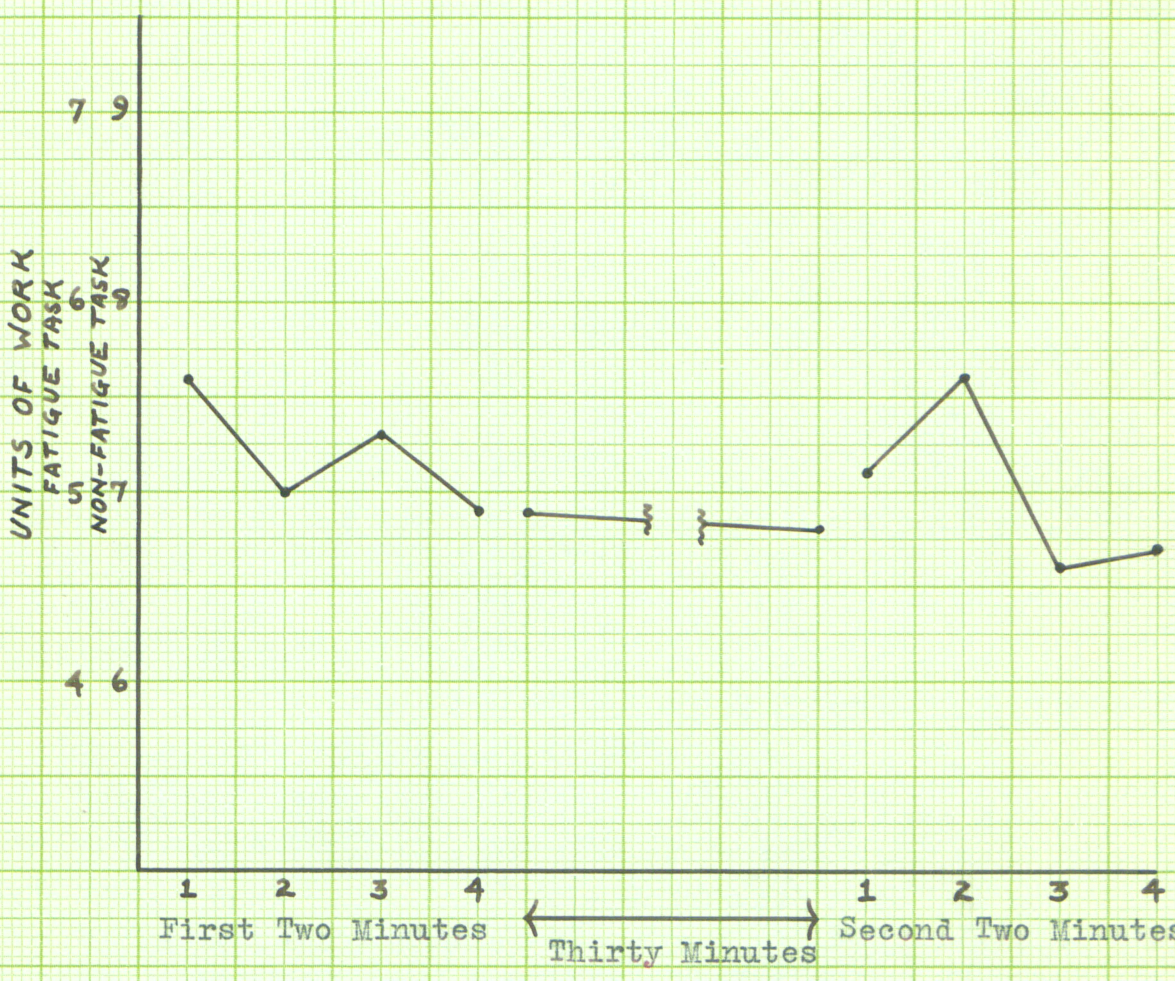

Fig. 1. Group curve showing average number of units of work completed per thirty-second interval during first and second two-minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two-minutes of the thirty minute fatigue task.

CONDITION I BAB

Fig. 2. Group curve showing average number of units of work completed per thirty-second interval during first and second two-minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two-minutes of the thirty minute fatigue task.

CONDITION XI BEB

Fig. 3. Group curve showing average number of units of work completed per thirty-second interval during first and second two-minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two-minutes of the thirty minute fatigue task.

CONDITION II ABA

Fig. 4. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION IX EFE

Fig. 5. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two-minutes of the thirty minute fatigue task.

CONDITION XII EBE

Fig. 6. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two-minutes of the thirty minute fatigue task.

CONDITION X FEF

TABLE VI

AVERAGE NUMBER OF UNITS OF WORK COMPLETED IN FINAL ONE-HALF MINUTE OF FIRST TWO MINUTES OF THE NON-FATIGUE TASK COMPARED WITH THE AVERAGE NUMBER OF UNITS OF WORK COMPLETED IN THE INITIAL ONE-HALF MINUTE OF THE SECOND TWO MINUTES OF THE NON-FATIGUE TASK FOR THE FOURTEEN CONDITIONS

Non-fatigue Task	Condition	Av.No.Units of Wk., Final 1/2 min. 1st 2"	Av.No.Units of Wk., Initial 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
B	I BAB	6.9	7.1	-.2	-3.%
	V BCB	6.8	6.9	-.1	-1.5%
	XI BEB	6.6	6.3	.3	4.5%
A	II ABA	5.2	4.4	.8	15.4%
	VII ADA	5.2	4.8	.4	7.7%
C	III CDC	14.9	16.8	-1.9	-11.3%
	VI CBC	16.2	18.7	-2.5	-15.6%
D	IV DCD	18.1	21.2	-3.1	-17.1%
	VIII DAD	20.2	22.8	-2.6	-12.9%
	XIII DED	11.6	13.2	-1.6	-13.8%
E	IX EFE	3.5	2.9	.6	17.1%
	XII EBE	4.	3.9	.1	2.5%
	XIV EDE	3.8	3.6	.2	5.3%
F	X FEF	7.8	6.7	1.1	14.1%

TABLE VII

AVERAGE NUMBER OF UNITS OF WORK COMPLETED IN INITIAL ONE-HALF MINUTE OF FIRST TWO MINUTES OF THE NON-FATIGUE TASK COMPARED WITH THE AVERAGE NUMBER OF UNITS OF WORK COMPLETED IN THE INITIAL ONE-HALF MINUTE OF SECOND TWO MINUTES OF THE NON-FATIGUE TASK FOR THE FOURTEEN CONDITIONS

Non-fatigue Task	Condition	Av.No.Units of Wk., Initial 1/2 min. 1st 2"	Av.No.Units of Wk., Initial 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
B	I BAB	7.6	7.1	.5	6.6%
	V BCB	7.4	6.9	.5	6.8%
	XI BEB	6.8	6.3	.5	7.4%
A	II ABA	4.9	4.4	.5	10.2%
	VII ADA	5.4	4.8	.6	11.1%
C	III CDC	16.6	16.8	-.2	-1.2%
	VI CBC	17.7	18.7	-1.	-5.7%
D	IV DCD	20.6	21.2	-.6	-2.9%
	VIII DAD	23.2	22.8	.4	1.7%
	XIII DED	13.9	13.2	.7	5. %
E	IX EFE	3.6	2.9	.7	19.4%
	XII EBE	4.	3.9	.1	2.5%
	XIV EDE	3.8	3.6	.2	5.3%
F	X FEF	8.	6.7	1.3	16.3%

TABLE VIII

AVERAGE NUMBER OF UNITS OF WORK COMPLETED IN THE INITIAL AND FINAL ONE-HALF MINUTE OF FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK AND THE PERCENTAGE DECREMENTS FOR THE FOURTEEN CONDITIONS

Non-fatigue Task	Condition	Av.No.Units of Wk., Initial 1/2 min. 1st 2"	Av.No.Units of Wk., Final 1/2 min. 1st 2"	Absolute Loss	% Dec.	Av.No. Units of Wk. Init'l 1/2min. 2nd 2"	Av.No. Units of Wk. Final 1/2min. 2nd 2"	Ab. Loss	% Dec
B	I BAB	7.6	6.9	.7	9.2%	7.1	6.7	.4	5.6
	V BCB	7.4	6.8	.6	8.1%	6.9	6.5	.4	5.8
	XI BEB	6.8	6.6	.2	2.9%	6.3	6.4	-.1	-1.5
A	II ABA	4.9	5.2	-.3	-6.1%	4.4	5.	-.6	-13.6
	VII ADA	5.4	5.2	.2	3.7%	4.8	4.8	-	-
C	III CDC	16.6	14.9	1.7	10.2%	16.8	14.8	2.	11.4
	VI CBC	17.7	16.2	1.5	8.4%	18.7	15.2	3.5	18.7
D	IV DCD	20.6	18.1	2.5	12.1%	21.2	19.4	1.8	8.5
	VIII DAD	23.2	20.2	3.	12.9%	22.8	20.4	2.4	10.5
	XIII DED	13.9	11.6	2.3	16.5%	13.2	13.2	-	-
E	IX EFE	3.6	3.5	.1	2.8%	2.9	3.3	-.4	-13.8
	XII EBE	4.	4.	-	-	3.9	3.9	-	-
	XIV EDE	3.8	3.8	-	-	3.6	3.6	-	-
F	X FEF	8.	7.8	.2	2.5%	6.7	7.4	-.7	-10.4

TABLE IX

GROUP TOTALS, AVERAGES, PERCENTAGE DECREMENTS IN UNITS OF WORK COMPLETED DURING THE FIRST AND LAST TWO MINUTES OF THE THIRTY-MINUTE FATIGUE TASKS FOR EACH CONDITION

Fatigue Task	Condition	Total No. Units of Work, 1st 2"	Av. No. Units of Work 1st 2"	Total No. Units of Work, last 2"	Av. No. Units of Work last 2"	Absolute Loss	Percent Decrement
B	II ABA	719	28.76	719	28.76	-	-
	VI CBC	683	27.32	728	29.12	-1.80	-6.6%
	XII EBE	620	24.8	763	30.52	-5.72	-23.1%
A	I BAB	496	19.84	477	19.08	.76	3.83%
	VIII DAD	425	17.	427	17.08	-.08	-.5%
C	IV DCD	1849	73.96	1838	73.52	.44	.6%
	V BCB	1111	44.44	1380	55.2	-10.76	-24.2%
D	III CDC	1536	61.44	1712	68.48	-7.04	-11.5%
	VII ADA	1794	71.76	1748	69.92	1.84	2.6%
	XIV EDE	1184	47.36	1240	49.6	-2.24	-4.7%
E	X FEF	360	14.4	335	13.4	1.	6.9%
	XI BEB	363	14.52	350	14.	.52	3.6%
	XIII DED	355	14.2	339	13.56	.64	4.5%
F	IX EFE	610	24.4	662	26.48	-2.08	-8.5%

primary ability than to a task involving a different primary ability.

Summarizing, then, by both approaches used and by both criteria of objective decrement, the transfer of fatigue is found to be greater within the factors of either numerical or verbal ability, and less when the subject changes over from one factor to the other in the course of the work. Said another way, the evidence so far indicates the existence of verbal and numerical factors as functional entities, isolable by the transfer of fatigue method.

Experiment II

This experiment is concerned with transfer of fatigue within the same factor as compared with transfer of fatigue between the numerical and spatial, and spatial and verbal factors. The experiment further deals with tasks varying in similarity in ways other than factorial identity or difference. Some consideration is given to all of the conditions within the same factors as opposed to all of the experimental conditions involving crossed factors.

Results for Amount. Tables X through XX, and Tables XXXVIII through XLI in the Appendix, Section G, present the data for percent decrement and critical ratios for the percentage of cases showing decrement in units of work completed per half-minute of the non-fatigue task, where one set of the fatigue tasks is composed of tasks of different factorial order from

the non-fatigue tasks. According to Table X, in which all fourteen experimental conditions are represented, an insignificantly greater percent of cases showed decrement in the intra-factorial conditions. The other data, as will be pointed out, show certain complicating features operating in certain of the tasks, namely, the spatial tasks and one verbal task, Task A, completion. Also, a common operation was found to exist between Task B, a verbal task, and Task C, a spatial task, which tended to complicate the results.

In Table XI, effort was made to purify the data by leaving out Conditions III CDC, IV DCD, V BCB, and VI CBC. These eliminations were justified on two bases. Firstly, both spatial tasks were characterized by great practice effect. Tasks C and D, both as fatigue and non-fatigue tasks show either large increments or negligible decrements. In Condition III CDC, for example, it is strongly suggested that the similarity of the two tasks was so great that the work in one task actually practiced the other. Apriori reasoning upon examination of the materials themselves would indicate the same possibility. Secondly, a definite relationship was found to exist between Task C, spatial, and Task B, verbal. See Table XIX, in which the Condition VI CBC shows a greater number of cases exhibiting decrement than does Condition III CDC. A study of the vocabulary and card tasks suggests that Tasks B and C involve the same operations -- that of choosing likenesses and differences -- though the tasks

TABLE X

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
V BCB, VI CBC, VII ADA, VIII DAD, XI BEB, XII EBE, XIII DED, XIV EDE	19.69%	.098%	52.5%	3.5%	.83%	5.4%	.154
I BAB, II ABA, III CDC, IV DCD, IX EFE X FEF	14.36%	.096%	53.33%	4.1%			

TABLE XI

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
VII ADA, VIII DAD, XI BEB, XIII DED, XIV EDE, XII EBE	14.19%	.094%	50.7%	4.1%	10.3%	6.4%	1.61
I BAB, II ABA, IX EFE, X FEF	24.84%	.248%	61. %	4.9%			

TABLE XII

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
VIII DAD, XI BEB, XII EBE, XIII DED, XIV EDE	7.87%	.063%	49.6%	4.5%	17.1%	7.0%	2.44
I BAB, IX EFE, X FEF	23.58%	.314%	66.7%	5.4%			

TABLE XIII

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
VII ADA, VIII DAD	6.41%	.128%	54.%	7.0%	16.%	9.9%	1.62
III CDC, IV DCD	-10.48%	-.210%	38.%	6.9%			

TABLE XIV

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND DIFFERENT OPERATION

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
IV BCB, VI CBC	5.5%	.11 %	58.%	6.9%	12.%	9.9%	1.21
I BAB, II ABA	4.03%	.083%	46.%	7.0%			

represent two different abilities in accordance with the factorial analysis of Thurstone. Table XX, a comparison of the percentage of cases showing decrement in Condition I BAB as opposed to Condition V BCB, points to the same possibility of operational similarity between Tasks C and B, since the latter interfactorial condition resulted in more cases showing decrement than did the intra-factorial condition, Condition I BAB. It is possible, then, that operational similarity is more fundamental in producing transferred fatigue than is factorial similarity alone. However, the marked transferred decrement in Conditions IX EFE and X FEF, both within the numerical factor, would indicate the factors to be more basic to fatigue transfer than the operations in the tasks therein.

In Table XII an additional elimination is made, since Task A or Condition II ABA was another case in which practice effect apparently masked fatigue decrement. See Table XII, Experiment I, row 4, which shows the increments in Task A in Condition II ABA, in the final one-half minutes of both the first and second two minutes of the non-fatigue task. With Condition II ABA thus eliminated because of its susceptibility to practice, it is clearly seen from Table XVI that a significantly fewer percentage of cases exhibited decrement when the tasks were alternated between different factors, than when the change in tasks remained within the same factor.

In Table XIII, it is seen that fewer cases showed decrement in working in the spatial factor alone than when the work was changed from spatial to verbal, or from verbal to spatial factors. In interpreting this and the remainder of the tables in which the spatial factor is pitted against another factor, the existence of similarity between the two spatial tasks to the point of near identity must be borne in mind. This practice effect operates to lessen the fatigue transfer or to mask it in switching to the same mental ability. A further aspect of practice effect, that of practice effect in each of the spatial tasks themselves, is discussed in the graphical treatment.

Table XIV, as mentioned above, is apparently complicated by the similarity of operation in Tasks B and C, so that more fatigue actually transferred between these tasks than between Tasks A and B, though the former are statistically located in separate factors.

Table XV shows a significantly greater number of cases showing fatigue within the numerical ability than under the conditions of changing from numerical to spatial, and from spatial to numerical. This critical ratio of 2.39 is real evidence for a greater fatigue transfer within the numerical ability than between it and the spatial ability. The reverse table, Table XVI, where the comparison is between the spatial tasks and the numerical and spatial alternated, at first seems to refute the aforementioned evidence of distinction

TABLE XV

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XIII DED, XIV EDE	1.7.%	.034%	54.%	6.9%	22.%	9.2%	2.39
IX EFE, X FEF	20.81%	.416%	76.%	6.0%			

TABLE XVI

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XIII DED, XIV EDE	1.71%	.034%	54.%	7.0%	16.%	9.9%	1.62
III DDC, IV DCD	-10.48%	-.210%	38.%	6.9%			

TABLE XVII

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σ_{D_p}	Critical Ratio, D/σ_{D_p}
VI CBC, V BCB	5.5 %	.11%	58.%	6.9%	20.%	9.8%	2.04
III CDC, IV DCD	-10.48%	-.210%	38.%	6.9%			

TABLE XVIII

A COMPOSITE COMPARISON OF THE PERCENTAGE DECREMENT AND PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND DIFFERENT OPERATION

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
III CDC, IV DCD	-10.48%	-.210%	38.%	6.9%	8.%	9.8%	.816
I BAB, II ABA	4.03%	.083%	46.%	7.0%			

TABLE XIX

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION

Condition	%Cases Showing Decrement	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
VI CBC	52%	9.9%	8.%	14.1%	.567
III CDC	44%	9.9%			

TABLE XX

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND DIFFERENT OPERATION

Condition	%Cases Showing Decrement	SE_p	Difference between %	$6D_p$	Critical Ratio, $D/6D_p$
V BCB	64%	9.6%	16.%	13.8%	1.16
VI BAB	48%	9.9%			

between the spatial and numerical factors, but this apparent contradiction must be considered in the light of the large practice effect in the spatial ability, which practice effect produces a spuriously low percentage of cases showing decrement in Conditions III CDC, and IV DCD.

Table XVII is a composite of conditions composed of a similar operation and different factors versus conditions composed of the same operation and the same factor. This evidence, too, at first points to the possibility of operational similarity being stronger than factorial similarity. To be accurate, it must be observed that the total percent decrement for the spatial conditions, which turns out in fact to be an increment, and the percent of cases showing decrement are not valid bases for comparison, unless it is taken into account, as it probably should be, that any two tasks involving the same operation and same factor would practice each other. The evidence for operational similarity of Tasks B and C does not suffer through lack of other comparison, however, for the high percentage of cases showing decrement in Condition VI CBC and Condition V BCB is evidence enough for suspecting a more than ordinary inter-factorial relationship between the two tasks.

Table XVIII, like Table XIII, is complicated by the increment rather than decrement, in the spatial tasks so that no dependable inferences may be drawn as to the relative strengths of similar operations in the same factor and different

TABLE XXI

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND DIFFERENT OPERATION

Conditions	Total % Increase in Errors	Av. % Increase in Errors	%Cases Showing Increase in Errors	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
IV BCB, VI CBC	14.1%	.282%	42.%	6.9%	8.%	9.6%	.833
II BAB, II ABA	-20.2%	-.404%	34.%	6.6%			

operations within the same factor. Tasks C and D are taken to be similar operations in the same factor; Tasks A and B are different operations in the same factor. Additional tables for amount for Experiment II appear in the Appendix, Section G.

Results for Accuracy. The tables for errors, Tables XXI and XXII, and Tables XLII through LIV found in the Appendix, Section G, paralleling those for units discussed above, show the practice effects in Tasks C and D operating to reduce, rather than to increase, the number of errors made as work progresses in the spatial factor. Further evidence for the similarity of operation in Tasks B and C is furnished in Table XXI, where the total percent increase in errors and the percent of cases showing an increase in errors is greater where the operation is similar and the factors different than where the operations are dissimilar and the factor the same. In Table XXII, the critical ratio of 3.29 obtained between the percent of cases showing increase in errors in Conditions VI CBC and V BCB versus Conditions III CDC and IV DCD, further supports evidence already observed to the effect that Tasks C and D are so alike as to practice one another. Furthermore, as will be discussed below, the fact that so many units of C and D could be done in a given time interval explains their improvements, as measured by the criterion of accuracy, within each task itself and aside from transferred practice effect.

TABLE XXII

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATIN

Conditions	Total % Increase in Errors	Av. % Increase in Errors	%Cases Showing Increase in Errors	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
VI CBC, V BCB	14.1%	.282%	42.%	6.9%	28.%	8.5%	3.29
III CDC, IV DCD	-78.5%	-1.57 %	14.%	4.8%			

Graphical Analysis. The group curves in which the spatial tasks occur as the non-fatigue tasks show, save but in one instance, enormous drops in the initial half-minutes of work in both the first and second two minutes of the non-fatigue task. These unusually marked decrements are accounted for by the same fact that is responsible for the large practice gains in these same tasks over a longer period of work, namely, the high degree of homogeniety of the spatial tasks. It will be seen from Table VII, Experiment I, as well as from the ordinates of the work curves and from any other table furnishing units of work done in Tasks C or D, that the average number of units of work completed in Tasks C and D are as much as seven times greater than the average number of units of work completed in other tasks in the same interval of time. Such a homogeneity, at the same time as it provides many more opportunities for practicing the spacial tasks, requires an almost infinitely greater use of the same response mechanisms on the part of the subject per unit of time than required in a less homogeneous task. These data lead to the significant observation that an unpracticed task shows marked decrement over short periods of time, and marked rise over longer time periods, such as the thirty-minute one used in this study.

The graphical representation of the conditions supports the trends evident in the statistical treatment, with some slight mitigation of the evils attendant with dealing with

the percentage decrements and the percentage of cases exhibiting decrement, since the graphs present the gains and losses in efficiency in short units of time. Condition I BAB shows a slight rise between the final one-half minute of the first two minutes and the initial one-half minute of the second two minutes. This rise is smaller than the rise occurring between the same two intervals in Condition VIII DAD. In view of the much greater rise in Condition VIII DAD and the fact that Task A can in no way be considered directly to have practiced Task D, the rise in Task D must be attributed to the fact that thiry minutes of work in Task A enabled Task D largely to recover from the decrement resulting from the first two minutes of work in Task D.

Using the same reasoning as just applied, examination of the graphs for Condition II ABA as compared with Condition V CBC, Condition IX EFE as compared with Condition XIII DED, shows a greater transfer of fatigue between tasks involving the same factor than between tasks involving different factors. This supports, then, a functional distinction between the verbal, numerical, and spatial factors. This last mentioned comparison of Condition II ABA and Condition V CBC opposes previously observed evidence indicating greater decrement to be transferred with similarity of operation than with similarity of factor.

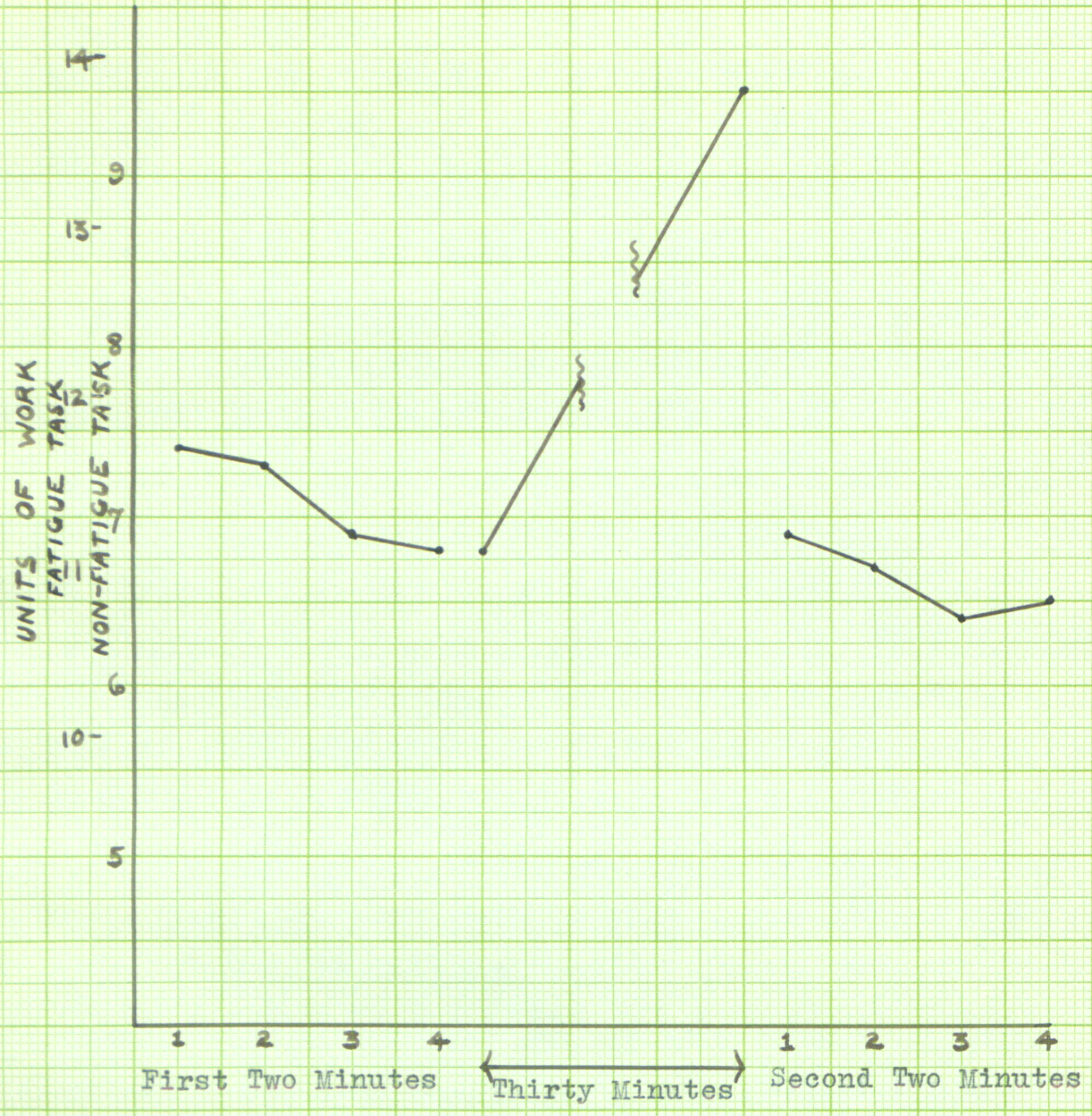

Fig. 7. Group curve showing average number of units of work completed per thirty-second interval during first and second two-minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two-minutes of the thirty minute fatigue task.

CONDITION V BCB

Fig. 8. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION VII ADA

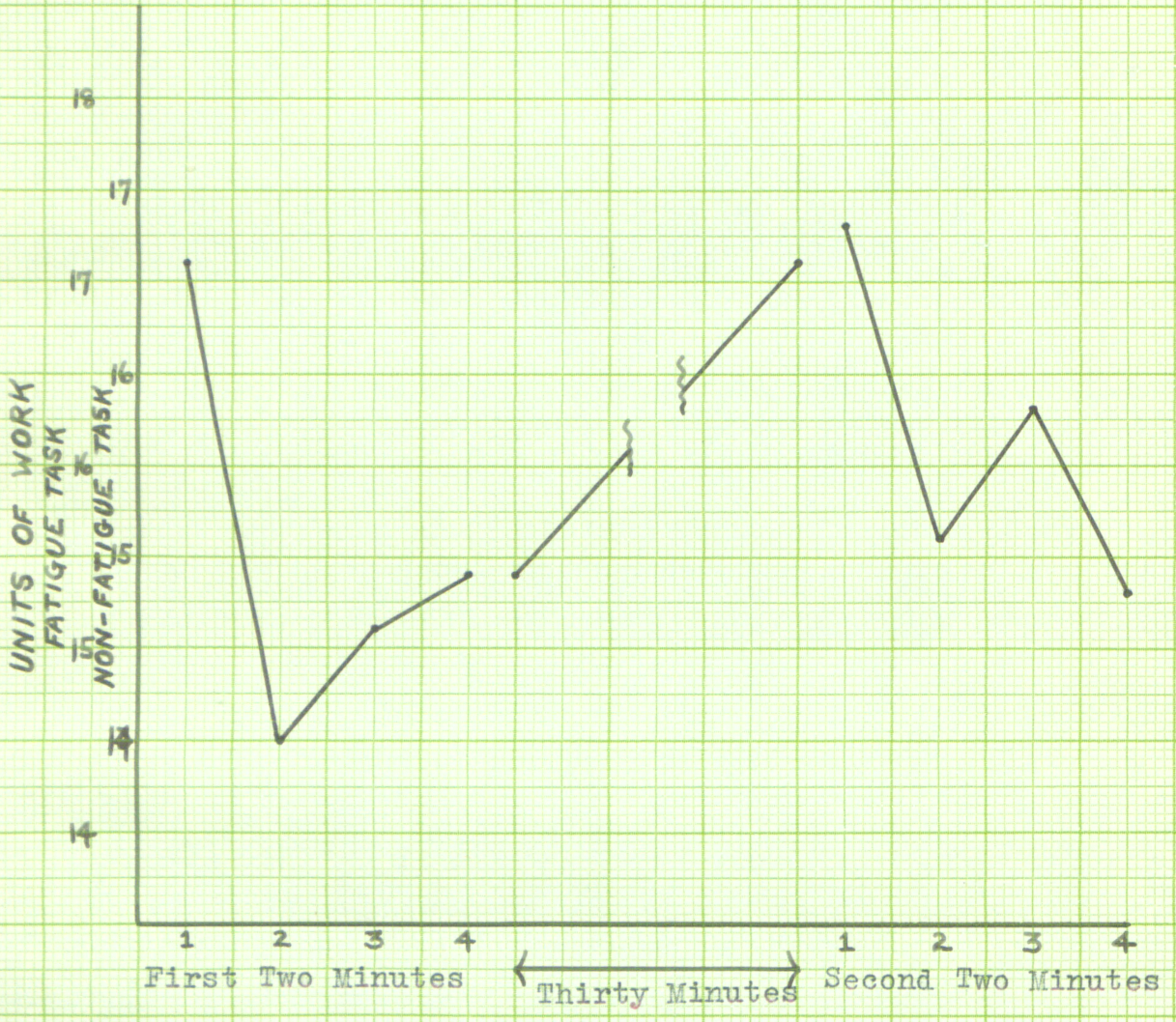

Fig. 9. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION III CDC

Fig. 10. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION VI CBC

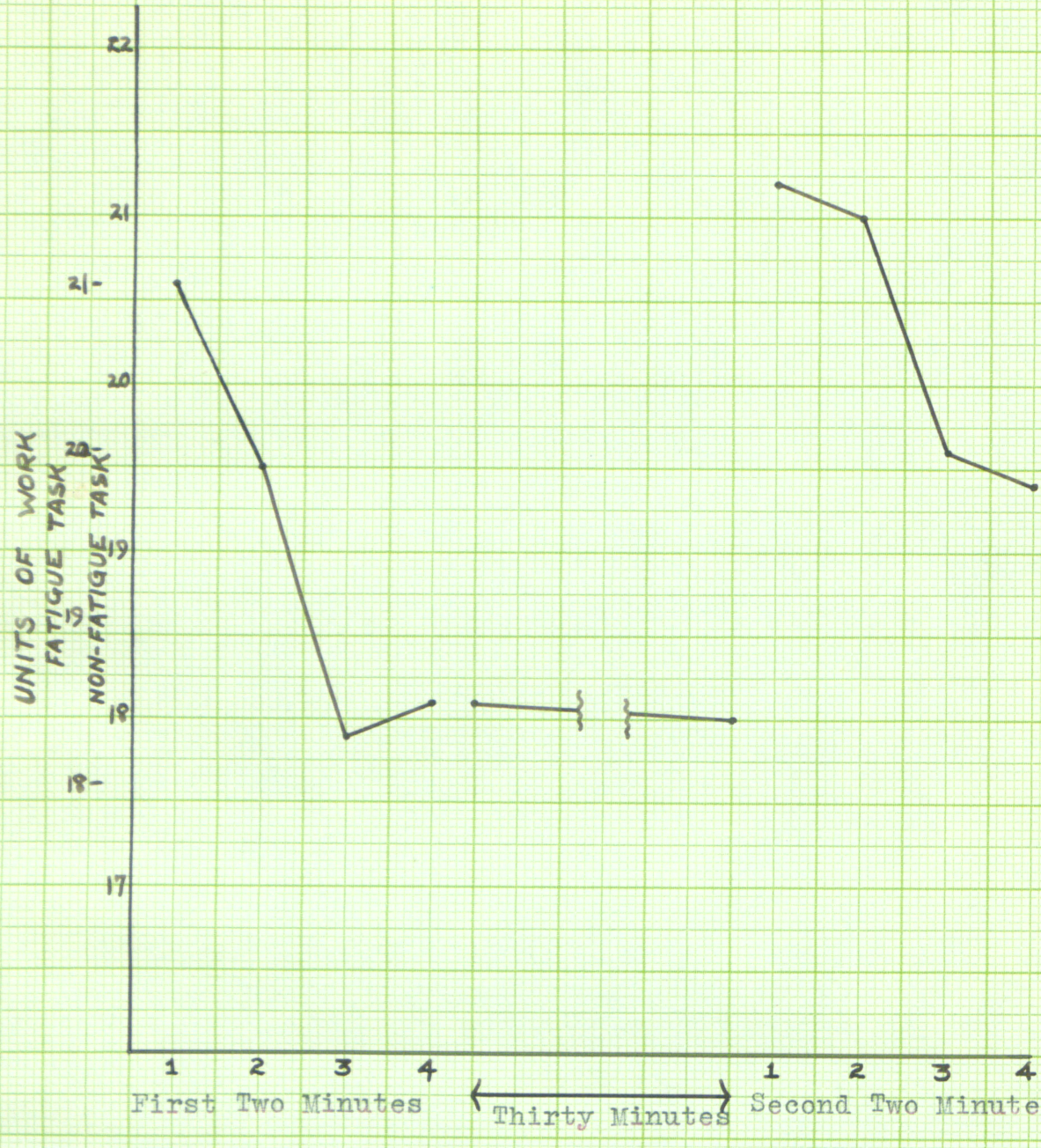

Fig. 11. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION IV DCD

Fig. 12. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION VIIDCDAD

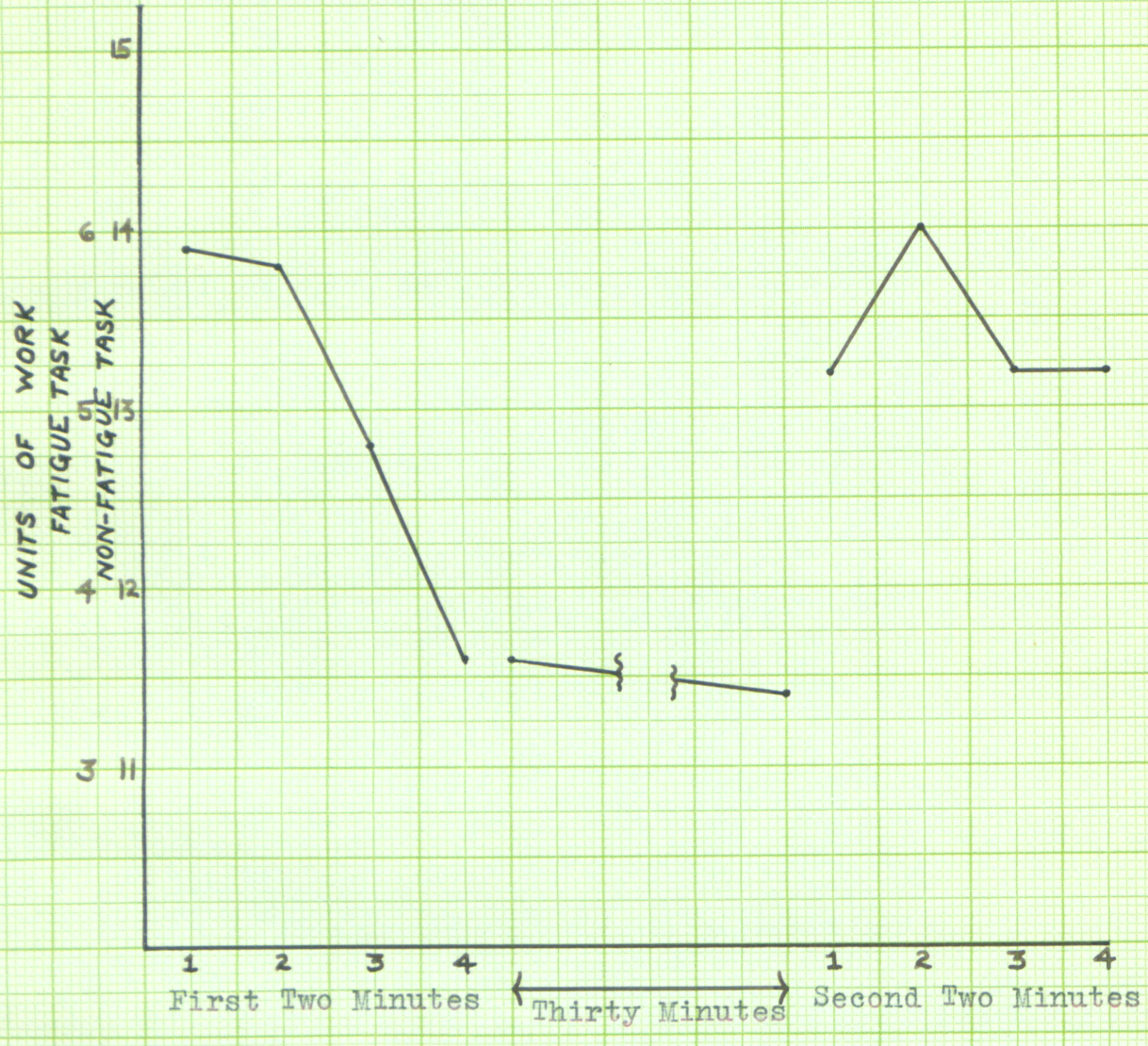

Fig. 13. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION XIII DED

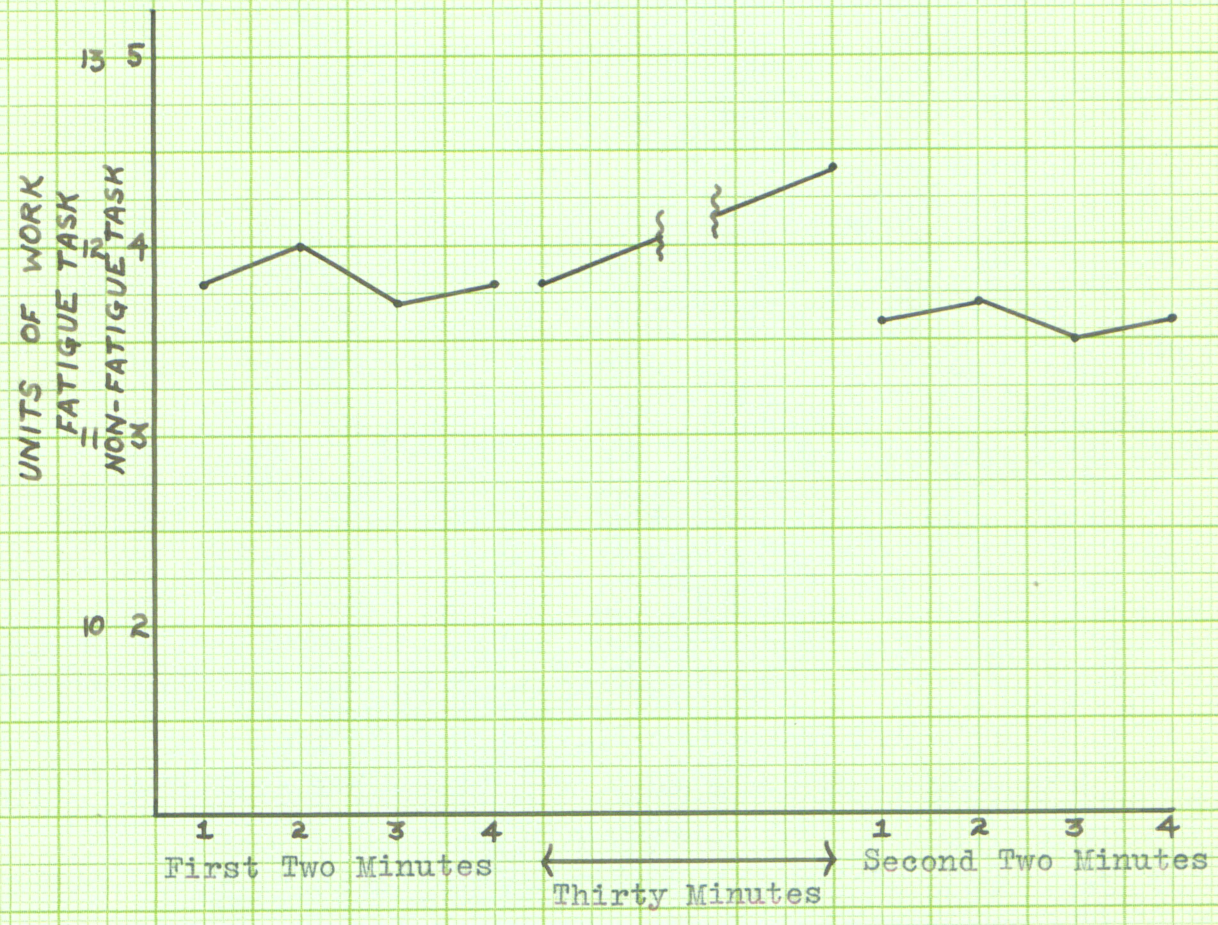

Fig. 14. Group curve showing average number of units of work completed per thirty-second interval during first and second two minutes of the non-fatigue task, and the average number of units of work done per thirty-second interval during the first and last two minutes of the thirty minute fatigue task.

CONDITION XIV EDE

Discussion of Contradictions. Apparent contradictions to the above distinctions are found in the graphical picture of Condition IV DCD which shows a rise from the final one-half minute of the first two minutes to the initial one-half minute of the second two minutes, as opposed to Condition V BCB which shows only a relatively small increment; Condition III CDC which shows a rise from the final one-half minute of the first two minutes to the initial one-half minute of the second two minutes, as compared with Condition VII ADA or Condition XIV, EDE, each of which displays a slight drop. However, explanations for these data are not lacking. The comparison of Condition IV DCD and Condition V BCB involves, as already stated, the two complicating variables of practice due to the extreme homogeneity and near-identity of the spatial tasks, and the fatigue transfer between Tasks B and C resulting from the similarity of their operations of selecting likenesses and differences. As for the comparison of Condition III CDC with Condition VII ADA or Condition XIV EDE, it is seen from Table VI, Experiment I, that the percent decrement in average number of units of work completed in the final one-half minute of the first two minutes of the non-fatigue task versus the average number of units completed in the initial one-half minute of the second two minutes of the non-fatigue task is less than the percent decrement developing in the same intervals in either of these non-fatigue tasks, i.e., A or E, when they

are intercepted by tasks within their respective factors.

The foregoing trends are in the main supported when the comparison is between the average number of units of work completed during the initial one-half minute of the first two minutes and the average number of units of work completed during the initial one-half minute of the second two minutes, the one exception being Condition VII ADA which shows slightly more decrement than Condition II ABA.

The graphical treatment of the data points to the same sort of relationship, between similarity of tasks and transfer of fatigue, as Robinson found between the degree of similarity between original learning and an interpolated task in experiments on retroactive inhibition. Robinson's hypothesis, which has been verified to some extent by himself, Skaggs, Harden, and Cheng, states that, "As similarity between interpolation and original memorization is reduced from near identity, retention falls away to a minimum and then rises again, but with decreasing similarity, it never reaches the level obtaining with maximum similarity."[1.] As applied to the present data, the theoretical curve starts where there is no similarity between tasks -- this is a condition such as Condition XII EBE where both the factor and operation in the tasks are different -- and the smallest

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1. Robinson, E. S., "The Similarity Factor in Retroaction," Amer. J. Psychol., 1927, 39, 297-312.

transfer of fatigue is obtained. From this low point of zero fatigue transfer, the curve rises where different factors but similar operations are involved, as in Condition V BCB. The curve ascends to the high point of maximum transfer, existing where the two tasks are factorially alike. This situation is illustrated by Condition IX EFE, where the factor is the same throughout, and the largest transfer of all conditions is obtained. The final point, lower even than the initial one, is reached where the factor is the same and the task and operation so nearly identical that the fatigue transfer is reduced to a minimum, and an actual practice benefit is obtained. This last condition occurs between Tasks C and D, which are not only in the same factor but are so much alike in principle that work on one of the tasks facilitated subsequent work on the other.[1.] Figure 15 shows this theoretical curve of relation between factorial and operational similarity of tasks and the transfer of fatigue.

The large number of increments in the thirty-minute tasks, shown in Table IX, Experiment I, considered in

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1. On this point, the Manual states, p. 6: "The Space factor S is involved in any task in which the subject manipulates an object imaginally in two or three dimensions. The ability is involved in many mechanical tasks and in the understanding of mechanical drawings. Such material cannot be used conveniently in testing situations, so we have used a large number of tasks which are psychologically similar, such as Flags, Cards, and Figures."

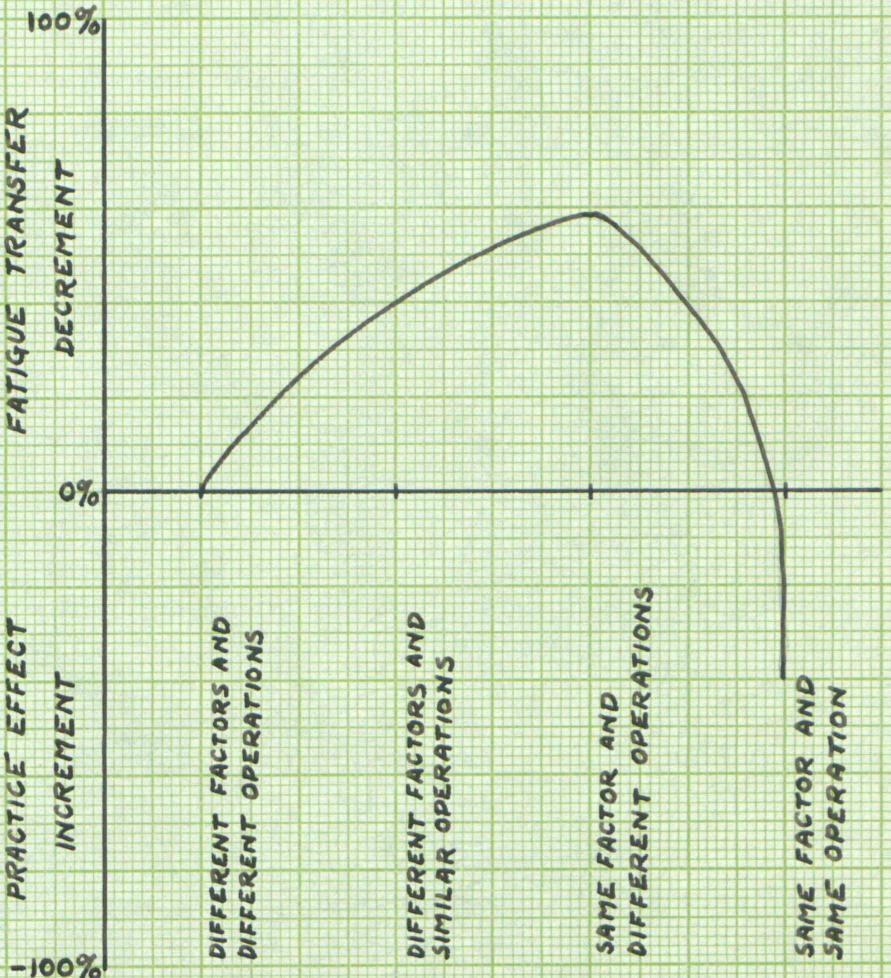

Fig. 15. Theoretical curve of relation between factorial and operational similarity of tasks and transfer of fatigue.

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connection with decrement occurring in the subsequent two minutes of a different task indicates that decrement may transfer even when no objectively evident decrement has developed in the interpolated task. That is, decrement is found to transfer to the non-fatigue task even where the final level of performance of the fatigue task exceeds its initial level.

Summarizing the data of Experiment II, it is seen that in changing from one mental factor to another, the transfer of fatigue is less than the transferred fatigue accrued in remaining within the same factor, if uncomplicated either by a similarity of operations (without accompanying similarity of factor), or by practice effect. There is a very slight indication, at least when quantity of output is the criterion, that similarity of operation is of more influence in transfer of fatigue than is identity of factor alone, or identity of both factor and operation in which case actual facilitation occurs.

In general, the data show functional distinctions between the spatial and verbal factors, and between the spatial and numerical factors. But, unlike Experiment I, these results must be observed in the light of practice effect and operational interferences. There are rather clear indications of a theoretical curve of transfer of fatigue as a function of degree of similarity between materials, paralleling that of Robinson for degree of similarity and

retroactive inhibition. The spatid tasks show that, where the practice gain in a task exceeds the fatigue loss, the curve of work reverses itself. Thus, in the two-minute work curves for Tasks C and D as non-fatigue tasks, a sharp drop is noted in the first half-minutes. But in the thirty-minute fatigue curves for these two tasks, even where amount of previous practice is equilibrated, the curve rises, except in two out of the five instances. In these exceptions, the decrements were infinitesmal while the three increments were considerable. No constant relationship is found between the amount of decrement developing in thirty minutes and the amount of objective decrement in a two-minute non-fatigue task, so that the amount of fatigue which will transfer is apparently not a function of the output decrement in an intervening task.

It is well to note that part of the limitations imposed upon generalizations applied to the results of Experiment II spring not from the spatial factor per se, but from the fact that the two tasks representing the spatial factor were not only of the same factor but involved the same operation as well. The evidence revealed by their similarity of operation and factor might well be as important psychologically as any evidence which might be uncovered by the spatial factor operating alone. The varying degree of homogeneity inherent in the tasks representing the verbal, spatial, and numerical factors is reason, also, as already implied, for further

caution in interpretation. That is, the tasks typifying the particular factors differed in their degree of homogeneity, in addition to their factorial variance.

Summary and Conclusions

As a result of the procedure followed and the data obtained, the following conclusions regarding transfer of fatigue between the same and different primary abilities are justified:

1. Two mental abilities, verbal and numerical, are found to be functionally distinct from one another and isolable by the method of transfer of fatigue. The transferred fatigue and percentage of cases showing transfer are greater in changing to a task involving the same primary ability than in changing to a task involving another primary ability, when both output and accuracy are the criteria.

2. The evidence for a functional distinction between the statistically independent factors of spatial and verbal, and spatial and numerical, is somewhat less clear. It is probable that the trends toward independence herein suggested are real, but interpretation is complicated by the presence of practice effect and uncontrolled operational similarity between tasks.

3. It is possible that similarity of basic mental operations, such as recognizing likenesses and differences, is more fundamental to transfer of fatigue between tasks than is factorial identity alone. It is clear that two tasks involving both the same factor and same operation exert a facilitative effect on one another, not present when there is only operational similarity.

4. Transfer of fatigue between tasks is related to the factorial and operational similarity of the tasks. The hypothetical curve suggested by the present data starts at a point of minimum

similarity between tasks of different factors, where there is minimum transfer of fatigue, rises where the tasks involve similar operations but different factors, ascends to a high point of maximum fatigue transfer where the two tasks are factorially identical but operationally dissimilar, and descends to a point below the initial point where the tasks embody the same factor as well as the same operation. At this final point, increment rather than decrement results between tasks.

5. No consistent relationship is found to exist between the amount of objective decrement produced in a task, and the amount of measurable fatigue which it will transfer to an immediately subsequent task.

6. An unpracticed highly homogeneous mental task yields a work curve which shows a marked drop in the initial minutes of work and a marked tendency to rise over a prolonged period of work.

Interpretation and Discussion

The results of this investigation cannot be interpreted in terms of any already established principles of the work decrement. The present data are, in fact, a refutation of Robinson's principle of homogeneity. The results show that the tasks possessing the highest degree of homogeneity, the spatial tasks, display an actual improvement in a continuous work period, rather than a decrement. Consistent with this benefit effect in the task itself, there was a transferred improvement to subsequent mental work in the same factor. On the other hand, the two tasks representing the numerical factor exhibited marked decrement within themselves and marked transfer of fatigue to one another, though they are

less homogeneous than the spatial tasks. A new principle of the work decrement is thus suggested to the effect that tasks so homogeneous as to be nearly identical in both factor and operation serve to practice one another, and consequently, they transfer improvement rather than decrement to one another.

The law of fatigue transfer states that the work decrement of a given stimulus-response connection is relative to the decrements which have developed in other stimulus-response connections. This is true to the degree to which the systems are related. An extension of this principle is called for to apply to the kind of factorial and operational similarity between tasks such as was found in the present study. Some characteristic of the tasks involving the functioning of a primary factor, probably the neural components of the factor, causes a greater transfer of fatigue within the same factor than between different factors. The fatigue that developed as a result of continuous mental work in one task, except in the case of the intra-spatial conditions, carried over to a subsequent mental performance to the degree to which the two tasks involved identical or similar functions. But no evidence was found to the effect that a constant relationship exists between amount of decrement in the intervening task and the amount of transferred fatigue.

It would be entirely unjustified on the basis of the

still broad evidence of the present study to make inferences regarding neural functioning. How limited are the sensory-neuro-muscular arcs involved in a single primary ability is in no way indicated herein. The present data say simply that certain tasks representing factorially analyzed factors are shown by the method of transfer of fatigue to function as more or less independent mechanisms in the organism.

The highly homogeneous spatial tasks used in the present study agree in results with the laws of competition and stage of practice. The law of competition states that the fatigue decrement will depend upon the number of competing tendencies involved. According to this law, the least practiced tasks should show the greatest decrement. The principle of practice states that the strength of a specific stimulus-response connection determines its susceptibility to decrement. Taking these laws in order, it is seen that the spatial tasks used herein did show the greatest decrement in a short interval of work, and were the least firmly established and exhibited the greatest practice gain of the tasks used. They displayed the greatest increment over the longer time interval because of this same susceptibility to practice. That is to say, in a short interval of time the large decrement was readily observable, while over a longer time period the practice effect accumulated to obscure the decrement. It is of course undoubtedly true that less decrement, proportionally, accumulated during the thirty-minute

period than within the thirty-second periods, but this fact again is simply a reaffirmation of the principles of interference and practice, since thirty minutes of work in a task is expected to increase the absolute level of performance of that task by eliminating competing tendencies and by strengthening neural connections.

Although evidence for distinct verbal and numerical abilities was considerably more convincing than that for the functional independence of a spatial factor, this is not taken to mean that the latter does not exist or that it cannot be isolated by the same methods followed in the present study. Rather, the large practice gains characteristic of the spatial tests used, unfortunately tended to obscure, or at least make precarious interpretation in this direction, clear-cut distinction between the spatial and verbal factors, and between spatial and numerical factors as defined by factor analysis.

Other experiments are suggested both by the limitations and positive findings of this study. First, an experiment might be undertaken to compare and investigate further the relative strengths of what have here been called similar mental operations as opposed to similar mental factors. Second, an experiment is called for similar to the present one, but correlating subjective fatigue with output criteria. Certainly during the thirty-minute fatigue tasks the present author had undeniable indications of subjective fatigue on

the part of the subjects, even where an objective increment took place. Such a study should, if possible, include blocks as another output criterion. Third, an experiment should be conducted to test the existence, as entities, of the other primary factors not adapted herein. A refinement upon the present study is suggested in the use of tasks among which homogeneity is more nearly equal. Fourth, it is highly important that evidence be presented of the susceptibility to training of these mental abilities. Closely akin to this last problem is that of the hereditary basis for primary mental abilities.

Bibliography

Arai, T. Mental fatigue. Teacher's College Contributions, Columbia University, 1912, 54, 1-115.

Bills, A. G. Fatigue in mental work. Physiol. Rev., 1937, 17, 3, 436-451.

Bills, A. G. General Experimental Psychology. New York: Longmans Green, 1937, Part V.

Bills, A. G. The hygiene of mental work. Les Editions du Levrier, College Philosophique et Theologique des Dominicans. Ottawa. 1940.

Bills, A. G. Inhibition and facilitation. Psychol. Bull., 1927, 24, 8, 473-487.

Bills, A. G. Some additional principles of mental fatigue. Psychol. Bull., 1934, 31, 671.

Bills, A. G.,and McTeer, W. Transfer of fatigue and identical elements. J. Exper. Psychol., 1932, 15, 23-36.

Bolton, T. L. Ueber die Beziehung zwischen Ermudung Raumsinn der Haut und Muskelleistung. Psychol. Arbeit., 1902, 5, 175-234.

Chapman, J. C. A study of initial spurt in addition. J. Ed. Psychol., 1915, 6, 419-426.

Chapman, J. C. The effect of rapid changes of work on performance. J. Exper. Psychol., 1917, 2, 165-170.

Chapman, J. C., and Nolan, W. J. Initial spurt in a simple mental function. Amer. J. Psychol., 1916, 27, 256-259.

Cohen, L. A. The locus of fatigue in a perceptual motor function. Unpubl. Thesis, University of Cincinnati, 1941.

Dockeray, F. The effects of physical fatigue on mental efficiency. Kansas Univ. Sci. Bull., 1915, 9, 197-243.

Dodge, R. The laws of relative fatigue. Psychol. Rev., 1917, 24, 89-113.

Fernberger, S. W. The influence of mental and physical work on the formation of judgments in lifted weight experiments. J. Exper. Psychol., 1916, 1, 508-532.

Freeman, F. N. Mental Tests. Houghton Mifflin, 1939, Chpt. XVI.

Garrett, H. E. Statistics in Psychology and Education. Longmans Green, 1940, pp. 493.

Guilford, J. P. Psychometric Methods. McGraw-Hill, 1936, Chpt. XIV.

Kronecker, H. Ueber die ermudung und erholung in quergestreiften muskeln. Ber. u. d. k. Sachs. gesel. d. Wiss. Math.-phys. Cl., Leipzig, 1871, 23.

Maggiora, A. Les lois de la fatigue etudiees dans les muscles de l'homme, Arch. Italiennes de Biol., 1890, 13, 187-241.

Mosso, A. Fatigue. New York: Putnam's Sons, 1915, pp. 334.

Oehrn, A. Experimentelle Studien zur Individual psychologie, Psychol. Arbeit., 1895, 1, 92-151.

Phillips, F. M. A comparison of the work done in successive minutes of the work period. J. Ed. Psychol., 1916, 7, 271-277.
Poffenberger, A. T. The effects of continuous mental work. Amer. J. Psychol., 1927, 39, 283-296.
Robinson, E. S. Principles of the work decrement. Psychol. Rev., 1926, 33, 123-134.
Robinson, E. S. Some factors determining the degree of retroactive inhibition. Psychol. Monog., 1920, 28, No. 6, pp. 36.
Robinson, E. S. The similarity factor in retroaction. Amer. J. Psychol., 1927, 39, 297-312.
Robinson, E. S., and Bills, A. G. Two factors in the work decrement. J. Exper. Psychol., 1926, 9, 415-444.
Robinson, E. S., and Robinson, F. R. Practice and the work decrement. Amer. J. Psychol., 1932, 44, 547.
Seashore, R. H. (Editor), Fields of Psychology. New York, Henry Holt, 1942, Chpt. XX.
Spearman, C. The Abilities of Man. New York: Macmillan, 1927, pp. 415.
Thorndike, E. L. Mental fatigue. Psychol. Rev., 1900, 7, 466-489; 547-579.
Thorndike, E. L. The curve of work. Psychol. Rev., 1912, 19, 165-194.
Thurstone, L. L. Multiple factor analysis. Psychol. Rev., 1931, 38, 406-427.
Thurstone, L. L. Primary mental abilities. Psychometric Monog., 1, Univ. of Chicago, 1938, pp. 121.
Thurstone, L. L. The factorial isolation of primary abilities. Psychometrika, Vol. I, No. 3.
Thurstone, L. L. The Vectors of Mind. University of Chicago, 1935, pp. 265.
Thurstone, L. L., and Thurstone, T. G. Manual. The Chicago Tests of Primary Mental Abilities, Am. Council on Ed., 1941, pp. 36.
Vickeray, K. The effects of change of work on the work decrement. J. Exper. Psychol., 1931, 14, 218.
Watson, J. B. Psychology from the Standpoint of a Behaviorist. Phila.: Lippincott, 1924, 369-372.
Weinland, J. D. Variability of performance in the curve of work. Arch. Psychol., 1927, 87.

Appendix

Section A. Directions for General Procedure, and for Each of the Six Tasks.

Section B. Sample Sheets of Each of the Six Tasks.

Section C. Supplementary Tables for Average Number of Units of Work Completed and Percent Decrement During the First and Second Two Minutes of the Non-Fatigue Task for all Fourteen Conditions.

Section D. Supplementary Tables for Average Number of Errors and Percent Increase in Errors During the First and Second Two Minutes of the Non-Fatigue Task for All Fourteen Conditions.

Section E. Tables of Percentile Ranks Corresponding to the L and Q Scores in the American Council on Education Psychological Examination for the Subjects in Each Group.

Section F. Supplementary Tables for Experiment I of the Comparison of the Percentage Decrement and Percentage of Cases Showing Decrement in Amount Done per Half-Minute in the Non-Fatigue Task, and the Corresponding Tables for Errors, When the Conditions Compared Contain Different Factorial and Operational Relationships between the Fatigue and the Non-Fatigue Tasks.

Section G. Supplementary Tables for Experiment II of the Comparison of the Percentage Decrement and Percentage of Cases Showing Decrement in Amount Done per Half-Minute in the Non-Fatigue Task, and the Corresponding Tables for Errors, When the Conditions Compared Contain Different Factorial and Operational Relationships between the Fatigue and the Non-Fatigue Tasks.

Section A. Directions for General Procedure, and for Each of the Six Tasks.

DIRECTIONS FOR DAY I

Today you are to learn three tasks. Ask as many questions as you wish in order to understand fully what you are to do. The next time you come here we will assume that you need no more help or instructions. It is absolutely essential that you understand the tasks before you leave today.

(1) Look at the explanation and examples given on the first sheet before you. Follow the directions. Ask any questions you have. These practice problems are given so as to make sure that you understand the nature of the task.

(2) At regular intervals of time, the experimenter will tell you to "Mark!". You are to make a definite vertical mark after the exact figure or question which you have just finished. But be sure to go right on working without interruption. Use a check mark (✓) or a cross (X) to indicate the answers you believe correct.

(3) When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

(4) Do not skip any question. Put some answer down in every instance.

(5) Follow the same routine as outlined above with the other tasks.

PLEASE VERIFY THE TIME OF YOUR NEXT APPOINTMENT BEFORE YOU LEAVE

VOCABULARY

The first word in the following line is "big".

big	ill	large	down	sour

One of the other words means the SAME as "big". The word "large" has been marked because it means the same as "big".

The first word in the following line is "ancient". Mark one of the other words that means the SAME as "ancient".

ancient	dry	long	happy	old

You should have marked "old" because it means the same as "ancient".

In each of the following lines mark the word that means the SAME as the first word.

quiet	blue	still	tense	watery
safe	secure	loyal	passive	young
brave	hot	cooked	red	courageous

When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

COMPLETION

Read the definition below. Think of the word which fits the definition. The FIRST letter of the word is in the row of letters under the definition.

The first meal of the day. A B✗ C D E

The word is "Breakfast". "B" is marked because it is the first letter of the word "Breakfast".

Do the following example:

A place or building for athletic exercises. D G H T V

The word is "Gymnasium". You should have marked "G" because it is the first letter of the word "Gymnasium".

Do the following examples the same way:

The red fluid which circulates in the veins and arteries of man. B C D F G A one-cent piece made of copper. A B E H P A small or portable bed, as of canvas stretched on a frame. B C H N T

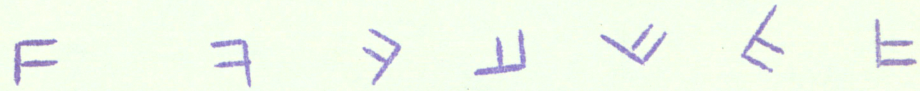
When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

FIGURES

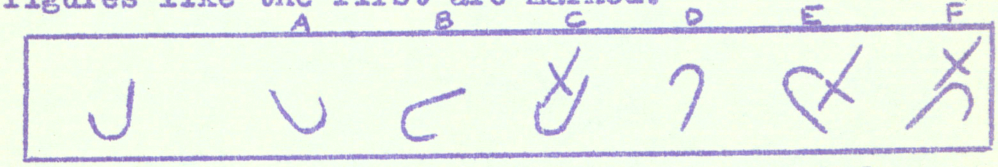
Look at the row of figures below. The first figure is like the letter F which is right side up. All the other figures are like the first but they have been turned in different directions.

Satisfy yourself that all of these figures look like the first one if they are turned right side up.

Now look at the next row of figures. The first one looks like an F. But none of the other figures would look like an F even if they were turned right side up. They are all made backward.

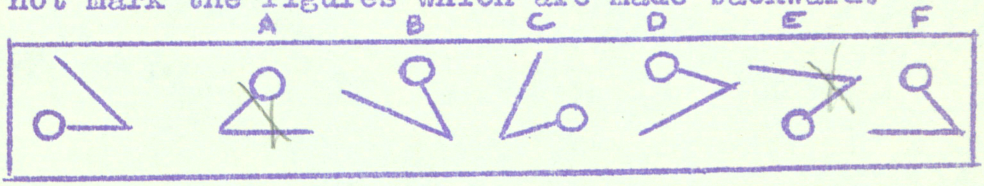


Some of the figures in the next row are like the first figure. Some are made backward. The figures like the first are marked.



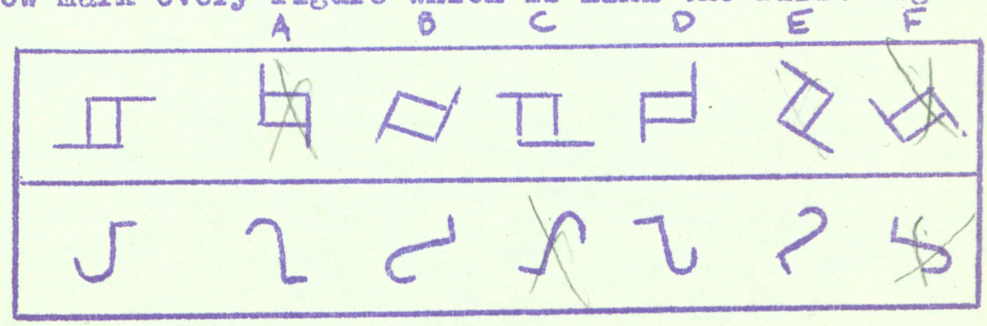
Notice that all the figures like the first figure are marked.

In the row of figures below, mark every figure which is LIKE the first figure in the row. Do not mark the figures which are made backward.



You should have marked the figures A and E.

In each row below mark every figure which is LIKE the first figure in the row.



When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

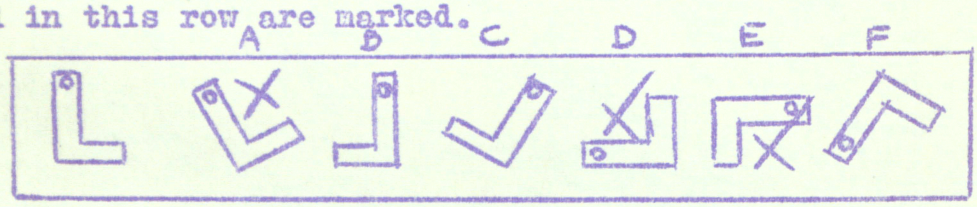
CARDS

Here is a picture of a card. It looks like an L, and it has a hole in one end.

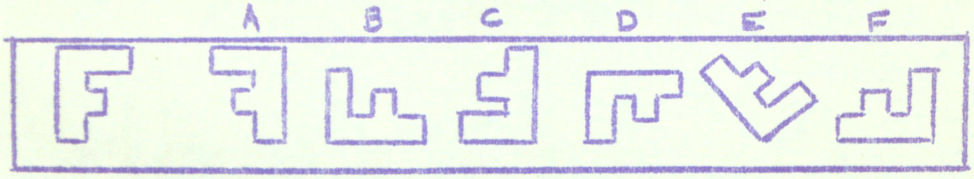
The two cards below are alike. You can slide one around on the page to fit the other exactly.

Now look at the next two cards. They are different. You cannot make them fit exactly by sliding them around on the page.

Here are more cards. Some of the cards are marked. The cards which are like the first card in this row are marked.

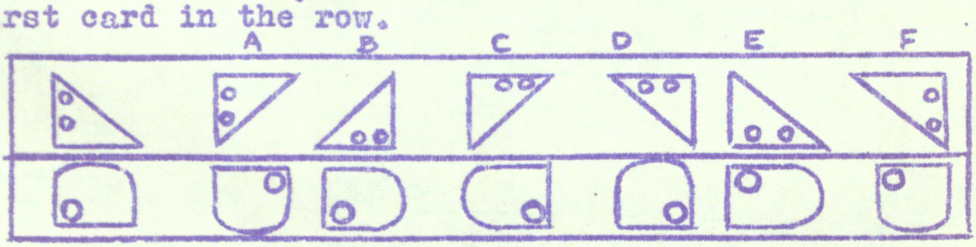


Below is another row of cards. Mark all the cards which are LIKE the first card in the row.



You should have marked the cards B and C.

Here are some more cards for you to mark. In each row mark every card that is like the first card in the row.



When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

ADDITION

Below are two columns of numbers which have been added. Add the numbers for yourself to see if the sums are correct.

	16	42
	38	61
	45	83
	99	176
R	..X..	.....
W	.....	..X..

The first sum is right so the space in the R row is marked. The second sum is wrong so the space in the W row is marked.

Check the sums of the columns below. If a sum is right, mark the space in the R row. If a sum is wrong, mark the space in the W row.

	17	35	63
	84	28	17
	29	61	89
	140	124	169
R	.....	..X..	...X.
W	..X..	.....	.....

When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

MULTIPLICATION

Below are two multiplication problems. Multiply the numbers for yourself to see if the products are correct.

	64 × 7 = 448	39 × 4 = 166
R	..X..	.....
W	.....	..X..

The first answer is right so the space in the R row is marked. The second answer is wrong so the space in the W row is marked.

Check the answers in the problems below. If the answer is right, mark the space in the R row. If the answer is wrong, mark the space in the W row.

	57 × 6 = 342	46 × 8 = 358	29 × 7 = 193
R	.....	.....	.....
W	.....	.....	.....

When you are reasonably satisfied that you understand the task and the correct procedure, tell the experimenter who will give you sheets with other samples on them. You will be told when to start and when to stop working. Work as fast as possible consistent with accuracy.

DIRECTIONS FOR DAYS II, III, IV, V

It is absolutely necessary that the following instructions be strictly adhered to in order to attach any significance to the work you do in this experiment.

(1) You will be given two tasks to do which are identical in principle with the ones you learned the last time you were here.

(2) Start work and stop work promptly according to the signal of the experimenter.

(3) The experimenter will watch your progress carefully, and will have the next sheet ready to place before you so as to avoid any delay in going from one sheet to the next.

(4) You will be interrupted during the first task, and you will then immediately begin working on the second task, until you are signaled to change back to the first task.

(5) The experimenter will see that there is no confusion in switching from one task to the other. Your full responsibility consists in doing the work placed before you, doing it as quickly as possible consistent with accuracy.

(6) Use a check mark (✓) or a cross (X) to indicate the answers you believe correct.

(7) Mistakes may be erased, but they must be erased well. It is probably advisable to go on working rather than to use time in correcting errors.

(8) The instructions for starting the first task will always consist of the words "Ready!...Begin!" But there will be no interruption whatsoever when you are to change tasks. In these instances, simply begin immediately to work on the new task without any other signal from the experimenter who will have already placed the new task before you.

(9) Be sure to work as fast and as accurately as you can because your score will be the total number of correct answers you make in the time allowed.

(10) Remember that at regular intervals of time, the experimenter will tell you to "Mark!" You are to make a definite vertical mark after the exact figure or question which you have just finished. But be sure to go right on working without interruption.

(11) Do not skip any question. Put same answer down in every instance.

PLEASE ASK ANY QUESTIONS YOU HAVE NOW.

Section B. Sample Sheets of Each of the Six Tasks.

VOCABULARY

In each row of five words below, mark the word which means the same as the first word in that row.

fetid	humorous	concentrated	stinking	internal
dubious	calm	doubtful	selfish	ignorant
balmy	refreshing	hopeless	quick	capable
debonair	moderate	boiling	magnetic	elegant
aromatic	digested	fragrant	disintegrating	noisy
respectable	ugly	plural	framed	decent
evident	inflated	religious	apparent	idiotic
palatial	complete	royal	distant	clear
proper	ready	prophetic	correct	near
fertile	expert	equal	sane	prolific
studious	distinctive	diligent	nonsensical	wordy
overpowering	passable	close	stunning	good
exasperating	bodily	signifying	right	irritating
oppressive	heavy	priestly	fatal	physical
myriad	gay	comprehensible	innumerable	talented
reprehensible	known	culpable	laborious	careful
sentimental	charitable	residual	keen	romantic
tinsel	superficial	shady	upper	fierce
puny	dogged	pointed	colored	tiny
diffused	scientific	fine	dispersed	inactive
complex	remarkable	hateful	sculptured	intricate
interchangeable	saddened	frank	transmutable	golden
unintentional	desirable	observant	feudal	accidental
fake	novel	fraudulent	game	connecting
actual	parallel	shapely	factual	roomy
fancy	hot	enormous	ornamental	brotherly
limp	flaccid	comfortable	forfeited	confirmed
faraway	dark	safe	injurious	remote
sacrilegious	profane	cloaked	sweet	typical
sacrosanct	obvious	verbose	new	sacred
integral	showy	superficial	composite	musical
obsolete	elemental	outward	dank	antiquated
voluntary	blessed	extreme	intentional	elevated
libertine	handy	freethinking	smart	cordial
haggard	loyal	minor	thin	large
concordant	harmonic	tasty	perfumed	hurt
panic	preeminent	fear	visible	expansive
specious	devoted	inviolable	plausible	dreary
obstreperous	homely	courteous	criminal	vociferous
immaterial	spiritual	mawkish	canonized	likely
spoken	liquid	uttered	splendid	dismissed
plundered	ravaged	despondent	shared	holy
obstinate	hairy	calm	headstrong	gleeful
recondite	cheerful	kind	borrowed	occult
mutual	handy	reciprocal	generous	tall
reserved	true	marked	restrained	principal
requisite	harmful	indispensable	apart	membranous
parasitic	laughable	sumptuous	divine	sychophantic
last	moronic	final	rough	watery
obscene	plural	[illegible] quick	dirty	sacrificial
factitious	artifical	manly	familiar	childish
ethereal	customary	natural	void	celestial
overbearing	proud	cheerless	small	loose
musical	rich	tuneful	hard	present

OMPLETION
ark the first letter of the word which fits the definition.

native lump of precious metal.
G K L M R

large, destructive fire.
C F T G V

he name for any of the various groups of fixed stars.
F C B D E

he third day of the week.
M R S T C

head or portrait in a side view.
W M R O P

bulbous plant with bell-shaped flowers of various colors.
V D T K S

oxious small animals or insects, as rats, fleas, etc.
V G I H T

perfumed ointment for dressing the hair.
G J H I P

he who terrorizes legitimate business, by threat or violence.
T I R S B

he of the ultra-liberal party in politics.
G H I M R

he part of the body from the waist to the knees of a person seated.
H L K J O

covering for the foot, usually of leather.
M N P R S

noisy breathing in sleep.
C A B S V

vessel in which to bathe.
R O Z I T

he vapor that escapes when a substance is burned.
B S P R F

social gathering of men only.
A B C W S

he who cultivates the land.
P N F G H

he rule to treat others as ## we ourselves wish to be treated.
J H I G B

dle talk or scandal about others.
S U G N B

boundary consisting of posts, wire, etc.
F G H I J

pipe or passageway to convey away smoke, hot air, etc.
C D E F G

channel for carrying away water.
E F G H I

disease attacking many at the same time.
A B C D E

15

A shoulder ornament worn on uniforms.
C D E F Y

An apparatus used in France for beheading a criminal.
E F G H T

A day of gaiety and joy in celebration of some event, etc.
D E A F H

A man or boy who has charge of feeding and caring for horses.
L J K G R

A fall of water over a precipice.
L C A B E

A lizard-like reptile possessing the power of changing its color.
T I B Q C

Heat and light evolved by ignition and combustion.
P O F E D

The pain or uneasiness caused by want of food.
G H I ## W T

One of the limbs by which men and animals walk.
L N M P O

Decayed vegetable matter used as fuel when dried.
J K L M P

A regular, measured walk, especially of soldiers.
N O M F T

A cylinder containing carbon, lead, etc., for writing.
L T P I R

A collar button.
B S T U V

A raw hide.
P Q R S T

The rounded handle of a door.
C D E K O

A single pass of a needle and thread through anything made by sewing.
P S F E W

A close-fitting covering for the foot and leg.
G P T R S

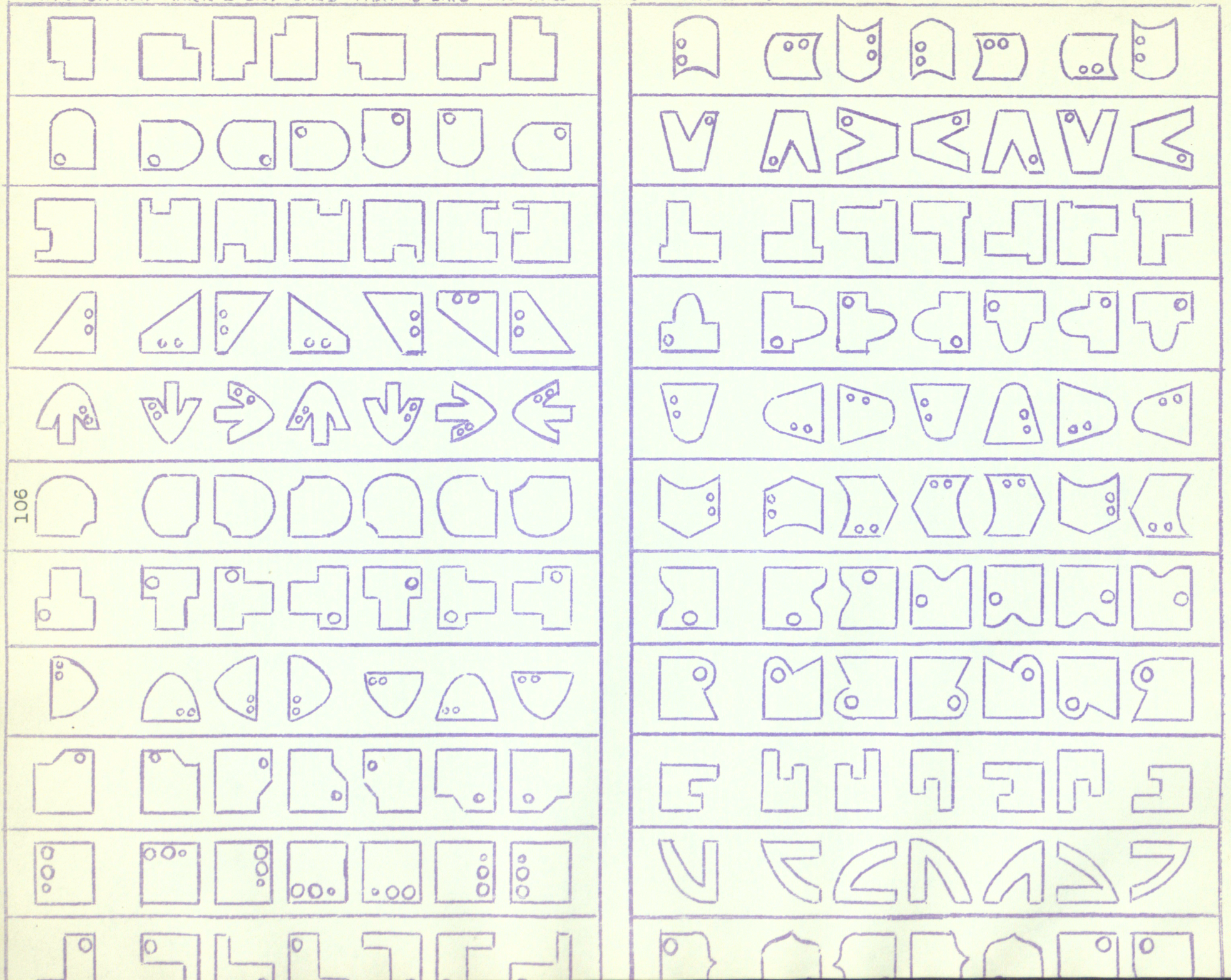
A mass of visible vapor floating in the atmosphere.
B C D H E

A large natural hollow in the earth.
A B C F R

A restaurant at which patrons serve themselves.
P T F N C

The joint on which a door, gate, or lid, etc., turns or swings.
O H I J M

IN EACH ROW MARK EVERY CARD THAT IS LIKE THE FIRST CARD IN THE ROW.



IN EACH ROW PUT A MARK ON EVERY FIGURE WHICH IS LIKE THE FIRST FIGURE IN THE ROW.

ADDITION

Add each column. If the sum is right, mark the space in the R row. If the sum is wrong, mark the space in the W row.

	47	86	63	25	97	63	36	42	74	96	63
	97	54	79	86	86	36	39	75	86	24	57
	38	75	86	42	95	87	96	64	39	48	98
	64	48	53	75	67	45	47	75	47	75	47
	246	273	281	228	335	231	218	256	246	233	275
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	45	53	72	38	56	53	79	75	96	95	64
	68	95	86	97	65	86	45	83	45	86	89
	63	67	79	74	23	79	88	57	96	75	43
	39	83	96	55	86	54	37	83	74	57	86
	215	298	333	164	230	272	259	298	311	323	282
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	83	46	97	86	96	54	75	36	96	42	83
	67	95	54	36	83	37	83	45	84	55	47
	85	64	74	98	98	76	74	93	79	64	96
	74	58	89	77	57	92	98	68	35	97	35
	309	263	324	287	334	259	330	242	294	248	251
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	54	83	74	59	43	54	36	89	67	92	47
	95	65	49	83	57	96	64	53	46	57	74
	84	83	54	95	59	34	57	32	42	86	38
	37	76	97	88	75	98	85	41	46	23	54
	260	307	274	325	234	272	252	215	201	258	113
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	54	25	76	35	96	13	65	47	97	54	54
	96	84	28	67	83	46	98	42	25	46	36
	67	25	94	53	67	54	38	65	83	65	96
	92	68	86	74	94	57	92	57	74	23	76
	309	202	294	229	340	180	293	221	269	188	262
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	23	84	25	54	23	54	23	52	79	45	34
	85	63	57	65	42	68	57	94	36	26	83
	47	97	86	95	74	94	37	84	57	74	57
	36	54	84	68	32	63	86	94	36	94	36
	191	198	252	282	171	279	203	324	208	229	210
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	45	79	46	38	52	36	42	68	25	73	74
	68	31	83	24	87	54	39	45	95	46	93
	24	45	57	94	94	32	74	53	27	79	85
	74	63	73	45	68	75	84	79	83	45	67
	211	228	259	201	301	297	249	245	230	243	319
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...

MULTIPLICATION

If the answer is right, mark the space in the R row. If the answer is wrong, mark the space in the W row.

	83 × 8 = 654	46 × 7 = 322	57 × 9 = 513	74 × 5 = 360	78 × 4 = 312	65 × 6 = 380	27 × 7 = 189	93 × 3 = 289	98 × 5 = 490	66 × 7 = 482	48 × 8 = 384
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	46 × 7 = 312	87 × 4 = 348	95 × 8 = 750	23 × 7 = 151	48 × 9 = 432	56 × 5 = 280	37 × 8 = 286	86 × 3 = 258	49 × 4 = 176	95 × 7 = 565	54 × 6 = 334
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	74 × 3 = 232	57 × 7 = 399	29 × 6 = 174	86 × 9 = 774	35 × 8 = 280	28 × 8 = 244	64 × 7 = 448	49 × 5 = 224	72 × 6 = 442	94 × 4 = 376	78 × 6 = 478
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	76 × 4 = 302	28 × 9 = 262	96 × 7 = 672	57 × 4 = 238	45 × 6 = 280	38 × 3 = 114	29 × 9 = 281	87 × 4 = 348	94 × 8 = 752	56 × 7 = 392	36 × 9 = 344
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	65 × 3 = 275	79 × 3 = 227	56 × 8 = 448	52 × 7 = 374	43 × 9 = 387	78 × 6 = 478	87 × 8 = 686	76 × 6 = 456	52 × 7 = 354	38 × 3 = 114	89 × 3 = 247
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	....	...	...	...	...	...	...	...
	89 × 9 = 801	69 × 4 = 286	43 × 9 = 387	68 × 6 = 408	72 × 8 = 566	57 × 4 = 228	95 × 7 = 685	58 × 3 = 164	81 × 7 = 567	47 × 9 = 433	67 × 5 = 345
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	42 × 7 = 294	78 × 8 = 624	76 × 6 = 456	63 × 8 = 504	54 × 9 = 486	92 × 6 = 182	38 × 7 = 266	89 × 4 = 346	72 × 8 = 566	98 × 5 = 490	26 × 9 = 204
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	38 × 9 = 362	27 × 8 = 216	48 × 6 = 278	67 × 8 = 526	54 × 7 = 378	36 × 5 = 190	73 × 6 = 438	52 × 5 = 250	74 × 4 = 296	82 × 4 = 348	87 × 3 = 261
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	89 × 7 = 643	76 × 6 = 456	65 × 4 = 260	34 × 5 = 160	85 × 7 = 595	43 × 8 = 344	27 × 9 = 223	56 × 3 = 168	79 × 7 = 553	84 × 8 = 672	43 × 8 = 324
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...
	58 × 6 = 348	46 × 4 = 194	97 × 9 = 863	67 × 6 = 402	92 × 8 = 736	47 × 4 = 178	86 × 8 = 698	72 × 3 = 226	68 × 3 = 224	42 × 9 = 378	73 × 8 = 594
R	...	...	...	...	...	...	...	...	...	...	...
W	...	...	...	...	...	...	...	...	...	...	...

Section C. Supplementary Tables for Average Number of Units of Work Completed and Percent Decrement During the First and Second Two Minutes of the Non-Fatigue Task for All Fourteen Conditions.

TABLE I

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION I BAB

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work,2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
I A	20	5.	18	4.5	.5	10.
I B	31	7.75	29	7.25	.5	6.5
I C	27	6.75	22	5.5	1.25	18.5
I D	35	8.75	29	7.25	1.50	17.1
I E	34	8.5	32	8.	.5	5.9
I F	24	6.	27	6.75	-.75	-12.5
I G	28	7.	23	5.75	1.25	17.8
I H	30	7.5	21	5.25	2.25	30.
I I	21.	5.25	26	6.5	-1.25	-23.8
I J	24	6.	31	7.75	-1.75	-29.1
I K	31	7.75	35	8.75	-1.	-12.9
I L	42	10.5	39	9.75	.75	7.3
I M	28	7.	30	7.5	- .50	-7.1
I N	33	8.25	38	9.5	-1.25	-15.1
I O	15	3.75	15	3.75	-	-
I P	47	11.75	40	10.	1.75	14.8
I Q	32	8.	22	5.5	2.5	31.2
I R	39	9.75	43	10.75	-1.	-10.2
I S	43	10.75	41	10.25	.50	4.6
I T	15	3.75	15	3.75	-	-
I U	25	6.25	27	6.75	-.50	-8.
I V	25	6.25	28	7.	-.75	-12.
I W	32	8.	35	8.75	-.75	-9.3
I X	11	2.75	12	3.	-.25	-9.
I Y	30	7.5	24	6.	1.50	20.
Total	722	180.50	702	175.50	5.00	2.77%
Average	28.88	7.22	28.08	7.02	.20	2.77%

TABLE II

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION V BCB

Subject	Total No. Units of Work, 1st 2"	Av. No. Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av. No. Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
I A	13	3.25	16	4.	-.75	-20.
I B	28	7.	24	6.	1.	14.3
I C	31	7.75	29	7.25	.50	6.5
I D	45	11.25	37	9.25	2.	17.8
I E	49	12.25	41	10.25	2.	16.3
I F	29	7.25	31	7.75	-.50	-6.8
I G	19	4.75	23	5.75	-1.	-21.
I H	27	6.75	23	5.75	1.	14.8
I I	22	5.50	19	4.75	.75	13.6
I J	19	4.75	19	4.75	-	-
I K	46	11.50	35	8.75	2.75	23.9
I L	26	6.50	29	7.25	-.75	-11.5
I M	27	6.75	26	6.50	.25	3.7
I N	26	6.50	22	5.50	1.	15.3
I O	13	3.25	14	3.50	-.25	-7.6
I P	55	13.75	50	12.50	1.25	9.0
I Q	24	6.	19	4.75	1.25	20.8
I R	32	8.	31	7.75	.25	31.2
I S	30	7.50	30	7.50	-	-
I T	14	3.50	12	3.	.50	14.2
I U	33	8.25	29	7.25	1.	12.1
I V	32	8.	29	7.25	.75	9.3
I W	26	6.50	25	6.25	.25	3.8
I X	9	2.25	18	4.50	-2.25	-100.
I Y	34	8.50	39	9.75	-1.25	-14.7
Total	709	177.25	670	167.50	9.75	5.5%
Average	28.36	7.09	26.80	6.70	.39	5.5%

TABLE III

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION XI BEB

Subject	Total No. Units of Work, 1st 2"	Av. No. Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av. No. Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
III A	27	6.75	27	6.75	-	-
III B	26	6.50	25	6.25	.25	3.8
III C	7	1.75	9	2.25	-.50	-28.6
III D	32	8.	27	6.75	1.25	15.6
III E	21	5.25	21	5.25	-	-
III F	27	6.75	30	7.50	-.75	-11.1
III G	22	5.50	24	6.	-.50	- 9.1
III H	30	7.50	31	7.75	-.25	- 3.3
III I	30	7.50	30	7.50	-	-
III J	20	5.	19	4.75	.25	5.
III K	31	7.75	37	9.25	-1.50	-19.3
III L	31	7.75	18	4.50	3.25	41.9
III M	31	7.75	24	6.	1.75	22.6
III N	26	6.50	27	6.75	-.25	-3.8
III O	37	9.25	33	8.25	1.	10.8
III P	25	6.25	23	5.75	.50	8.
III Q	30	7.50	28	7.	.50	6.7
III R	24	6.	26	6.50	-.50	-8.3
III S	32	8.	20	5.	3.	37.5
III T	15	3.75	20	5.	-1.25	-33.3
III U	35	8.75	31	7.75	1.	11.4
III V	23	5.75	27	6.75	-1.	-17.4
III W	25	6.25	18	4.50	1.75	28.
III X	34	8.50	34	8.50	-	-
III Y	23	5.75	23	5.75	-	-
Total	664	166.	632	158.	8.	4.82%
Average	26.56	6.64	25.28	6.32	.32	4.82%

TABLE IV

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION II ABA

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
I A	6	1.50	8	2.	-.50	-33.3
I B	25	6.25	22	5.50	.75	12.
I C	5	1.25	15	3.75	-2.50	-200.
I D	30	7.50	30	7.50	-	-
I E	23	5.75	23	5.75	-	-
I F	23	5.75	18	4.50	1.25	21.7
I G	14	3.50	16	4.	-.50	-14.3
I H	26	6.50	23	5.75	.75	11.5
I I	12	3.	10	2.50	.50	16.7
I J	19	4.75	17	4.25	.50	10.5
I K	28	7.	18	4.50	2.50	35.7
I L	17	4.25	21	5.25	-1.	-23.5
I M	21	5.25	16	4.	1.25	23.8
I N	25	6.25	26	6.50	-.25	-4.
I O	16	4.	14	3.50	.50	12.5
I P	23	5.75	27	6.75	-1.	-17.4
I Q	8	2.	15	3.75	-1.75	-87.5
I R	29	7.25	35	8.75	-1.50	-20.7
I S	14	3.50	17	4.25	-.75	-21.4
I T	17	4.25	8	2.	2.25	52.9
I U	26	6.50	25	6.25	.25	3.8
I V	21	5.25	21	5.25	-	-
I W	20	5.	16	4.	1.	20.
I X	8	2.	8	2.	-	-
I Y	20	5.	21	5.25	-.25	-5.
Total	476	119.	470	117.50	1.50	1.26%
Average	19.04	4.76	18.8	4.7	.06	1.26%

TABLE V

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITIONS VII ADA

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
II A	23	5.75	22	5.50	.25	4.3
II B	30	7.50	29	7.25	.25	3.3
II C	16	4.	15	3.75	.25	6.3
II D	15	3.75	16	4.	-.25	-6.7
II E	34	8.50	23	5.75	2.75	32.4
II F	18	4.50	15	3.75	.75	16.7
II G	12	3.	13	3.25	-.25	-8.3
II H	27	6.75	25	6.25	.50	7.4
II I	20	5.	18	4.50	.50	10.
II J	17	4.25	17	4.25	-	-
II K	15	3.75	8	2.	1.75	46.7
II L	19	4.75	21	5.25	-.50	-10.5
II M	27	6.75	24	6.	.75	11.1
II N	11	2.75	14	3.50	-.75	-27.3
II O	21	5.25	24	6.	-.75	-14.3
II P	17	4.25	19	4.75	-.50	-11.8
II Q	20	5.	18	4.50	.50	10.
II R	23	5.75	21	5.25	.50	8.7
II S	15	3.75	18	4.50	-.75	-20.
II T	14	3.50	18	4.50	-1.	-28.6
II U	21	5.25	19	4.75	.50	9.5
II V	29	7.25	16	4.	3.25	44.8
II W	20	5.	26	6.50	-1.50	-30.
II X	25	6.25	17	4.25	2.	32.
II Y	17	4.25	18	4.50	-.25	-5.9
Total	506	126.50	474	118.50	8.	6.32%
Average	20.24	5.06	18.96	4.74	.32	6.32%

TABLE VI

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITIONS III CDC

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
II A	71	17.75	60	15.	2.75	15.4
II B	87	21.75	87	21.75	-	-
II C	28	7.	57	14.25	-7.25	-103.5
II D	40	10.	35	8.75	1.25	12.5
II E	64	16.	60	15.	1.	6.3
II F	27	6.75	41	10.25	-3.50	-51.8
II G	26	6.50	45	11.25	-4.75	-73.1
II H	38	9.50	37	9.25	.25	2.6
II I	48	12.	58	14.50	-2.50	-20.8
II J	67	16.75	78	19.50	-2.75	-16.4
II K	28	7.	17	4.25	2.75	39.3
II L	113	28.25	119	29.75	-1.50	-5.3
II M	64	16.	57	14.25	1.75	10.9
II N	87	21.75	60	15.	6.75	31.
II O	63	15.75	71	17.75	-2.	-12.7
II P	52	13.	53	13.25	-.25	-1.9
II Q	75	18.75	57	14.25	4.50	24.
II R	68	17.	82	20.50	-3.50	-20.6
II S	68	17.	83	20.75	-3.75	-22.1
II T	32	8.	46	11.50	-3.50	-43.7
II U	65	16.25	87	21.75	-5.50	-33.8
II V	80	20.	77	19.25	.75	3.7
II W	89	22.25	74	18.50	3.75	16.8
II X	68	17.	56	14.	3.	17.6
II Y	55	13.75	64	16.	-2.25	-16.4
Total	1503	375.75	1561	390.25	-14.50	-3.86%
Average	60.12	15.03	62.44	15.61	-.58	-3.86%

TABLE VII

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION VI CBC

Subject	Total No. Units of Work, 1st 2"	Av. No. Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av. No. Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
I A	38	9.50	39	9.75	-.25	-2.6
I B	54	13.50	45	11.25	2.25	16.7
I C	53	13.25	62	15.50	-2.25	-16.9
I D	53	13.25	63	15.75	-2.50	-18.9
I E	77	19.25	95	23.75	-4.50	-23.4
I F	66	16.50	67	16.75	-.25	-1.5
I G	57	14.25	56	14.	.25	1.8
I H	67	16.75	85	21.25	-4.50	-26.9
I I	74	18.50	50	12.50	6.	32.4
I J	48	12.	63	15.75	-3.75	-31.3
I K	41	10.25	55	13.75	-3.50	-34.1
I L	53	13.25	59	14.75	-1.50	-11.3
I M	76	19.	85	21.25	-2.25	-11.8
I N	137	34.25	136	34.	.25	.7
I O	78	19.50	73	18.25	1.25	6.4
I P	105	26.25	141	35.25	-9.	-34.3
I Q	71	17.75	71	17.75	-	-
I R	97	24.25	87	21.75	2.50	10.3
I S	44	11.	41	10.25	.75	6.8
I T	58	14.50	44	11.	3.50	24.1
I U	67	16.75	48	12.	4.75	28.4
I V	41	10.25	39	9.75	.50	4.8
I W	103	25.75	82	20.50	5.25	20.3
I X	49	12.25	40	10.	2.25	18.3
I Y	68	17.	49	12.25	4.75	27.9
Total	1675	418.75	1675	418.75	0	0
Average	67	16.75	67	16.75	0	0

TABLE VIII

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION IV DCD

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
II A	61	15.25	73	18.25	-3.	-19.6
II B	89	22.25	89	22.25	-	-
II C	56	14.	68	17.	-3.	-21.4
II D	68	17.	62	15.50	1.50	8.8
II E	98	24.50	97	24.25	.25	1.
II F	43	10.75	44	11.	-.25	-2.3
II G	54	13.50	59	14.75	-1.25	-9.3
II H	53	13.25	50	12.50	.75	5.6
II I	68	17.	80	20.	-3.	-17.6
II J	103	25.75	119	29.75	-4.	-15.5
II K	33	8.25	29	7.25	1.	12.1
II L	144	36.	115	28.75	7.25	20.1
II M	79	19.75	99	24.75	-5.	-25.3
II N	76	19.	77	19.25	- .25	-1.3
II O	71	17.75	79	19.75	-2.	-11.4
II P	88	22.	77	19.25	2.75	12.5
II Q	86	21.50	84	21.	.50	2.3
II R	106	26.50	115	28.75	-2.25	-8.4
II S	82	20.50	81	20.25	.25	1.2
II T	47	11.75	64	16.	-4.25	-36.1
II U	91	22.75	94	23.50	-.75	-3.3
II V	86	21.50	116	29.	-7.50	-34.8
II W	92	23.	94	23.50	.50	-2.2
II X	60	15.	79	19.75	-4.75	-31.6
II Y	70	17.50	86	21.50	-4.	-22.8
Total	1904	476.00	2030	507.50	-31.50	- 6.62%
Average	76.16	19.04	81.20	20.30	-1.26	- 6.62%

TABLE IX

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION VIII DAD

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No. Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
II A	69	17.25	72	18.	-.75	-4.3
II B	76	19.	77	19.25	-.25	-1.3
II C	102	25.50	87	21.75	3.75	14.7
II D	62	15.50	39	9.75	5.75	37.1
II E	126	31.50	107	26.75	4.75	15.
II F	55	13.75	53	13.25	.50	3.6
II G	89	22.25	78	19.50	2.75	12.4
II H	86	21.50	56	14.	7.50	34.8
II I	96	24.	94	23.50	.50	2.1
II J	95	23.75	105	26.25	-2.50	-10.5
II K	29	7.25	61	15.25	-8.	-110.3
II L	150	37.50	200	50.	-12.50	-33.3
II M	84	21.	93	23.25	-2.25	-10.7
II N	91	22.75	74	18.50	4.25	18.6
II O	97	24.25	96	24.	.25	1.
II P	57	14.25	62	15.50	-1.25	-8.7
II Q	79	19.75	91	22.75	-3.	-15.2
II R	86	21.50	96	24.	-2.50	-11.6
II S	99	24.75	110	27.50	-2.75	-11.1
II T	83	20.75	69	17.25	3.50	16.9
II U	85	21.25	71	17.75	3.50	16.5
II V	95	23.75	89	22.25	1.50	6.3
II W	81	20.25	89	22.25	-2.	-9.9
II X	66	16.50	74	18.50	-2.	-12.1
II Y	94	23.50	87	21.75	1.75	7.4
Total	2132	533.00	2130	532.50	.50	.09%
Average	85.28	21.32	85.2	21.3	.02	.09%

TABLE X

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION XIII DED

Subject	Total No. Units of Work, 1st 2"	Av. No. Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av. No. Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
IV A	71	17.75	81	20.25	-2.50	-14.1
IV B	44	11.	58	14.50	-3.50	-31.8
IV C	81	20.25	70	17.50	2.75	13.5
IV D	56	14.	58	14.50	-.50	-3.7
IV E	23	5.75	46	11.50	-5.75	-100.
IV F	52	13.	40	10.	3.	23.1
IV G	80	20.	94	23.50	-3.50	-17.5
IV H	54	13.50	42	10.50	3.	22.2
IV I	20	5.	28	7.	-2.	-40.
IV J	26	6.50	39	9.75	-3.25	-50.
IV K	66	16.50	46	11.50	5.	30.3
IV L	59	14.75	48	12.	2.75	18.6
IV M	55	13.75	65	16.25	-2.50	-18.2
IV N	80	20.	75	18.75	1.25	6.3
IV O	53	13.25	65	16.25	-3.	-22.6
IV P	60	15.	40	10.	5.	33.3
IV Q	53	13.25	51	12.75	.50	3.8
IV R	44	11.	39	9.75	1.25	11.4
IV S	43	10.75	57	14.25	-3.50	-32.6
IV T	65	16.25	60	15.	1.25	7.7
IV U	25	6.25	33	8.25	-2.	-32.
IV V	49	12.25	49	12.25	-	-
IV W	61	15.25	55	13.75	1.50	9.8
IV X	58	14.50	72	18.	-3.50	-24.1
IV Y	26	6.50	42	10.50	-4.	-61.5
Total	1304	326.00	1353	338.25	- 12.25	-3.76%
Average	52.16	13.04	54.12	13.53	-.49	-3.76%

TABLE XI

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION IX EFE

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
III A	16	4.	15	3.75	.25	6.3
III B	22	5.50	21	5.25	.25	4.6
III C	9	2.25	6	1.50	.75	33.3
III D	12	3.	10	2.50	.50	16.7
III E	15	3.75	12	3.	.75	20.
III F	16	4.	11	2.75	1.25	31.3
III G	13	3.25	13	3.25	-	-
III H	8	2.	6	1.50	.50	25.
III I	17	4.25	17	4.25	-	-
III J	13	3.25	13	3.25	-	-
III K	13	3.25	12	3.	.25	7.7
III L	17	4.25	15	3.75	.50	11.8
III M	21	5.25	17	4.25	1.	19.0
III N	14	3.50	14	3.50	-	-
III O	21	5.25	21	5.25	-	-
III P	18	4.50	17	4.25	.25	5.6
III Q	12	3.	11	2.75	.25	8.3
III R	11	2.75	9	2.25	.50	18.1
III S	20	5.	14	3.50	1.50	30.
III T	12	3.	7	1.75	1.25	41.6
III U	12	3.	13	3.25	-.25	-8.3
III V	13	3.25	11	2.75	.50	15.4
III W	10	2.50	10	2.50	-	-
III X	22	5.50	19	4.75	.75	13.6
III Y	11	2.75	10	2.50	.25	9.1
Total	368	92.00	324	81.00	11.00	11.96%
Average	14.72	3.68	12.96	3.24	.44	11.96%

TABLE XII

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION XII EBE

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
III A	19	4.75	17	4.25	.50	10.5
III B	27	6.75	25	6.25	.50	7.4
III C	11	2.75	9	2.25	.50	18.2
III D	15	3.75	13	3.25	.50	13.3
III E	19	4.75	16	4.	.75	15.8
III F	19	4.75	18	4.50	.25	5.3
III G	12	3.	14	3.50	-.50	-16.7
III H	8	2.	10	2.50	-.50	-25.
III I	25	6.25	27	6.75	-.50	-8.
III J	17	4.25	17	4.25	-	-
III K	16	4.	16	4.	-	-
III L	15	3.75	15	3.75	-	-
III M	20	5.	17	4.25	.75	15.
III N	13	3.25	14	3.50	-.25	-7.7
III O	18	4.50	20	5.	-.50	-11.1
III P	14	3.50	17	4.25	-.75	-21.4
III Q	14	3.50	16	4.	-.50	-14.2
III R	15	3.75	14	3.50	.25	6.7
III S	21	5.25	18	4.50	.75	14.3
III T	12	3.	14	3.50	-.50	-16.7
III U	11	2.75	11	2.75	-	-
III V	14	3.50	11	2.75	.75	21.4
III W	9	2.25	9	2.25	-	-
III X	18	4.50	21	5.25	-.75	-16.7
III Y	19	4.75	17	4.25	.50	10.5
Total	401	100.25	396	99.00	1.25	1.25%
Average	16.04	4.01	15.84	3.96	.05	1.25%

TABLE XIII

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION XIV EDE

Subject	Total No. Units of Work, 1st 2"	Av. No. Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av. No. Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
IV A	17	4.25	15	3.75	.50	11.8
IV B	10	2.50	8	2.	.50	20.
IV C	11	2.75	9	2.25	.50	18.2
IV D	17	4.25	16	4.	.25	5.9
IV E	12	3.	9	2.25	.75	25.
IV F	14	3.50	11	2.75	.75	21.4
IV G	21	5.25	21	5.25	-	-
IV H	20	5.	21	5.25	-.25	-5.
IV I	13	3.25	12	3.	.25	7.7
IV J	17	4.25	19	4.75	-.50	-11.7
IV K	11	2.75	8	2.	.75	27.3
IV L	12	3.	14	3.50	-.50	-16.7
IV M	21	5.25	19	4.75	.50	9.5
IV N	18	4.50	16	4.	.50	11.1
IV O	25	6.25	23	5.75	.50	8.
IV P	15	3.75	14	3.50	.25	6.6
IV Q	13	3.25	11	2.75	.50	15.4
IV R	17	4.25	15	3.75	.50	11.8
IV S	9	2.25	12	3.	-.75	-33.3
IV T	13	3.25	13	3.25	-	-
IV U	17	4.25	16	4.	.25	5.9
IV V	11	2.75	10	2.50	.25	9.1
IV W	17	4.25	18	4.50	-.25	-5.9
IV X	14	3.50	14	3.50	-	-
IV Y	19	4.75	19	4.75	-	-
Total	384	96.00	363	90.75	5.25	5.47%
Average	15.36	3.84	14.52	3.63	.21	5.47%

Section D. Supplementary Tables for Average Number of Errors and Percent Increase in Errors During the First and Second Two Minutes of the Non-Fatigue Task for all Fourteen Conditions.

TABLE XIV

AVERAGE NUMBER OF UNITS OF WORK COMPLETED AND PERCENT DECREMENT DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION X FEF

Subject	Total No. Units of Work, 1st 2"	Av.No.Units of Wk. per 1/2 min. 1st 2"	Total No. Units of Work, 2nd 2"	Av.No.Units of Wk. per 1/2 min. 2nd 2"	Absolute Loss	Percent Decrement
III A	26	6.50	23	5.75	.75	11.5
III B	34	8.50	36	9.	-.50	-5.9
III C	18	4.50	15	3.75	.75	16.7
III D	26	6.50	26	6.50	-	-
III E	35	8.75	34	8.50	.25	2.9
III F	31	7.75	37	9.25	-1.50	-19.4
III G	38	9.50	31	7.75	1.75	18.4
III H	14	3.50	11	2.75	.75	21.4
III I	48	12.	47	11.75	.25	2.1
III J	33	8.25	30	7.50	.75	9.1
III K	33	8.25	32	8.	.25	3.
III L	38	9.50	31	7.75	1.75	18.4
III M	37	9.25	35	8.75	.50	5.4
III N	26	6.50	22	5.50	1.	15.4
III O	41	10.25	38	9.50	.75	7.3
III P	34	8.50	30	7.50	1.	11.8
III Q	25	6.25	27	6.75	-.50	-8.
III R	29	7.25	24	6.	1.25	17.2
III S	31	7.75	24	6.	1.75	22.6
III T	23	5.75	21	5.25	.50	8.7
III U	30	7.50	27	6.75	.75	10.
III V	19	4.75	11	2.75	2.	42.1
III W	24	6.	24	6.	-	-
III X	54	13.50	49	12.25	1.25	9.3
III Y	33	8.25	26	6.50	1.75	21.2
Total	780	195.	711	177.75	17.25	8.85%
Average	31.2	7.8	28.44	7.11	.69	8.85%

TABLE XV

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION I BAB

Subject	Total No. Errors, 1st 2"	Av. No. Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av. No. Errors per 1/2 Min. 2nd 2"	Absolute Increase	Percent Increase
I A	3	.75	3	.75	-	-
I B	4	1.	7	1.75	.75	75.
I C	1	.25	1	.25	-	-
I D	4	1.	2	.50	-.50	-50.
I E	7	1.75	5	1.25	-.50	-28.6
I F	5	1.25	10	2.50	1.25	100.
I G	-	-	2	.50	.50	∞
I H	7	1.75	7	1.75	-	-
I I	2	.50	4	1.	.50	100.
I J	6	1.50	7	1.75	.25	16.6
I K	2	.50	2	.50	-	-
I L	-	-	2	.50	.50	∞
I M	4	1.	-	-	-1.	-100.
I N	1	.25	2	.50	.25	100.
I O	1.	.25	1	.25	-	-
I P	11	2.75	7	1.75	-1.	-36.3
I Q	1	.25	6	1.50	1.25	500.
I R	9	2.25	13	3.25	1.	44.4
I S	7	1.75	-	-	-1.75	-100.
I T	6	1.50	2	.50	-1.	-66.6
I U	7	1.75	4	1.	-.75	-42.8
I V	4	1.	6	1.50	.50	50.
I W	4	1.	1	.25	-.75	-75.
I X	2	.50	5	1.25	.75	150.
I Y	1	.25	2	.50	.25	100.
Total	99	24.75	101	25.25	.50	2.02
Average	3.96	.99	4.04	1.01	.02	2.02

TABLE XVI

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION V BCB

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
I A	2	.50	6	1.50	1.00	200.
I B	4	1.	2	.50	-.50	-50.
I C	-	-	1	.25	.25	∞
I D	2	.50	1	.25	-.25	-50.
I E	2	.50	2	.50	-	-
I F	3	.75	2	.50	-.25	-33.3
I G	-	-	3	.75	.75	∞
I H	2	.50	6	1.50	1.	200.
I I	6	1.50	5	1.25	-.25	-16.6
I J	6	1.50	7	1.75	.25	16.6
I K	1	.25	-	-	.25	-100.
I L	4	1.	4	1.	-	-
I M	8	2.	2	.50	-1.50	-75.
I N	4	1.	5	1.25	.25	25.
I O	3	.75	4	1.	.25	33.3
I P	13	3.25	12	3.	-.25	-7.6
I Q	3	.75	4	1.	.25	33.3
I R	9	2.25	11	2.75	.50	22.2
I S	7	1.75	6	1.50	-.25	-14.4
I T	2	.50	4	1.	.50	100.
I U	4	1.	1	.25	-.75	-75.
I V	3	.75	1	.25	.50	-66.6
I W	3	.75	4	1.	.25	33.3
I X	2	.50	1	.25	-.25	-50.
I Y	1	.25	-	-	-.25	-100.
Total	94	23.50	94	23.50	.00	0.0
Average	3.76	.94	3.76	.94	.00	0.0

TABLE XVII

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION XI BEB

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
III A	1	.25	1	.25	-	-
III B	4	1.	8	2.	1.	100.
III C	2	.50	5	1.25	.75	150.
III D	9	2.25	8	2.	- .25	-11.1
III E	1	.25	4	1.	.75	300.
III F	5	1.25	3	.75	-.50	-40.
III G	-	-	7	1.75	1.75	∞
III H	-	-	-	-	-	-
III I	2	.50	3	.75	.25	50.
III J	5	1.25	4	1.	-.25	-20.
III K	-	-	3	.75	.75	∞
III L	4	1.	3	.75	-.25	-25.
III M	5	1.25	5	1.25	-	-
III N	5	1.25	8	2.	.75	60
III O	9	2.25	6	1.50	-.75	-33.3
III P	4	1.	3	.75	-.25	-25.
III Q	1	.25	1	.25	-	-
III R	5	1.25	3	.75	-.50	-40.
III S	2	.50	6	1.50	1.	200.
III T	3	.75	2	.50	-.25	-33.3
III U	6	1.50	2	.50	-1.	-66.7
III V	3	.75	3	.75	-	-
III W	9	2.25	8	2.	-.25	-11.1
III X	2	.50	5	1.25	.75	150.
III Y	6	1.50	4	1.	-.50	-33.3
Total	93	23.25	105	26.25	3.	12.9
Average	3.72	.93	4.2	1.05	.12	12.9

TABLE XVIII

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION II ABA

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
I A	1	.25	2	.50	.25	100.
I B	5	1.25	5	1.25	-	-
I C	3	.75	1	.25	-.50	-66.7
I D	9	2.25	6	1.50	-.75	-33.3
I E	5	1.25	3	.75	-.50	-40.
I F	8	2.	7	1.75	-.25	-12.5
I G	3	.75	2	.50	-.25	-33.3
I H	8	2.	4	1.	-1.	-50.
I I	5	1.25	2	.50	-.75	-60.
I J	6	1.50	5	1.25	-.25	-16.7
I K	4	1.	1	.25	-.75	-75.
I L	3	.75	3	.75	-	-
I M	2	.50	4	1.	.50	100.
I N	4	1.	2	.50	-.50	-50.
I O	5	1.25	-	-	1.25	-100.
I P	6	1.50	4	1.	.50	-33.3
I Q	2	.50	4	1.	.50	100.
I R	12	3.	18	4.50	1.50	50.
I S	3	.75	1	.25	-.50	-66.7
I T	5	1.25	5	1.25	-	-
I U	7	1.75	3	.75	-1.	-57.1
I V	8	2.	5	1.25	-.75	-37.5
I W	6	1.50	6	1.50	-	-
I X	2	.50	4	1.	.50	100.
I Y	4	1.	1	.25	-.75	-75.
Total	126	31.50	98	24.50	-7.	-22.2
Average	5.04	1.26	3.92	.98	- .28	-22.2

TABLE XIX

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION VII ADA

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
II A	2	.50	3	.75	.25	50.
II B	3	.75	2	.50	-.25	-33.3
II C	3	.75	3	.75	-	-
II D	1	.25	2	.50	.25	100.
II E	2	.50	3	.75	.25	50.
II F	1	.25	3	.75	.50	200.
II G	3	.75	3	.75	-	-
II H	3	.75	2	.50	-.25	-33.3
II I	5	1.25	3	.75	-.50	-40.
II J	-	-	3	.75	.75	∞
II K	2	.50	1	.25	-.25	-50.
II L	4	1.	5	1.25	.25	25.
II M	3	.75	6	1.50	.75	100.
II N	2	.50	3	.75	.25	50.
II O	5	1.25	4	1.	-.25	-20.
II P	6	1.50	2	.50	-1.	-66.7
II Q	1	.25	2	.50	.25	100.
II R	8	2.	4	1.	-1.	-50.
II S	6	1.50	2	.50	-1.	-66.7
II T	5	1.25	3	.75	-.50	-40.
II U	5	1.25	1	.25	-1.	-80.
II V	6	1.50	5	1.25	-.25	-16.7
II W	3	.75	2	.50	-.25	-33.3
II X	2	.50	6	1.50	1.	200.
II Y	5	1.25	3	.75	-.50	-40.
Total	86	21.50	76	19.	-2.50	-11.6
Average	3.44	.86	3.04	.76	-.10	-11.6

TABLE XX

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION III CDC

Subject	Total No. Errors, 1st 2"	Av. No. Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av. No. Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
II A	1	.25	2	.50	.25	100.
II B	4	1.	-	-	-1.	-100.
II C	6	1.50	6	1.50	-	-
II D	2	.50	-	-	-.50	-100.
II E	3	.75	2	.50	-.25	-33.3
II F	1	.25	2	.50	.25	100.
II G	6	1.50	9	2.25	.75	50.
II H	7	1.75	2	.50	-1.25	-71.4
II I	1	.25	5	1.25	1.	400.
II J	2	.50	2	.50	-	-
II K	2	.50	-	-	-.50	-100.
II L	10	2.50	3	.75	-1.75	-70.
II M	8	2.	6	1.50	-.50	-25.
II N	10	2.50	1	.25	-2.25	-90.
II O	4	1.	4	1.	-	-
II P	3	.75	1	.25	-.50	-66.7
II Q	3	.75	2	.50	-.25	-33.3
II R	1	.25	-	-	-.25	-100.
II S	2	.50	1	.25	-.25	-50.
II T	8	2.	8	2.	-	-
II U	3	.75	3	.75	-	-
II V	1	.25	1	.25	-	-
II W	6	1.50	1	.25	-1.25	-83.3
II X	2	.50	1	.25	-.25	-50.
II Y	2	.50	-	-	-.50	-100.
Total	98	24.50	62	15.50	-9.00	-36.73
Average	3.92	.98	2.48	.62	-.36	-36.73

TABLE XXI

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION VI CBC

Subject	Total No. Errors, 1st 2"	Av. No. Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av. No. Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
I A	5	1.25	2	.50	-.75	-.60
I B	-	-	-	-	-	-
I C	-	-	-	-	-	-
I D	2	.50	-	-	.50	-100.
I E	-	-	-	-	-	-
I F	12	3.	7	1.75	-1.25	-41.6
I G	5	1.25	1	.25	-1.	-80.
I H	2	.50	-	-	-.50	-100.
I I	4	1.	10	2.50	1.50	150.
I J	8	2.	9	2.25	.25	12.5
I K	1	.25	7	1.75	1.50	600.
I L	-	-	2	.50	.50	∞
I M	8	2.	-	-	-2.	-100.
I N	1	.25	3	.75	.50	200.
I O	-	-	2	.50	.50	∞
I P	4	1.	12	3.	2.	200.
I Q	2	.50	2	.50	-	-
I R	7	1.75	7	1.75	-	-
I S	1	.25	1	.25	-	-
I T	4	1.	1	.25	-.75	-75.
I U	1	.25	6	1.50	1.25	500.
I V	3	.75	2	.50	-.25	-33.3
I W	1	.25	1	.25	-	-
I X	-	-	3	.75	.75	∞
I Y	-	-	3	.75	.75	∞
Total	71	17.75	81	20.25	2.50	14.1
Average	2.84	.71	3.24	.81	.10	14.1

TABLE XXII

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION IV DCD

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
II A	3	.75	1	.25	-.50	-66.6
II B	2	.50	-	-	-.50	-100.
II C	4	1.	4	1.	-	-
II D	2	.50	1	.25	-.25	-50.
II E	4	1.	3	.75	-.25	-25.
II F	-	-	-	-	-	-
II G	10	2.50	2	.50	-2.00	-80.
II H	-	-	4	1.	1.	∞
II I	2	.50	1	.25	-.25	-50.
II J	5	1.25	-	-	-1.25	-100.
II K	-	-	-	-	-	-
II L	20	5.	5	1.25	-3.75	-75.
II M	9	2.25	6	1.50	-.75	-33.3
II N	1	.25	3	.75	.50	200.
II O	2	.50	1	.25	-.25	-50.
II P	-	-	-	-	-	-
II Q	2	.50	2	.50	-	-
II R	-	-	-	-	-	-
II S	5	1.25	-	-	-1.25	-100.
II T	1	.25	1	.25	-	-
II U	1	.25	1	.25	-	-
II V	-	-	8	2.	2.	∞
II W	2	.50	1	.25	-.25	-50.
II X	4	1.	2	.50	-.50	-50.
II Y	-	-	-	-	-	-
Total	79	19.75	46	11.50	-8.25	-41.77
Average	3.16	.79	1.84	.46	-.33	-41.77

TABLE XXIII

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION VIII DAD

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
II A	2	.50	1	.25	-.25	-50.
II B	-	-	3	.75	.75	∞
II C	2	.50	2	.50	-	-
II D	3	.75	3	.75	-	-
II E	6	1.50	2	.50	-1.	-66.6
II F	-	-	-	-	-	-
II G	1	.25	3	.75	.50	200.
II H	3	.75	2	.50	-.25	-66.6
II I	2	.50	2	.50	-	-
II J	-	-	-	-	-	-
II K	-	-	-	-	-	-
II L	4	1.	20	5.	4.	400.
II M	7	1.75	2	.50	-1.25	-71.4
II N	-	-	-	-	-	-
II O	2	.50	2	.50	-	-
II P	5	1.25	2	.50	-.75	-60.
II Q	1	.25	2	.50	.25	100.
II R	1	.25	-	-	-.25	-100.
II S	2	.50	1	.25	-.25	-50.
II T	1	.25	4	1.	.75	300.
II U	-	-	-	-	-	-
II V	3	.75	6	1.50	.75	100.
II W	2	.50	2	.50	-	-
II X	3	.75	3	.75	-	-
II Y	-	-	-	-	-	-
Total	50	12.50	62	15.50	3.00	24.
Average	2	.50	2.48	.62	.12	24.

TABLE XXIV

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK
CONDITION XIII DED

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
IV A	2	.50	9	2.25	1.75	350.
IV B	4	1.	3	.75	-.25	-25.
IV C	8	2.	4	1.	-1.	-50.
IV D	8	2.	5	1.25	-.75	-37.5
IV E	1	.25	3	.75	.50	200.
IV F	1	.25	1	.25	-	-
IV G	4	1.	4	1.	-	-
IV H	2	.50	2	.50	-	-
IV I	5	1.25	5	1.25	-	-
IV J	1	.25	4	1.	.75	300.
IV K	1	.25	1	.25	-	-
IV L	3	.75	-	-	-.75	-100.
IV M	11	2.75	8	2.	-.75	-27.2
IV N	4	1.	4	1.	-	-
IV O	-	-	4	1.	1.	∞
IV P	-	-	-	-	-	-
IV Q	1	.25	1	.25	-	-
IV R	2	.50	1	.25	-.25	-50.
IV S	2	.50	6	1.50	1.	200.
IV T	-	-	-	-	-	-
IV U	2	.50	4	1.	.50	100.
IV V	-	-	1	.25	.25	∞
IV W	2	.50	2	.50	-	-
IV X	2	.50	1	.25	-.25	-50.
IV Y	-	-	-	-	-	-
Total	66	16.50	73	18.25	1.75	10.6
Average	2.64	.66	2.92	.73	.07	10.6

TABLE XXV

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION IX EFE

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
III A	-	-	-	-	-	-
III B	2	.50	3	.75	.25	50.
III C	4	1.	2	.50	-.50	-50.
III D	-	-	2	.50	.50	∞
III E	-	-	-	-	-	-
III F	2	.50	2	.50	-	-
III G	-	-	1	.25	.25	∞
III H	-	-	1	.25	.25	∞
III I	1	.25	2	.50	.25	100.
III J	-	-	-	-	-	-
III K	3	.75	3	.75	-	-
III L	1	.25	-	-	-.25	-100.
III M	1	.25	2	.50	.25	100.
III N	2	.50	2	.50	-	-
III O	2	.50	-	-	-.50	-100.
III P	-	-	-	-	-	-
III Q	1	.25	-	-	-.25	-100.
III R	1	.25	1	.25	-	-
III S	-	-	1	.25	.25	∞
III T	-	-	1	.25	.25	∞
III U	-	-	-	-	-	-
III V	1	.25	-	-	-.25	-100.
III W	1	.25	3	.75	.50	200.
III X	1	.25	-	-	-.25	-100.
III Y	2	.50	5	1.25	.75	150.
Total	25	6.25	31	7.75	1.50	24.
Average	1	.25	1.24	.31	.06	24.

TABLE XXVI

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION XII EBE

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
III A	2	.50	1	.25	-.25	-50.
III B	1	.25	-	-	-.25	-100.
III C	4	1.	1	.25	-.75	-75.
III D	5	1.25	5	1.25	-	-
III E	-	-	1	.25	.25	∞
III F	2	.50	-	-	-.50	-100.
III G	-	-	1	.25	.25	∞
III H	3	.75	-	-	-.75	-100.
III I	-	-	-	-	-	-
III J	1	.25	1	.25	-	-
III K	-	-	-	-	-	-
III L	-	-	-	-	-	-
III M	1	.25	1	.25	-	-
III N	1	.25	4	1.	.75	300.
III O	1	.25	1	.25	-	-
III P	-	-	-	-	-	-
III Q	-	-	2	.50	.50	∞
III R	-	-	-	-	-	-
III S	-	-	-	-	-	-
III T	-	-	1	.25	.25	∞
III U	-	-	3	.75	.75	∞
III V	4	1.	1	.25	-.75	-75.
III W	1	.25	3	.75	.50	200.
III X	-	-	-	-	-	-
III Y	5	1.25	4	1.	-.25	-20.
Total	31	7.75	30	7.50	-.25	-3.2
Average	1.24	.31	1.2	.30	-.01	-3.2

TABLE XXVII

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON*FATIGUE TASK
CONDITION XIV EDE

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
IV A	2	.50	2	.50	-	-
IV B	-	-	-	-	-	-
IV C	-	-	1	.25	.25	∞
IV D	4	1.	1	.25	-.75	-75.
IV E	-	-	-	-	-	-
IV F	-	-	-	-	-	-
IV G	-	-	-	-	-	-
IV H	1	.25	-	-	-.25	-100.
IV I	-	-	-	-	-	-
IV J	1	.25	1	.25	-	-
IV K	3	.75	-	-	-.75	-100.
IV L	-	-	-	-	-	-
IV M	1	.25	-	-	-.25	-100.
IV N	-	-	2	.50	.50	∞
IV O	3	.75	2	.50	-.25	-33.3
IV P	-	-	-	-	-	-
IV Q	1	.25	1	.25	-	-
IV R	-	-	-	-	-	-
IV S	-	-	1	.25	.25	∞
IV T	-	-	2	.50	.50	∞
IV U	1	.25	-	-	-.25	-100.
IV V	-	-	-	-	-	-
IV W	1	.25	1	.25	-	-
IV X	-	-	1	.25	.25	∞
IV Y	-	-	1	.25	.25	∞
Total	18	4.50	16	4.00	-.50	-11.11
Average	.72	.18	.64	.16	-.02	-11.11

TABLE XXVIII

AVERAGE NUMBER OF ERRORS AND PERCENT INCREASE IN ERRORS DURING FIRST AND SECOND TWO MINUTES OF THE NON-FATIGUE TASK CONDITION X FEF

Subject	Total No. Errors, 1st 2"	Av.No.Errors per 1/2 min. 1st 2"	Total No. Errors, 2nd 2"	Av.No.Errors per 1/2 min. 2nd 2"	Absolute Increase	Percent Increase
III A	2	.50	-	-	-.50	-100.
III B	-	-	-	-	-	-
III C	-	-	-	-	-	-
III D	1	.25	4	1.	.75	300.
III E	-	-	1	.25	.25	∞
III F	-	-	2	.50	.50	∞
III G	2	.50	2	.50	-	-
III H	1	.25	-	-	-.25	-100.
III I	3	.75	1	.25	-.50	-66.7
III J	-	-	-	-	-	-
III K	1	.25	1	.25	-	-
III L	1	.25	-	-	-.25	-100.
III M	1	.25	4	1.	.75	300
III N	-	-	2	.50	.50	∞
III O	1	.25	-	-	-.25	-100.
III P	-	-	-	-	-	-
III Q	2	.50	2	.50	-	-
III R	1	.25	-	-	-.25	-100.
III S	1	.25	2	.50	.25	100.
III T	1	.25	-	-	-.25	-100.
III U	-	-	1	.25	.25	∞
III V	-	-	-	-	-	-
III W	2	.50	1	.25	-.25	-50.
III X	-	-	-	-	-	-
III Y	2	.50	-	-	-.50	-100.
Total	22	5.50	23	5.75	.25	4.5
Average	.88	.22	.92	.23	.01	4.5

Section E. Tables of Percentile Ranks Corresponding to the L and Q Scores in the American Council on Education Psychological Examination for the Subjects in Each Group.

TABLE XXIX

PERCENTILE RANKS CORRESPONDING TO THE L AND Q SCORES IN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FOR GROUP I

Subject	Percentile Ranks	
	L	Q
I A	.27	.47
I B	.71	.43
I C	.99	.65
I D	-	-
I E	.97	.80
I F	.24	.18
I G	.54	.62
I H	.65	.78
I I	.31	.43
I J	.14	.27
I K	-	-
I L	.97	.90
I M	.75	.78
I N	.91	.80
I O	.45	.51
I P	-	-
I Q	-	-
I R	.55	.07
I S	-	-
I T	-	-
I U	-	-
I V	.84	.47
I W	.95	.85
I X	.28	.16
I Y	.95	.80
Total	11.47	9.97
Average	.637	.553

TABLE XXX

PERCENTILE RANKS CORRESPONDING TO THE L AND Q SCORES IN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FOR GROUP II

Subject	Percentile Ranks	
	L	Q
II A	.71	.58
II B	-	-
II C	.55	.03
II D	-	-
II E	.98	.87
II F	.93	.98
II G	.43	.43
II H	-	-
II I	-	-
II J	-	-
II K	-	-
II L	.70	.58
II M	.85	.58
II N	.56	.80
II O	.97	.62
II P	.24	.23
II Q	.87	.75
II R	-	-
II S	.29	.75
II T	.85	.48
II U	.96	.98
II V	-	-
II W	-	-
II X	.71	.26
II Y	-	-
Total	10.60	8.92
Average	.706	.594

TABLE XXXI

PERCENTILE RANKS CORRESPONDING TO THE L AND Q SCORES IN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FOR GROUP III

Subject	Percentile Ranks	
	L	Q
III A	-	-
III B	.61	.82
III C	-	-
III D	.66	.62
III E	-	-
III F	.84	.60
III G	.58	.47
III H	.99	.72
III I	.86	.47
III J	.33	.47
III K	.97	.62
III L	.78	.85
III M	.51	.75
III N	-	-
III O	-	-
III P	.91	.32
III Q	.95	.52
III R	.99	.87
III S	-	-
III T	.67	.32
III U	.93	.82
III V	-	-
III W	-	-
III X	-	-
III Y	-	-
Total	11.58	9.24
Average	.772	.617

TABLE XXXII

PERCENTILE RANKS CORRESPONDING TO THE L AND Q SCORES IN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FOR GROUP IV

Subject	Percentile Ranks	
	L	Q
IV A	-	-
IV B	.86	.75
IV C	.56	.51
IV D	.26	.02
IV E	.66	.23
IV F	.82	.91
IV G	.99	.91
IV H	.88	.66
IV I	.51	.20
IV J	.34	.97
IV K	-	-
IV L	.99	.58
IV M	-	-
IV N	.24	.91
IV O	-	-
IV P	.86	.58
IV Q	-	-
IV R	.64	.93
IV S	.17	.47
IV T	-	-
IV U	-	-
IV V	.80	.40
IV W	.96	.99
IV X	-	-
IV Y	.86	.40
Total	11.40	10.42
Average	.670	.612

TABLE XXXIII

PERCENTILE RANKS CORRESPONDING TO THE L AND Q SCORES IN THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION FOR THE FOUR EXPERIMENTAL GROUPS COMBINED

Groups	Primary Ability	Total of Percentiles	Average Percentile Rank
I, II, III, IV	L	45.05	.693
I, II, III, IV	Q	38.55	.593

Section F. Supplementary Tables for Experiment I of the Comparison of the Percentage Decrement and Percentage of Cases Showing Decrement in Amount Done per Half-Minute in the Non-Fatigue Task, and the Corresponding Tables for Errors, When the Conditions Compared Contain Different Factorial and Operational Relationships between the Fatigue and the Non-Fatigue Tasks.

TABLE XXXIV

A COMPOSITE COMPARISON OF PERCENTAGE DECREMENT AND THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE OF THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XI BEB, XII EBE	6.07%	.121%	44. %	7.0%	22.7%	8.9%	2.55
IX EFE, X FEF, I BAB	23.58%	.314%	66.7%				

TABLE XXXV

A COMPOSITE COMPARISON OF PERCENTAGE DECREMENT AND THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE OF THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Decrement	Av. % Decrement	%Cases Showing Decrement	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XI BEB, XII EBE	6.07%	.121%	44%	7.0%	17%	8.5%	2.
I BAB, II ABA, IX EFE, X FEF	24.84%	.248%	61%	4.9%			

TABLE XXXVI

A COMPOSITE COMPARISON OF THE TOTAL PERCENT INCREASE IN ERRORS AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av.% Increase in Errors	%Cases Showing Increase in Errors	SE_p	Diff. betw. %	$6D_p$	Critical Ratio, $D/6D_p$
XI BEB, XII EBE	9.7%	.194%	32.%	6.6%	6.7%	8.6%	.779
IX EFE, X FEF, I BAB	30.5%	.407%	38.7%	5.6%			

TABLE XXXVII

A COMPOSITE COMPARISON OF THE TOTAL PERCENT INCREASE IN ERRORS AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	%Cases Showing Increase in Errors	SE_p	Diff. betw. %	$6D_p$	Critical Ratio, $D/6D_p$
XI BEB, XII EBE	9.7%	.194%	32.%	6.6%	2.%	8.1%	.247
I BAB, II ABA, IX EFE, X FEF	8.3%	.083%	34.%	4.7%			

Section G. Supplementary Tables for Experiment II of the Comparison of the Percentage Decrement and Percentage of Cases Showing Decrement in Amount Done per Half-Minute in the Non-Fatigue Task, and the Corresponding Tables for Errors, When the Conditions Compared Contain Different Factorial and Operational Relationships between the Fatigue and the Non-Fatigue Tasks.

TABLE XXXVIII

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	% Cases Showing Decrement	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
VIII DAD	52%	9.9%	20.%	13.7%	1.46
VIII DGD	32%	9.3%			

TABLE XXXIX

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND DIFFERENT OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION

Condition	% Cases Showing Decrement	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
III BAB	48%	9.9%	4. %	14.1%	.284
III CDC	44%	9.9%			

TABLE XL

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	%Cases Showing Decrement	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
XIII DED	44%	9.9%	12.%	13.6%	.882
XIV DED	32%	9.3%			

TABLE XLI

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING DECREMENT IN AMOUNT DONE PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	% Cases Showing Decrement	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
XIV EDE	64%	9.6%	8.%	13.1%	.611
IX EDE	72%	9. %			

TABLE XLII

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	%Cases Showing Increases in Errors	SE_p	Diff. betw. %	$6D_p$	Critical Ratio, $D/6D_p$
V BCB, VI CBC VII ADA, VIII DAD, XI BEB, XII EBE, XIII DED, XIV EDE	35.69%	.178%	33. %	3.3%	5.67%	4.9%	1.16
I BAB, II ABA, III CDC, IV DCD, IX EFE X FEF	-70.18%	-.468%	27.33%	3.6%			

TABLE XLIII

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	% Cases Showing Increase in Errors	SE_p	Diff. Betw. %	$6D_p$	Critical Ratio, $D/6D_p$
VII ADA, VIII DAD, SI BEB, XII EBE, XIII DED, XIV EDE	21.6%	.144%	30.%	3.7%	4.%	6.0%	.667
I BAB, II ABA IX EFE, X FEF	8.3%	.083%	34.%	4.7%			

TABLE XLIV

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	% Cases Showing Increase in Errors	SE_p	Diff. betw. %	$6D_p$	Critical Ratio, $D/6D_p$
VIII DAD, XI BEB, XII EBE, XIII DED, XIV EDE	33.2%	.266%	28. %	4.0%	10.7%	6.9%	1.55
I BAB, IX EFE, X FEF	30.5%	.407%	38.7%	5.6%			

TABLE XLV

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	% Cases Showing Increase in Errors	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
VII ADA, VIII DAD	12.4%	.248%	32.%	6.6%	18.%	8.2%	2.20
III CDC, IV DCD	-78.5%	-1.57%	14.%	4.8%			

TABLE XLVI

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	% Cases Showing Increase in Errors	SE_p	Diff. betw. %	$6D_p$	Critical Ratio, $D/6D_p$
XIII DED, XIV EDE	-.5%	.01%	26.%	6.1%	8.%	9.1%	.879
IX EFE, X FEE	28.5%	.57%	34.%	6.6%			

TABLE XLVII

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Conditions	Total % Increase in Errors	Av. % Increase in Errors	% Cases Showing Increase in Errors	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
XIII DED, XIV EDE	-.5%	-.01%	26.%	6.1%	12.%	7.9%	1.52
III CDC, IV DCD	-78.5%	-1.57%	14.%	4.8%			

TABLE XLVIII

A COMPOSITE COMPARISON OF THE PERCENT INCREASE AND PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND A DIFFERENT OPERATION

Conditions	Total % Increase in Errors	Av. % Increase in Errors	% Cases Showing Increase in Errors	SE_p	Diff. betw. %	σD_p	Critical Ratio, $D/\sigma D_p$
III CDC, IV DCD	-78.5%	-1.57%	14.%	4.8%	20.%	8.3%	2.41
I BAB, II ABA	-20.2%	-.404%	34.%	6.6%			

TABLE XLIX

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	% Cases Showing Increase in Errors	SE_p	Difference between %	$6D_p$	Critical Ratio, $D/6D_p$
VIII DCD	24%	8.5%	12.%	10.7%	1.12
IV DCD	12%	6.5%			

TABLE L

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND DIFFERENT OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION

Condition	% Cases Showing Increase in Errors	SE_p	Difference between %	$6D_p$	Critical Ratio, $D/6D_p$
I BAB	48%	9.9%	32.%	12.4%	2.581
III CDC	16%	7.3%			

TABLE LI

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND SAME OPERATION

Condition	% Cases Showing Increase in Errors	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
VI CBC	16%	7.3%	24.%	12.2%	1.967
III CDC	40%	9.8%			

TABLE LII

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR AND SIMILAR OPERATION, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR AND A DIFFERENT OPERATION

Condition	% Cases Showing Increase in Errors	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
V BCB	44%	9.9%	4.%	14.1%	.284
I BAB	48%	9.9%			

TABLE LIII

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	% Cases Showing Increase in Errors	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
XIII DED	28%	9. %	16.%	11.1%	1.44
XIV DED	12%	6.5%			

TABLE LIV

A COMPARISON OF THE PERCENTAGE OF CASES SHOWING AN INCREASE IN ERRORS PER HALF-MINUTE IN THE NON-FATIGUE TASK WHEN THE FATIGUE TASK INVOLVES A DIFFERENT FACTOR, WITH THE RESULTS WHEN THE FATIGUE TASK INVOLVES THE SAME FACTOR

Condition	% Cases Showing Increase in Errors	SE_p	Difference between %	σD_p	Critical Ratio, $D/\sigma D_p$
XIV EDE	24%	8.5%	16.%	13.0%	1.23
XIX EBE	40%	9.8%			