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The Influence of Error Density on Error Detection Efficiency

Edward A. Ahr

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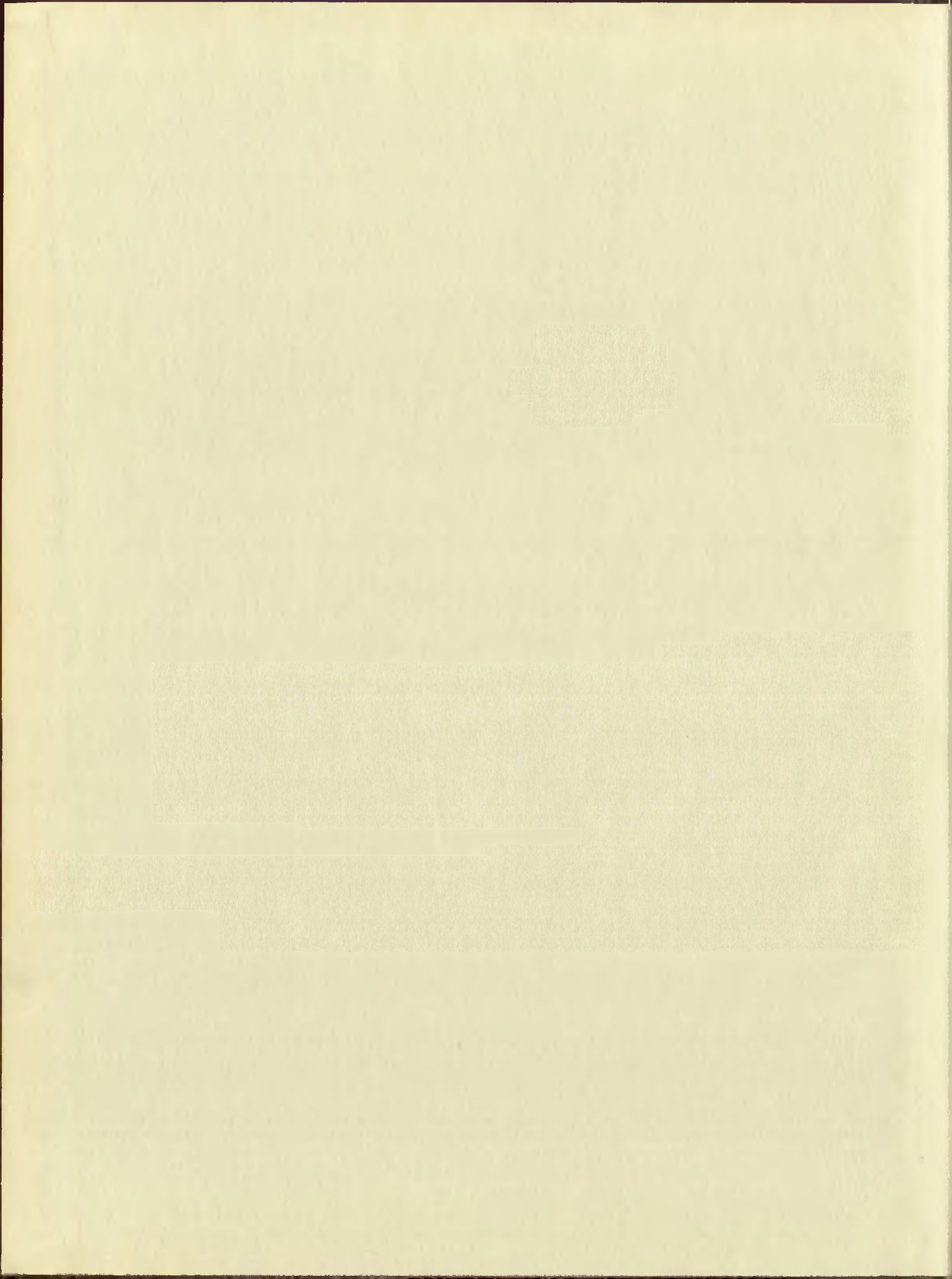
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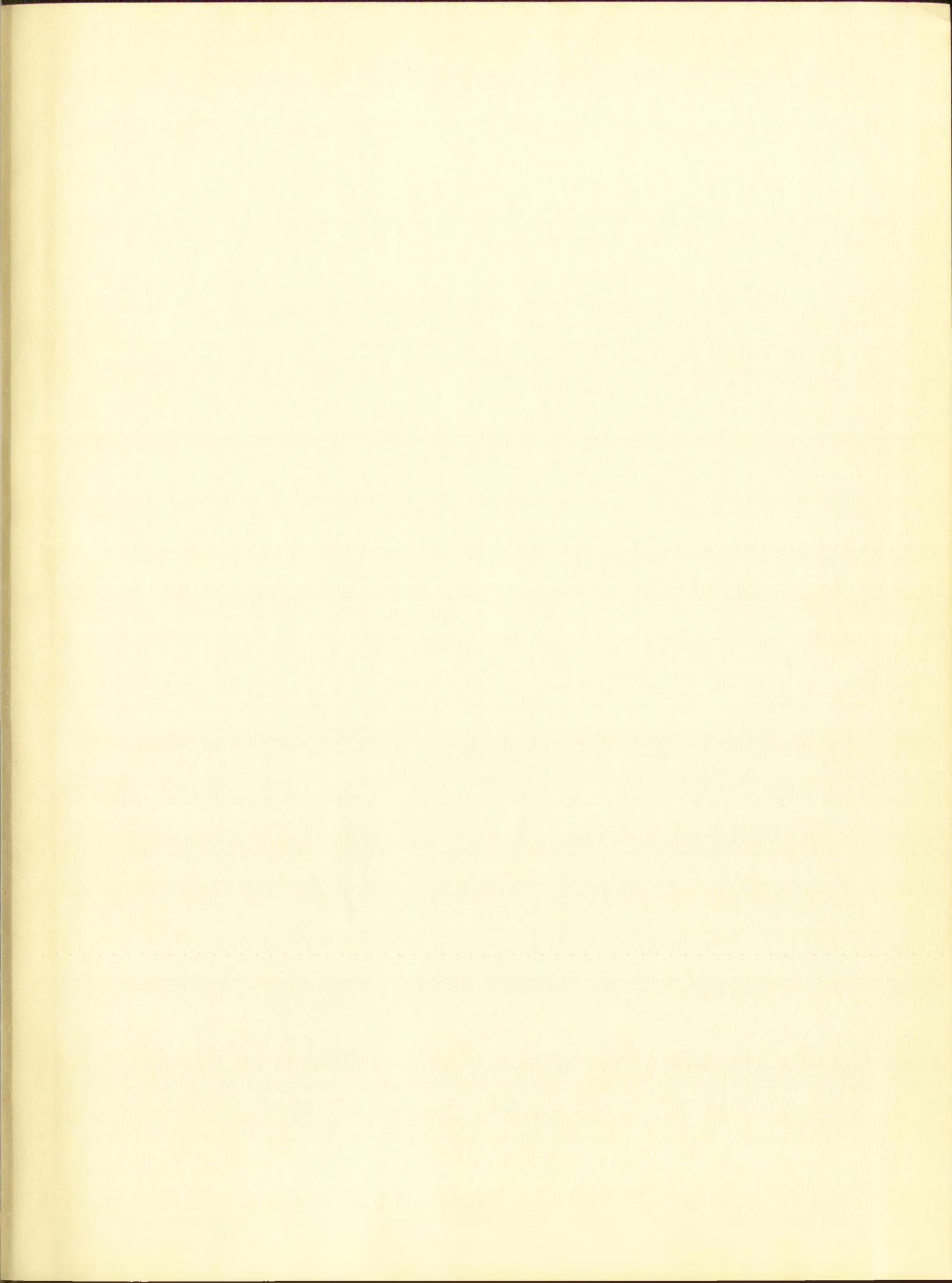
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THE INFLUENCE OF ERROR DENSITY ON
ERROR DETECTION EFFICIENCY

By

A. Edward Ahr

A Thesis

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in
Psychology

The University of New Mexico

1959

The Government of the United States

Department of the Interior

Office of the Director

Washington, D. C.

February 1, 1920

Dear Sir:

Very truly yours,

W. A. Rorer

W. A. Rorer

Director

Department of the Interior



This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

E. Castetter
DEAN

May 4, 1959
DATE

Thesis committee

Henry C. Ellis
CHAIRMAN
Robert M. Morgan
Erno Peterson

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British has been a great success in the
University of New South Wales and the
University of Sydney.

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Statement of the Board

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Statement of the Board

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CHAPTER 1

INTRODUCTION

The problem of maintaining efficiency in monotonous perceptual tasks has become increasingly important in recent years. Technological advances have increased automation which requires human monitoring of equipment which seldom fails. Radarscopes must be searched by air force personnel for unidentified objects which appear infrequently. Inspection of products in industry represents another monitoring task, to mention a few.

The error of not detecting machinery failures, foreign objects, or imperfect products is of major interest. Regardless whether the error is attributable to mechanical or human perceptual or motor disturbances, the consequence remains the same if the error is allowed to go undetected, i.e., loss of human energy, time, and expense.

Statement of the problem.--It was the purpose of this study (a) to investigate the effect of error density (level, rate, or number of errors) on checking efficiency in a proofreading situation under normal conditions, i.e., comfortable working conditions without stress; and (b) to investigate the effects of experience in detecting errors at one level of density on the detection of errors at a later time in which the density level has been changed. This would show if there is a relationship between signal detection and habituation as well as signal density, and would reflect the possible role of learning in the detection of error signals.

Specifically, the present study was a simulated proofreading experiment. The primary hypothesis stated that checking efficiency,

INTRODUCTION

The problem of maintaining efficiency in a system is a complex one. It has become increasingly important in recent years. Many of the advances have involved attention to the human factor. The equipment which makes these advances possible is of increasing importance. The personnel for maintaining these systems are of increasing importance. Inspection of products in industry represents a substantial part of the total cost of production.

The error of not detecting a defect is a serious one. It is often the result of human factors. The error of not detecting a defect is a serious one. It is often the result of human factors. The error of not detecting a defect is a serious one. It is often the result of human factors.

Statement of the problem—It is the purpose of this study to investigate the effect of error factors (level, time, and fatigue) on the detection of defects in a production system. The conditions of the study are: (a) to investigate the effect of error factors (level, time, and fatigue) on the detection of defects in a production system. The conditions of the study are: (a) to investigate the effect of error factors (level, time, and fatigue) on the detection of defects in a production system. The conditions of the study are: (a) to investigate the effect of error factors (level, time, and fatigue) on the detection of defects in a production system.

Specifically, the present study was designed to investigate the effect of error factors (level, time, and fatigue) on the detection of defects in a production system. The present study was designed to investigate the effect of error factors (level, time, and fatigue) on the detection of defects in a production system.

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in terms of percentage of errors caught, increases with the density of errors in the material. As shall be seen in Chapter II, experiments in radar monitoring and dial reading point to the correctness of this hypothesis. The writer was interested in examining proofreading behavior to determine if similar relationships between these variables were present.

Information was also sought on the following subsidiary problems.

- (c) Do false reports (reporting the detection of an error when one is not present) correlate with the probability of error detection? (d) Are different kinds of typographical errors of grossly unequal difficulty to detect?

in terms of percentage of error output. The results of the experiment
errors in the material. It will be seen in Figure 1 that the
in radar monitoring and that reading time of the occurrence of the
hypothesis. The writer was interested in examining the possibility of
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were present.

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(c) Do false reports (reporting the detection of an error when one is
not present) correlate with the probability of error detection? (b)
are different kinds of typographical errors of grossly repeated
difficulty to detect?

EXPERIMENTAL CONTENT
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CHAPTER II

REVIEW OF THE LITERATURE

Much of the literature concerning our present problem is to be found in technical reports made by or for various branches of the armed services. The majority of the studies deal with factors of time or density in relation to signal detection. Signal refers to those stimuli that the O is instructed to detect.

Sustained activity.--Recent studies on operators monitoring visual displays having infrequent signals indicate a drop in the percentage of signals detected as time on the watch progresses. Mackworth (12) has demonstrated that Ss' efficiency in detection of signals declined as a two-hour watch progressed. The signals were double steps of a clock hand normally stepped 0.3 inches every second. There were 24 double steps per hour which were given at irregular intervals. A breakdown of the two-hour watch into four successive half-hour spells shows that checking efficiency decreased in terms of percent signals detected to 84.3, 74.2, 73.2, and 72.0, respectively. Similarly, an analysis of the data into one-hour-watch periods demonstrated the same advantage in favor of the first half-hour (84.7) compared with the second (69.6). Mackworth interpreted the decrease in efficiency in time as an example of partial experimental extinction of a conditioned voluntary response, this extinction being the product of a lack of reinforcement arising from the absence of knowledge of results. He considered minor stimulus-to-stimulus variations in efficiency to depend more on the S's opinion of the likelihood of a signal occurring at a given moment. Similar decrements in Ss' ability to detect

REVIEW OF THE LITERATURE

Most of the literature concerning the present problem is to be found in technical reports made by or for various branches of the armed services. The majority of the studies that will be referred to in this review are in relation to signal detection. Signal theory in these studies that the d' is measured to detect.

Sustained activity.--Recent studies on operators monitoring visual displays having indicated a drop in the percentage of signals detected as time on the watch progresses. Mackworth (12) has demonstrated that d' efficiency in detection of signals declined as a two-hour watch progressed. The signals were a light on a clock hand normally swept 0.2 inches every second. There were 24 double steps per hour which were given as irregular intervals. Breakdown of the two-hour watch into four successive half-hour periods shows that checking efficiency decreased in terms of percent of hits detected to 81.3, 73.2, and 72.4, respectively. Mackworth's analysis of the data into one-hour watch periods demonstrated the same advantage in favor of the first half-hour (81.3) compared with the second (69.6). Mackworth interpreted the decrease in efficiency in time as an example of partial experimental extinction of a conditioned voluntary response, this extinction being the product of a lack of reinforcement arising from the absence of knowledge of the time. He considered minor stimulus-to-stimulus variations as unlikely to depend more on the d' estimate of the likelihood of a signal occurring at a given moment. Similar observations in the military were made.

infrequent signals have been shown when Ss were required to detect targets on simulated radar displays (13). Similar results have been found for industrial inspectors (20).

In contrast to the above studies, other investigators have failed to find such a decrement in the S's ability to detect signals under sustained activity. Broadbent (2) employed latency of detection of nontransient signals (signals remained until detected) as his criterion of checking efficiency instead of percentage of signals detected as in the previous studies mentioned. He found no increase in the average latency of detection, rather an increase in variance. This could be explained by the difference in response measure employed in this study and that mentioned above. Mackworth's and Deese's Ss had less time to detect a signal than Broadbent's Ss. Specifically, the response measure for the former was all-or-none, whereas the latter's measure was continuous. Whether a decrement was found or not, the underlying fact emerging from these studies is that many signals definitely above the absolute threshold were not detected early, midway, or late in the session.

Signal density.--Deese and Ormond (5) employed a PPI-type cathode ray to simulate a search-radar' scope. Targets were presented at rates of 10, 20, 30, and 40 per hour during a three-hour watch at variable time intervals, resulting in 46, 64, 83, and 88 percent detection, respectively. Mackworth (13) also varied signal density and found that signal detection improved as signal density increased.

In a study designed to determine factors influencing the operation of special double-number dials, Weldon et al (19) studied the

independent signals have been shown to be independent in the
analysis on standard test signals (Fig. 2). The results are
shown for industrial frequencies (50).

In contrast to the above method, other investigators have
found that such a treatment is not sufficient to reveal
sustained activity. However, it is possible to obtain
persistent signals (signals recorded until stopped) as the
of checking efficiency instead of persistence of signals recorded in
the previous studies mentioned. We found no increase in the
frequency of detection, rather an increase in variance. This result is
explained by the difference in response between signals in this study
and that mentioned above. Persistence of signals in this study is
detect a signal when threshold is reached. In contrast, the
measure for the former was signal-to-noise ratio. The
was continuous. Whether a treatment was used or not, the
last sampling from these studies in that way signals are
the absolute threshold was not reached early, rather, as in
section.

Signal density --- the number of signals per unit time
try to simulate a natural signal. The results are shown in
rates of 10, 20, 30, and 40 per hour. The results are shown in
variable time intervals, resulting in 10, 20, 30, and 40
location, respectively. The results are shown in Fig. 3. It
found that signal detection is improved as signal density increases.
In a study designed to determine factors influencing the
time of signal detection, the results are shown in Fig. 4.

effect of error density on error detection in which Ss were asked to check dial settings to determine if they were accurate. Errors were built-into the dial setting procedure at percentages of 1.72, 6.31, 10.17, 13.10, 17.80, and 21.35, resulting in 80.65, 86.34, 93.44, 96.19, 96.88, and 95.31 percent detection, respectively. These data offer more evidence that checking efficiency is a function of density and the probability of an error being detected increases with error density. It is possible that dial setting ability could explain this trend rather than the number of errors faced. However, an analysis of scores on a test of dial setting ability for the various groups made it safe to conclude that dial checking ability in different groups was not responsible for the relationship of error density to checking efficiency.

Theory based on this current work tends to ignore the classical problem of description of subjective states in attention, set, or vigilance. Rather, it has centered around theoretical concepts somewhat useful in describing the relationship between efficiency in detecting signals and various environmental conditions.

Mackworth (12) tentatively postulated vigilance as an excitatory state, and in opposition to it, he proposed an inhibitory process analogous to the concept of external inhibition discussed in the literature on classical conditioning. The decrement in performance is regarded as an example of partial extinction in which an inhibitory state is built up. Improvement in performance following a distraction is interpreted as a form of disinhibition suggesting the existence of an inhibitory state. When performance returns to the initial level after a break from the vigilance task for an allotted time it is

effect of error density on error detection in 1971. It was also
shown that testing by calculating the error rate is not
built into the final testing procedure in procedures of 1971, 1972,
1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982,
1983, 1984, 1985, and 1986. However, an analysis of
other more evidence that testing of density as a function of
and the probability of an error being detected increases with
density. It is possible that this testing might have been
trend rather than the number of errors tested. However, an analysis
shows on a test of this testing ability for the various procedures.
It also is possible that this testing ability is different from
was not responsible for the relationship of error density to
efficiency.

theory based on this evidence may be that the
probes of description of subjects' responses in the laboratory
violence. Rather, it has been shown that the relationship between
what useful in describing the results with error rate is
testing signals and various experimental conditions.
Mason (1971) tentatively postulated violence as an inhibitory
state, and in opposition to it, he proposed an inhibitory process.
analogous to the concept of external inhibition observed in the
state on classical conditioning. The concept of inhibition is
regarded as an example of partial extinction in which an inhibitory
state is built up. Improvement in performance following a delay
is interpreted as a form of disinhibition resulting in violation of
an inhibitory state. When performance returns to the initial level
after a probe from the stimulus, then for an inhibitory state is

explained as spontaneous recovery from the inhibitory state. In a paper on classical conditioning and human watch-keeping, Broadbent (2) shares Mackworth's opinions and has also used the idea of stimulus selectivity to explain monitoring behavior and classical conditioning.

Deese (4) takes issue with the application of the inhibitory construct. Mackworth assumes that a continuous decline in detectability is the rule for visual search under monotonous conditions, but studies by Deese and Ormond (5) indicate that sometimes detectability rises instead of falls with continuous search and curves of detectability fluctuate in a highly irregular manner as a function of time. Rather than introduce an "unnecessary" inhibitory construct for any linear decline in the O's ability to detect signals, Deese assumes this represents a dissipation in the initial excitatory state of vigilance.

Deese has suggested two alternative hypotheses, reinforcement and expectancy. The basic assumption involved in both, is that the maintenance of a given level of vigilance in an O depends to some extent upon stimulus events extrinsic to the O.

Sometimes there is a linear decline in the probability of detection, often times not. The reinforcement hypothesis assumes that the signals which occur in the O's field of search determine the future course of his detectability. Specifically, either the occurrence or the detection of a signal leads to a near return to the O's initial state of vigilance. One prediction following from this statement would be that signals close together in time will, on the average, have a higher probability of detection than signals spaced at longer intervals. Or, rather than predict from the rate of

explained an experiment whereby the subjects were given a paper on classical conditioning and human perception, and then asked to explain the behavior and physical conditioning.

Deese (1) takes issue with the application of the term "vigilance" to the study of human perception. He suggests that a vigilance task is one in which the subject is required to maintain a certain level of attention for a period of time. He suggests that a vigilance task is one in which the subject is required to maintain a certain level of attention for a period of time. He suggests that a vigilance task is one in which the subject is required to maintain a certain level of attention for a period of time.

Deese has suggested two alternative procedures, continuous and expectancy. The main question involved is how to maintain a level of vigilance in an experiment in which the subject is required to maintain a certain level of attention for a period of time.

Sometimes there is a linear decline in the amount of attention, often times all. The relationship between the amount of attention and the amount of time is often linear. The relationship between the amount of attention and the amount of time is often linear.

Since the detection of a signal leads to a new state of vigilance, the question following from this statement would be how should the subject be trained to maintain a certain level of attention for a period of time. It is suggested that the subject should be trained to maintain a certain level of attention for a period of time.

signals, it could be hypothesized that the detectability of a second signal would be greater the smaller the time interval between two signals.

The expectancy hypothesis put forth by Deese (4) assumes that the excitatory state of vigilance is maintained in the following manner: "(a) the O's expectancy or prediction about the search task is determined by the actual course of stimulus events during his previous experience with the task, and (b) the O's level of expectancy determines his vigilance level and hence his probability of detection." The concept of expectation determining efficiency leads to the same prediction as the reinforcement theory in regards to detectability and the average rate of signal appearance i.e., signals at a high frequency have a higher probability of detection than signals at low frequency. However, they differ in regards to the intersignal question. The reinforcement hypothesis predicts that detectability of a second signal would be greater the smaller the interval between two signals. The expectancy hypothesis merely predicts that the detection of a given signal should be determined by the average of all signal intervals before the one in question. Thus, if the distribution of signal intervals is a random function of time, the probability of detection for any given signal in a series would be the same as that for any other signal.

The two hypotheses offered by Deese seem to differ on an elementary point, whether the probability of detection for a given signal is determined only by the temporal location of the signal immediately preceding the signal in question or whether it is determined by a rather indeterminate number of signals preceding the

signals, it could be hypothesized that the relationship of a given signal would be greater the earlier the time interval between the signals.

The expectancy hypothesis put forth by Lewis (1953) suggests that the expectancy state of vigilance is influenced by the "interval" between "a" and "b" the expectancy or probability of the occurrence of "b" is determined by the actual course of "a" and "b" and "c" the level of expectancy increases as vigilance level and hence the probability of detection. The concept of expectation is defined as the probability of a given signal as the reinforcement theory in terms of expectancy and the average rate of signal appearance. Lewis and his associates have a higher probability of detecting "a" signals in the frequency, however, they claim the probability of the interval between "a" and "b" is higher than the probability of "a" and "b" together. The reinforcement hypothesis suggests that the probability of second signal would be greater the earlier the interval between the signals. The expectancy hypothesis would predict that the probability of a given signal should be determined by the average of all signals intervals before the time in question. Thus, if the interval between signal intervals is a random function of time, the probability of detection for any given signal in a series would be the same as for any other signal.

The two hypotheses offered by Lewis would differ in the way they predict the probability of detection for a given signal is determined only by the average interval of the signals immediately preceding the signal in question or a series of signals and by a rather independent manner of signals preceding the signal.

signal in question. The expectancy hypothesis assumes that the O is capable of amassing data from the combined signal feedback; the reinforcement hypothesis suggests the O becomes passive to previous signals and concentrates on the last immediate signal.

In reviewing the studies presented above, Holland (8,9) felt the response measures were inadequate since the Es were not able to say what it was that changed during the monitoring task, i.e., whether percentage of signals detected is vigilance or result of vigilance. In an attempt to discover more relevant data, he applied an operant behavior model to the study of monitoring behavior. He hypothesized that success in detecting signals might depend on the emission of responses which make detection possible and termed these observing responses. Moreover, these observing responses might follow the same principles as instrumental responses and be controlled by the same type of environmental variables. Thus, in this scheme, detection of signals would be reinforcement for the observing responses.

Various schedules of signal presentation were employed to determine whether signal detection could serve as reinforcement for observing behavior. Working in the dark, Ss were required to report deflections of a pointer on a dial. The pointer was visible only when the S pressed a key which provided a flash of light for 0.07 second that illuminated the face of the dial. If a signal was detected, it was reported by pressing another key, which reset the pointer.

Ss encountering a fixed interval schedule began with a 1/2 minute interval schedule and after eight 40-minute schedules, the interval was increased to 1, 2, 3, and 4 minutes for eight sessions

signal is question. The response system...
regards of measuring time from the onset of...
reinforcement hypothesis...
and commentaries on the last...
In reviewing the...
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each. Inspection of cumulative response records for each S on the different fixed intervals shows a period in which no observing responses are emitted following each detection but resume to a high rate before the next signal. This temporal discrimination indicates that the observing rate is dependent on detection, or reinforcement.

Next, Ss encountered a fixed-ratio schedule of 36 observing responses before the pointer deflected for six 40-minute sessions, followed by 60, 84, 108, and 200 observing responses respectively. In this situation the S could minimize the number of signals by not responding. However, examination of these curves shows that Ss maximized the number of signals detected by observing at a high rate, rendering these results characteristic of conventional reinforcement on fixed-ratio schedules, since closely spaced responses were reinforced. Up to this point Holland demonstrated that signal detections could control the probability of emission of observing responses, thereby serving as reinforcement for these responses.

In order to determine whether the schedules used in classical vigilance studies would generate observing rates parallel to the probability of detection data cited previously, Holland conducted the following studies. Holland's first study dealt with those vigilance studies in which Mackworth and Deese demonstrated a decrement in the probability of detection as a detection session progressed. To tie this phenomenon in with his work, he presented 20 signals per hour to four Ss on a variable-interval schedule. All the Ss showed lower observing rates in the latter portions of the session. This decrement could be explained by the fact that

each. Inspection of the data...
different fixed intervals...
responses are...
rate before the next signal...
that the operating rate is...
next, 25 encountered a...
responses before the...
followed by 60, 90, 120, and 150...
in this situation...
not responding...
maintained the...
rate, rendering...
reinforcement on...
were...
detection...
responses, thereby...
it...
vigilance...
probability of...
the following...
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20 signals...
All the...
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this particular reinforcement schedule was inefficient to maintain the higher initial rate. Thus, the drop in observing rate parallels the decline in the percentage of signals detected in vigilance studies and is similar to within-session decline in rate on a variable-interval schedule in operant conditioning studies.

Previous vigilance studies also demonstrated that the percentage of signals detected increases as the signal frequency increases. To determine if rate of observing responses also increases, Holland presented signals on variable-interval schedules at 30, 60, 120, and 240 per hour in blocks of three 1-hour sessions to two Ss. The cumulative responses records show that the rate of observing is highest for the high signal rate and decreases as the signal rate decreases. Again this finding not only parallels results found in classical vigilance, but, likewise, variable-interval reinforcement in operant conditioning which shows high response rates to be associated with schedules having a short average interval (high density).

Holland's studies have demonstrated that signal detections can serve as reinforcements for observing responses. Further, detection data from vigilance studies may reflect the observing response rates generated by the particular schedules employed. He has provided a means of analysis at the behavioral level. Practical application of this data points to the acknowledgement of the precise control exerted by the environment over observing behavior in human operators, and that a variable interval schedule of signals appears to be the most promising schedules for situations in which it is desirable to maintain vigilance.

the particular responses of subjects to the
the higher initial rate. Thus, the drop in response rate
the decline in the percentage of signals detected in vigilance studies
and is similar to within-session decline in rate in a vigilance

interval schedule in operant conditioning studies.
Interval vigilance studies also demonstrated that the percentage
of signals detected increases as the signal frequency increases.

decrease in rate of observing responses and increases in
presented signals on variable-interval schedules at 10, 20, 30, and
150 per hour in blocks of three 1-hour sessions in the first

summative responses across days that the rate of observing
highest for the high signal rate and decreases as the signal rate
decreases. Again this finding has only partial validity in

classical vigilance, but, likewise, variable-interval schedules
in operant conditioning which show high response rates to be
associated with schedules having a short average interval (Lick

1961).

Lick's studies have demonstrated that signal detection in the
serve as reinforcements for observing responses. In fact, Lick's
data from vigilance studies may reflect the observing response rather

generated by the particular schedules employed. He has provided
means of analysis at the behavioral level. Lick's explanation of
this data points to the acknowledgment of the practice of this

erred by the environment over observing behavior in some situations
and that a variable interval schedule of signals appears to be the
most promising schedule for situations in which the behavior to

maintain vigilance.

CHAPTER III

EXPERIMENTAL DESIGN AND PROCEDURE

Materials.--Two pilot studies suggested the length of the manuscript should be limited to 15 pages to allow college students ample time to complete their simulated proofreading task within the time allotted for a normal class period. The manuscript was chosen on the basis of word familiarity, interest, and lack of emotion-provoking content, argumentative issues, or an exciting climax which might hinder Ss in their task of error detection.

Vernon (16) found that proofreaders were able to indefinitely maintain a mental set toward reading material with misprints of such a nature that the general meaning of the content was relegated to the background, the center of consciousness being occupied with the recognition of small details of the structure of letters and words. Since the Ss in the present study were nonprofessional proofreaders the requirements for the selection of the manuscript were adhered to as far as possible in order to aid the Ss in maintaining a mental set toward typographical errors and, at the same time, not become involved in the content of the material.

An excerpt from Andre Seigfried's book entitled Canada (15) served as the proofreading material. Permission was obtained from the publishers (Harcourt, Brace and Co., Inc.) of the book to reproduce Chapter II, Geography and the Canadian Problem. It was thought that this selection met the criteria imposed upon the manuscript to be used, thereby, aiding Ss to assume the main characteristic of proofreading.

EXPERIMENTAL DESIGN AND PROCEDURES

Materials.--Two main series were used in the present experiment. The first series consisted of 20 words which were selected for a normal class period. The materials were chosen on the basis of word familiarity, interest, and lack of word-association context, argumentative issues, or an existing class which might hinder in their task of word learning.

Form (1c) Form which was used is as follows:

maintain a mental set toward reading material with attention to such a nature that the general meaning of the content was related to the background, the center of consciousness being occupied with the recognition of small details of the various letters and

words. Since the 20 in the present case were not particularly profitable the requirements for the retention of the material were reduced to as far as possible in order to make the task less difficult. A mental set toward recognizing words and, at the same time, not become involved in the content of the material.

An excerpt from James' definition of word learning (James, 1911) served as the underlying material. The material was selected from the Phillips (1930) series (see also Phillips, 1930) of words as given in Chapter 11, Geometry and the Language of Words. It was thought that this series had the greatest number of words which might be used, thereby, eliminating the possibility of word-association or word-learning.

Subjects.---Two-hundred and sixteen students were selected at random from the undergraduate student body of the University of New Mexico.

Purpose and nature of built-in-errors.---To test the hypothesis that checking efficiency is a function of error density, the experiment was designed to confront different groups of Ss with manuscripts varying in the rate of errors. The 216 Ss were randomly assigned to six groups. Group I through VI consisted of 36 Ss each who faced 6, 9, 15, 30, 60, and 120 built-in-errors per five pages, respectively. Checking efficiency was defined as the ratio of the number of errors detected to the total number of errors present. Error level refers to the number of errors encountered per five pages.

Errors were systematically built into the material. This was accomplished by typing the 15 page manuscript onto six different sets of stencils. In this way a definite number of typographical errors could be inserted by the typist as a particular set of stencils was typed. This rendered all the manuscripts identical in content, for all practical purposes, yet different in the number and placement of errors for each group.

Uncontrolled factors might possibly be introduced if E arbitrarily assigned the errors in the manuscripts. Therefore, for each error that was inserted a table of random numbers was utilized to determine separately the line, the specific word in that line, the letter(s) to be altered in that word, and the type of error to be introduced.

Classification of errors.---The study was not primarily concerned with the kind of typographical error used in the proofreading

1938. The present study was conducted at the University of London.

It was found that the number of errors was significantly higher in the case of errors. The 100 ms error was found to be six groups. Group I through VI consisted of 10 subjects each. The 100 ms error was found to be 12, 30, 60, and 120 milliseconds per five pages, respectively. Reading efficiency was defined as the ratio of the number of errors detected to the total number of errors present. From the results to the number of errors detected per five pages.

Errors were systematically varied into the material. The results were summarized by Figure 10. It was found that the rate of errors in the case of a single error of presentation. In this case a single error of presentation could be inserted by the reader as a presentation error. This rendered all the remaining identical in content, for all physical responses, for differences in the rate and placement of errors for each group.

Uncontrolled factors in the present study were: (1) the order of presentation of the errors in the material; (2) the order of presentation of the errors in the material; (3) the order of presentation of the errors in the material; (4) the order of presentation of the errors in the material; (5) the order of presentation of the errors in the material; (6) the order of presentation of the errors in the material; (7) the order of presentation of the errors in the material; (8) the order of presentation of the errors in the material; (9) the order of presentation of the errors in the material; (10) the order of presentation of the errors in the material.

Discussion of the results of the present study is given in the following sections. It is concluded that the results of the present study are in agreement with the findings of other studies.

situation. Three types of error were selected from a tabulated list of typographical errors prepared by Scheidt (14) on the basis of their prominence. The errors chosen were omission, transposition, and substitution. Table 1 classifies, describes, and illustrates the three types of errors used in the study.

In order to avoid a situation wherein the six groups would be confronted with errors that were of grossly unequal difficulty to detect, the errors were introduced in proportionate numbers for the six different sets of manuscripts. This was easily accomplished since the various error levels were multiples of three. Thus, at the six error level, a S encountered each type of error twice; at the nine error level, each error three times, etc.

Instructions and procedure.--Each S received written directions which were orally read by the E at the beginning of the task. An attempt was made to establish a definite mental set as to the type of error Ss were to locate. For the purpose of the study, a typographical error was defined as any misspelled word or any word which did not fit the context of a sentence, i.e., cone instead of come. (The second clause of the definition was necessary due to the random method employed in inserting errors. The reader will recall that placement and type of error were randomly distributed without access to the actual manuscript to avoid any bias on the part of the E.) Ss were instructed to locate all the errors which fit this definition and to mark them with an X. Ss were not allowed to proof-read the manuscript a second time.

attention. Three types of error were selected from a list of 100
of typographical errors proposed by Gowers (1964) on the basis of
their prominence. The errors chosen were deletion, transposition,
and substitution. Table 1 illustrates the list of errors
the three types of errors used in the study.

In order to avoid a situation wherein the same error would be
encountered with errors that were of greater magnitude than the
errors were introduced in proportionate numbers for each
six different sets of manuscripts. This was easily accomplished
since the various error levels were assigned to errors. That is,
six error levels, a 1 encountered each type of error twice at the
same error level, each error three times, etc.

Instructions and procedure.—Each 2 manuscript set was prepared

which were orally read to the S at the beginning of the trial.
Attempts were made to establish a 100% correct reading of the
of error as well as to make the first error of the set a
typical error was defined as the first error of the set
which did not fit the criteria of a typical error. The
come. (The second error of the set was the first error of the
random method applied to random errors. The errors were
that placement and type of error were randomly distributed across
access to the actual manuscript to avoid any bias on the part of the
S.) It was instructed to read all the errors with 100% accuracy
delivered and to read them again at 100% accuracy and all the errors
read the manuscript a second time.

Table 1

CLASSIFICATION OF BUILT-IN-ERRORS

Error	Description	Example
Omission	One letter deleted	your - yor
Transposition	Exchange in position of two adjacent letters	time - tmie
Substitution	One letter wrong	work - wark

Table 1

CLASSIFICATION OF SPELLING ERRORS

Example	Description	Error
for - for	One letter deleted	Omission
size - size	Exchange in position of two adjacent letters	Transposition
son - son	One letter wrong	Substitution

Since Ss were drawn from several classes, they were randomly assigned to one of the six groups so that a particular class would not have an opportunity to bias any one error level.

It is noted that the above mentioned person is not
assigned to any of the six levels of the
not have an opportunity to be assigned to any of the six levels.

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CHAPTER IV

RESULTS

Checking efficiency at various error levels.--Although the manuscript dealt with one topic, and can be treated as continuous material, the error density was determined for each 5-page sequence so that three sets of data could be compared. The error level for the first 10-pages of any one manuscript remained constant. That is if a S encountered a 6 error level for the first 5-pages, the same error level followed in the second 5-pages. Thus, it was possible to study the effect of error density on checking efficiency for each set of data and at the same time measure the stability of the phenomenon under consideration.

Figure 1 shows how probability of detection varies as a function of error density for the first and second 5-page sequences. In general, error detection tends to increase with increasing error density up to an optimum point beyond which increments in error density reduce the probability of detection. Table 2 contains the data on percent error detection as a function of error density.

The combined mean percent errors detected by the various groups for the first 10-pages presented in Figure 2 shows the relationship between error detection and error density. Inspection of the curve reveals a steady increase in error detection as error density increases, with a tapering effect at the higher density levels.

The analysis of variance performed on percentage error detection presented in Tables 3 and 4 yielded F ratios of 14.65 and 7.53 respectively, both of which were significant beyond the 1% level

RESULTS

Effect of Error on the Accuracy of the First Response

The first response was recorded for each subject on each trial. The error rate was calculated as the number of errors divided by the total number of trials. The accuracy of the first response was calculated as the number of correct responses divided by the total number of trials. The results are shown in Figure 1. The accuracy of the first response was significantly higher than the error rate, indicating that subjects were able to respond correctly on the first trial more often than they were to respond incorrectly. The difference between accuracy and error rate was significant for all subjects and for all trials.

Figure 1 shows the accuracy of the first response and the error rate for each subject. The accuracy of the first response was significantly higher than the error rate, indicating that subjects were able to respond correctly on the first trial more often than they were to respond incorrectly. The difference between accuracy and error rate was significant for all subjects and for all trials. The results are shown in Figure 1. The accuracy of the first response was significantly higher than the error rate, indicating that subjects were able to respond correctly on the first trial more often than they were to respond incorrectly. The difference between accuracy and error rate was significant for all subjects and for all trials.

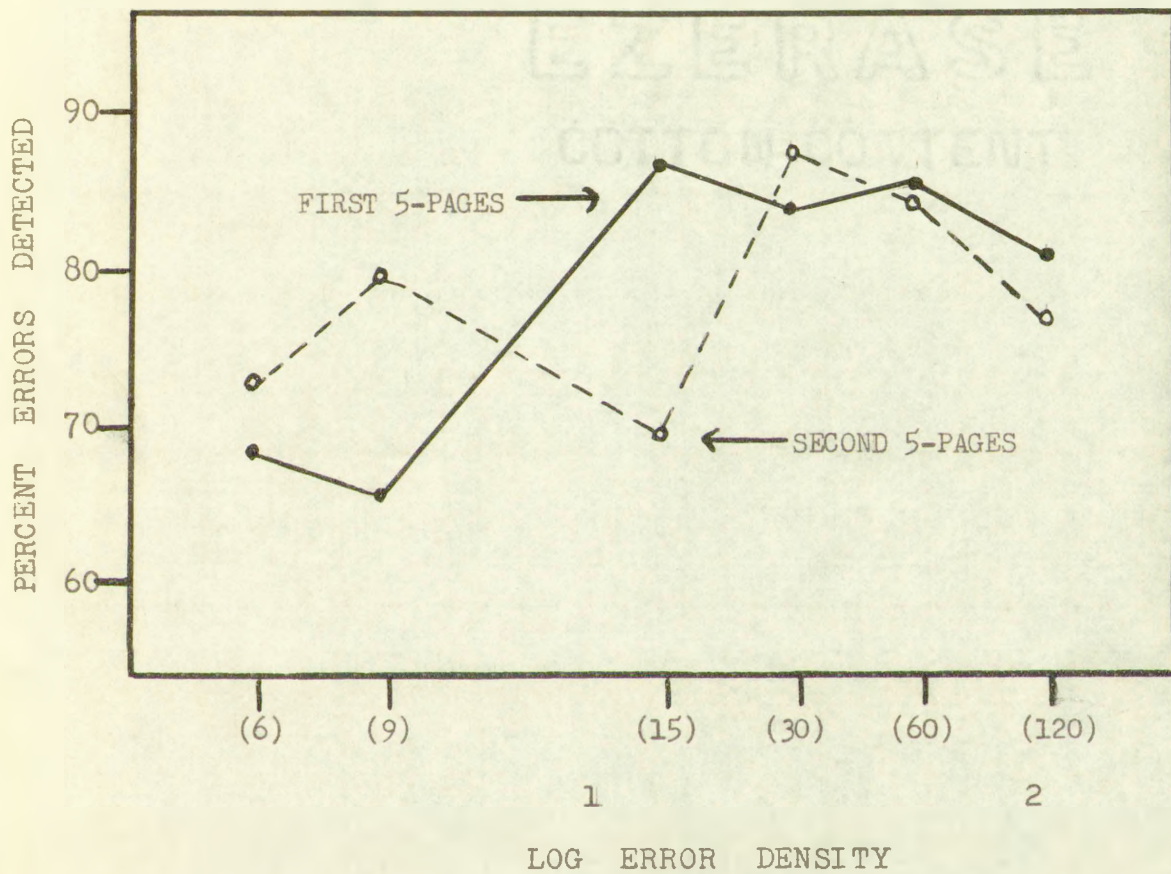


Figure 1. Percent Errors Detected as a Function of Average Rate of Error Appearance. The Number in Parenthesis is the Actual Error Level. Each Point Represents the Average Percent Errors Detected for 5-pages of Continuous Search for 36 Ss.

MILLERS FALLS

EXPERIMENT

COTTON CONTENT

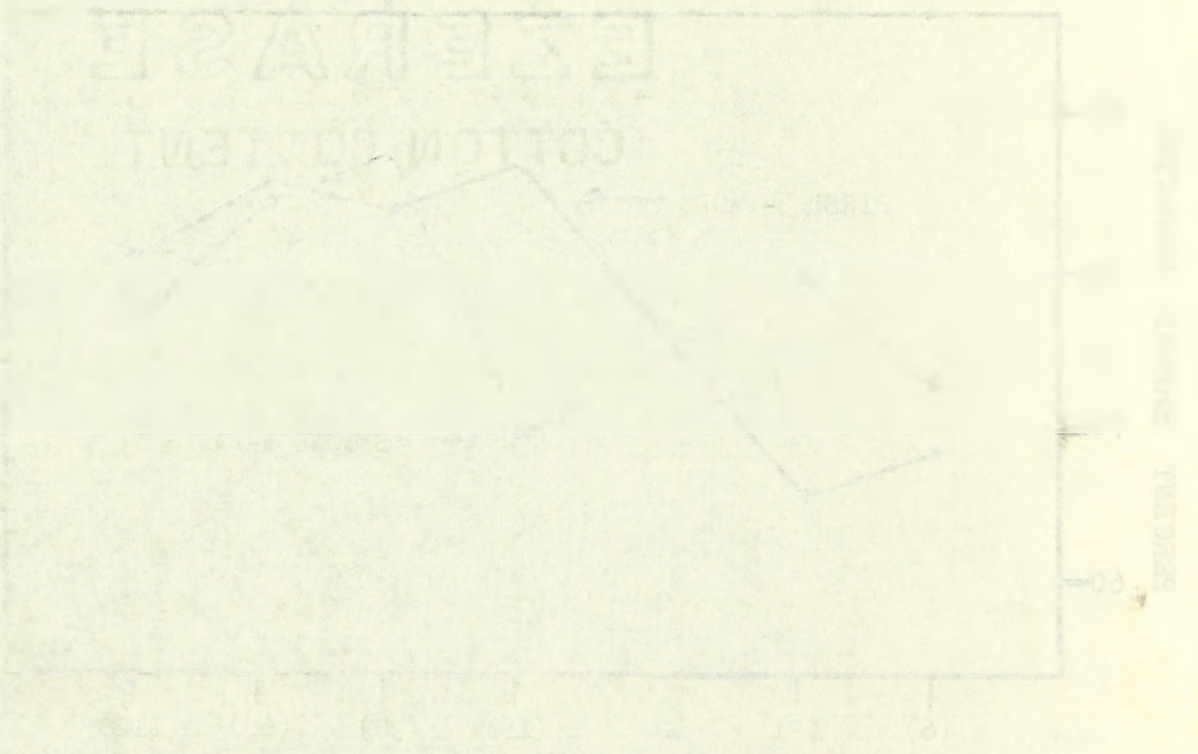


Figure 1. Cotton content of the cotton bolls in the experimental plots. The solid line represents the cotton content of the cotton bolls in the experimental plots. The dashed line represents the cotton content of the cotton bolls in the control plots. The horizontal dashed line represents the cotton content of the cotton bolls in the control plots.

Table 2

RELATIONSHIP BETWEEN ERROR DENSITY AND MEAN PERCENT ERRORS
DETECTED FOR VARIOUS GROUPS

Group	Error Density	Percent Errors Detected		
		Pages 1-5	Pages 6-10	Pages 1-10
I	6	.688	.727	.708
II	9	.663	.802	.733
III	15	.871	.698	.784
IV	30	.844	.878	.861
V	60	.856	.850	.853
VI	120	.812	.774	.793

RELATIONSHIP BETWEEN FIBER ERROR PERCENTAGE AND FIBER WEIGHT PERCENTAGE
 DETERMINED FOR VARIOUS GROUPS

Fiber Weight Percentages			Error Percentages	Group
1-10	11-20	21-30		
80.0	75.0	65.0	3	I
81.0	80.0	68.0	3	II
82.0	80.0	70.0	12	III
83.0	80.0	70.0	30	IV
84.0	80.0	70.0	60	V
85.0	80.0	70.0	100	VI

MILLERS FALLS
 EXERCISE
 COTTON CONTENT

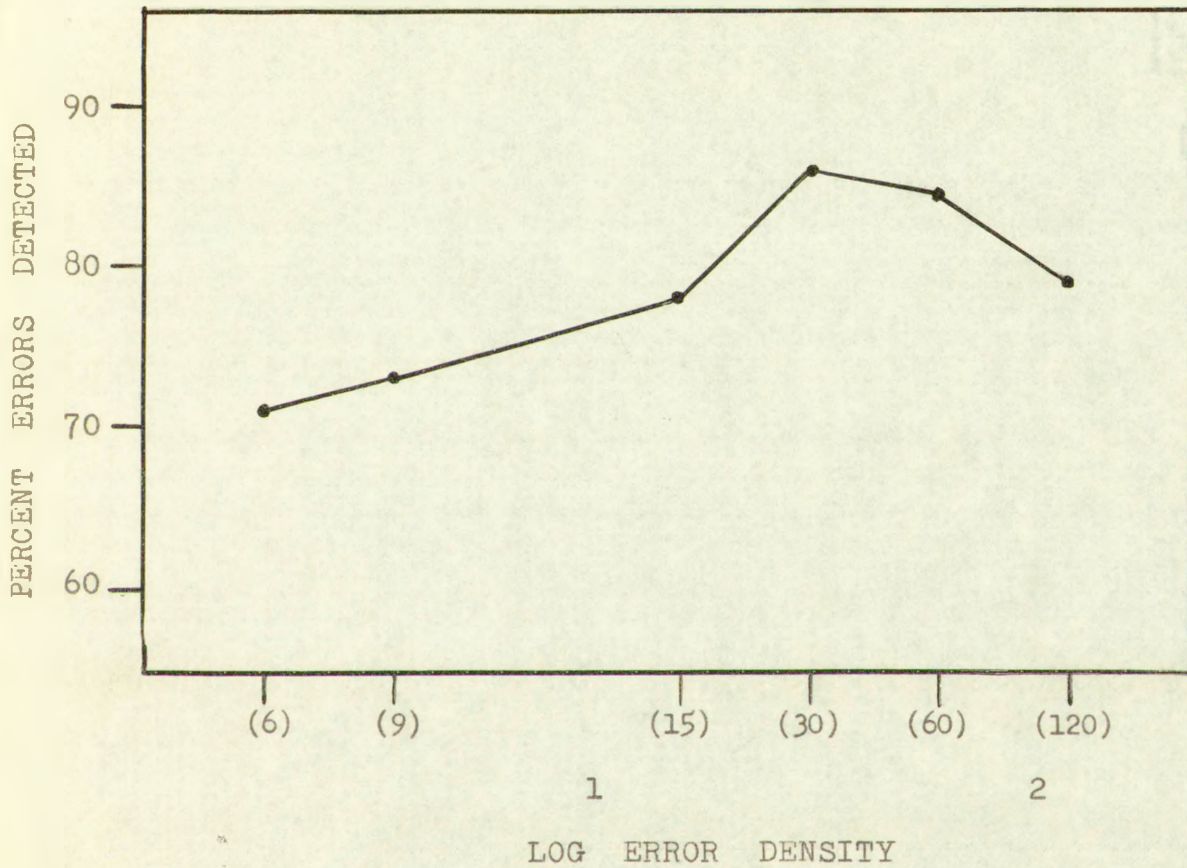


Figure 2. Percent Errors Detected as a Function of Average Rate of Error Appearance. Each Point Represents the Average Percent Errors Detected for the First and Second 5-page Sequences Combined.

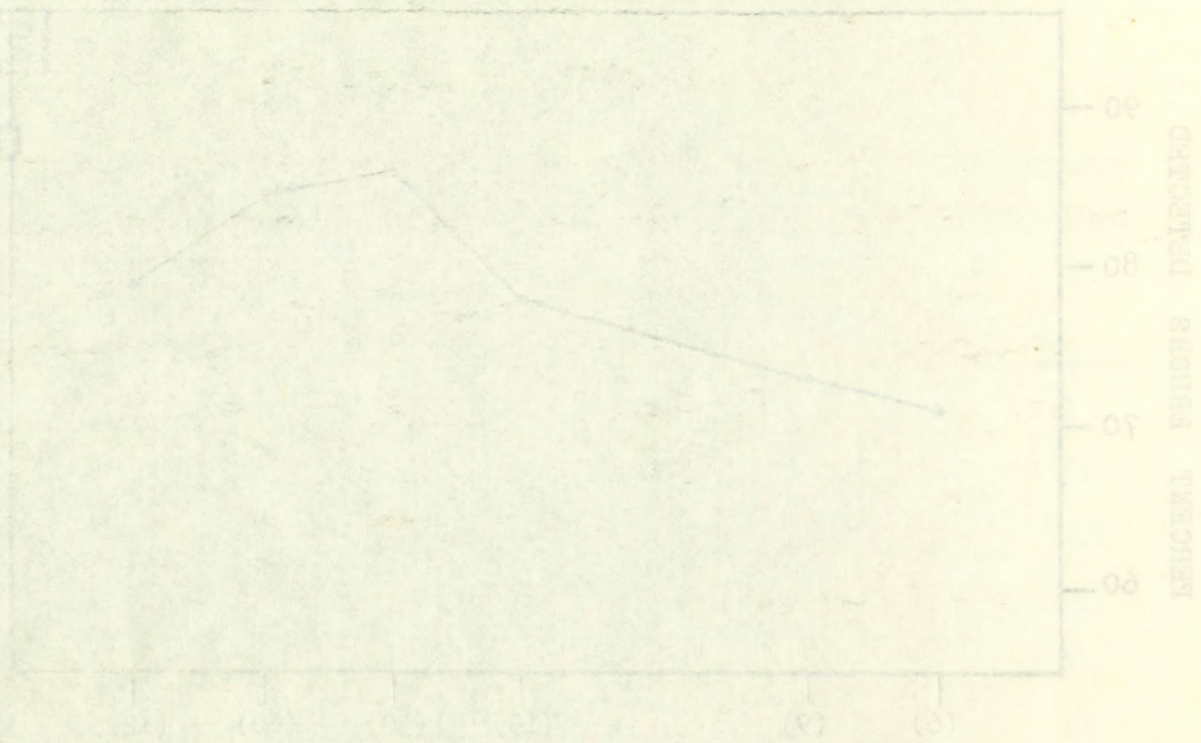


Figure 2. A graph showing the percentage of... (a) (b) (c) (d) (e)

Table 3

ANALYSIS OF VARIANCE OF PERCENT ERRORS DETECTED
IN FIRST 5-PAGES FOR VARIOUS GROUPS

Source of Variation	Sums of Squares	<u>df</u>	Mean Square	F
Error density	1.463	5	.293	14.65**
Within	4.156	210	.020	
Total	5.619	215		

** Significant at 1% level

Table 3

ANALYSIS OF VARIANCE OF YIELDING POTENTIAL
IN FIRST 5-PHASE AND VARIOUS GROUPS

Source of Variation	Sum of Squares	df	Mean Square	F
Error density	1.165	5	.233	11.07
Within	1.138	210	.005	
Total	2.303	215		

** Significant at 1% level

MILLERS' PALM
ERASE
COTTON CONTENT

Table 4

ANALYSIS OF VARIANCE OF PERCENT ERRORS DETECTED
IN SECOND 5-PAGES FOR VARIOUS GROUPS

Source of Variation	Sums of Squares	<u>df</u>	Mean Squares	F
Error Density	.865	5	.173	7.53**
Within	4.803	210	.023	
Total	5.668	215		

** Significant at 1% level

FIBRE COTTON CONTENT

Table 1

ANALYSIS OF VARIANCE OF FIBRE PERCENTAGE
IN SECOND 5-PACK FOR VARIOUS GROUPS

Source of Variation	Sum of Squares	df	Mean Square	F
Error Density	.882	2	.441	1.30*
Within	4.803	38	.126	
Total	5.685	40		

** Significant at 1% level

of confidence. Thus, the statistical analysis supports the conclusion that error detection varies as a function of error density. Figure 1 and 2 demonstrate that the difference in probability of detection produced by the various error levels is in the direction predicted; the group presented with errors at the lowest rate had the lowest detection and detection increased as error density increased until the highest levels were reached. Moreover, since both sets of data (first and second 5-pages) were statistically significant, and the general shape of the curves remained similar, it would seem to indicate that the relationship between error density and checking efficiency was stable under the conditions imposed by this experiment.

Hartley's (17) F max test was utilized to test for homogeneity of variance for samples of uniform size. The critical region was 2.91 and above. The F ratios were 5.38 and 4.85 for the first and second 5-page sequences respectively, indicating that the variances of the several samples are not equal and the hypothesis of homogeneity of variance was rejected. It is felt, however, that although the assumption of homogeneity of variance could not be strictly met, that this does not invalidate the use of the F test in this study. Lindquist (11, p.86) has pointed out that "in general, unless the heterogeneity of either form or variance is so extreme as to be readily apparent upon inspection of the data, the effect upon the F distribution will probably be negligible." Lindquist does recommend, however, that if one cannot meet the assumption of homogeneity of variance, that the level of significance be increased from, say, the 5% level to the 2.5% level in order to be more on

of confidence. Thus, the statistical analysis indicates that error detection varies as a function of error location. The results demonstrate that the difference in probability of detection produced by the various error locations is an expected result of the group presented with errors of 4-1000000 and 1-1000000. The results also indicate that detection of errors is higher in the highest levels were tested. However, when the level of error (first and second 2-pages) was statistically significant, the general shape of the curves remained similar. It would appear to be clear that the relationship between error location and detection efficiency was stable under the conditions tested in this experiment.

Barlett's (1947) test was applied to test the homogeneity of variance for samples of various sizes. The critical values are 1.91 and above. The F ratios were 1.12 and 1.25 for the first and second 2-page responses respectively, indicating that the variance of the several samples are not equal and the hypothesis of homogeneity of variance was rejected. It is felt, however, that although the assumption of homogeneity of variance would not be strictly met, this does not invalidate the use of the F test in this study. Lindqvist (1941) has pointed out that in general, the homogeneity of either one or two variables is not necessary for the results to be valid. Lindqvist's (1941) results are generally similar to those reported upon inspection of the data, but it is felt that a distribution will probably be rejected. It is felt, however, that if one cannot test the homogeneity of variance, then the level of significance is determined from the F ratio to the level of error. The level of error was 1.12 and 1.25.

the safe side. Since the F ratio for error density was significant beyond the 1% level, this recommendation is effectively met.

False detections at various error levels.--Deese (4) states that false reports vary from one individual to another, and do not correlate with the probability of detection in his radar monitoring studies. False detections in this study occurred when Ss reported the appearance of an error by marking a word with an X when the word was not actually a typographical error. Since data of this nature were readily accessible, the answer to this problem was considered as an additional objective.

Table 5 shows the total number of false detections for each group of Ss at the various error levels. An analysis of variance on the false detection data presented in Table 6 yielded an F of 2.41 which was significant at the 5% level. From Table 5 it appears that the frequency of false detections is independent of error density. There is no systematic increase in false detections as a function of error density as was demonstrated with the probability of correct detection. Moreover, analysis of variance of the false detections in the second and third sets of data presented in Tables 7 and 8 failed to show any such significant effect. Since statistical analysis for the latter two sets of data failed to bear out the initial finding that false reports are related to error density in an unsystematic fashion, this suggests that the relationship between false detections and error density is probably quite unstable.

Error difficulty in error detection.--The three kinds of typographical errors employed in this study were described in Table 1.

Table 5

RELATIONSHIP BETWEEN ERROR DENSITY AND FALSE
DETECTIONS FOR VARIOUS GROUPS

Groups	Error Density	False Detections		
		Pages		
		1-5	6-10	1-10
I	6	107	74	181
II	9	71	62	133
III	15	64	60	124
IV	30	140	89	229
V	60	73	101	174
VI	120	78	110	188

RELATIONSHIP BETWEEN ERROR DENSITY AND LOSS
 DETECTIONS FOR VARIOUS GROUPS

Groups	Error Density	False Detections	
		1-2	3-10
I	0	101	76
II	2	71	65
III	12	61	60
IV	30	110	89
V	60	12	101
VI	120	18	110

UNITED STATES
 PATENT OFFICE
 WASHINGTON, D. C.

Table 6

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF FALSE REPORTS
BY SUBJECTS FOR FIRST 5-PAGES

Source of Variation	Sums of Squares	<u>df</u>	Mean Square	F
Error Density	118.079	5	23.616	2.414*
Within	2054.695	210	9.784	
Total	2172.774	215		

* Significant at 5% level

MILLERS FALLS

REPORT ON THE WATER SUPPLY OF THE TOWN OF MILLERS FALLS

FOR THE YEAR 1902

Source of Variation	Per Cent of Capacity	Per Cent of Total	Per Cent of Total
Error of Density	1.12	0.02	0.02
Within	1.12	0.02	0.02
Total	1.12	0.02	0.02

Prepared by the Town Engineer

Table 7

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF FALSE REPORTS
BY SUBJECT FOR SECOND 5-PAGES

Source of Variation	Sum of Squares	<u>df</u>	Mean Square	F
Error Density	59.426	5	11.885	1.511
Within	1651.612	210	7.865	
Total	1711.038	215		

ANALYSIS OF VARIANCE OF TOTAL YIELD OF EARLY MATURING

COTTON IN EARLY FALL

Source of Variation	Sum of Squares	D.F.	Mean Square
Between Blocks	27.23	2	13.61
Within	121.77	20	6.09
Total	149.00	22	

Table 8

ANALYSIS OF VARIANCE OF TOTAL NUMBER OF FALSE
REPORTS BY ROWS, COLUMNS, AND INTERACTION

Source of Variation	Sum of Squares	<u>df</u>	Mean Square	F
Present Error Density	43.524	2	21.762	2.173
Previous Error Density	75.778	5	15.156	1.513
Present X Previous Error Density	57.032	10	5.703	-----
Within	1983.000	198	10.015	
Total	2159.334	215		

Table V

ANALYSIS BY VARIATION IN THE NUMBER OF DAYS
 BETWEEN THE DATE OF ORDER AND THE DATE OF DELIVERY

Source of Variation	Sum of Squares	df	Mean Square	F
Present Error Deviate	10.21	1	10.21	0.27
Previous Error Deviate	12.12	1	12.12	0.33
Present I Deviate Error Deviate	17.82	10	1.78	0.49
Residual	190.00	18	10.56	2.91
Total	230.15	20		

In order to determine if one error was more difficult to detect than another, the errors were inserted in proportionate numbers at the various error levels to achieve equal representation at each level.

Studying the 216 manuscripts collectively (combining the various error levels) appears to indicate that type of error plays a role in error detection. Table 9 gives the total mean percent error detection per type of error. It can readily be seen that the most difficult type of error to detect was omission, followed by transposition and substitution.

A breakdown of the data into the first, second, and third 5-pages (error levels still combined) is likewise found in Table 9. Inspection of this Table indicates that each type of error retains its relative position in detection difficulty in each phase of the study.

Influence of previous density on present density.--The first 10-pages of the manuscript were concerned with the influence of error density on checking efficiency, whereas the entire manuscript was involved in the secondary problem of determining the effect, if any, of previous density on present density. The first 10-pages became the previous density; the last 5-pages acted as the present density. This was an attempt to determine if Ss develop some sort of habituation or learned set as a result of having 10-pages of proofreading experience with a fixed density level. If this was the case, then presumably the effect of this habituation would appear if the density level were changed for the last 5-page sequence.

Just as the first and second 5-pages were subdivided into six different groups varying in error density, the third 5-pages were

Table 9

MEAN PERCENT OF EACH TYPE OF ERROR DETECTED
BY TOTAL SUBJECTS AT ALL LEVELS

Classification of Error	Mean Percent Error Detected			Total Mean Percent Error Detected
	1-5	6-10	11-15	
Omission	.761	.744	.720	.742
Transposition	.822	.776	.810	.803
Substitution	.891	.889	.870	.883

Page 9

STATE OF TEXAS, COUNTY OF DALLAS

IN PROBATE COURT

Name of Beneficiary	Amount of Beneficiary's Share			Total
	1-11	1-12	1-13	
John	100.	100.	100.	300.00
John	100.	100.	100.	300.00
John	100.	100.	100.	300.00

COTTON

divided into three different error levels per group. Thus, one-third of the Ss in each of the six initial groups had their error level changed to 6, 30, or 120 errors for the remaining 5-page sequence. The result was cast in the form of a 3 X 6 factorial design with Ss randomized.

Figure 3 shows the percent errors detected in proofreading current material as a function of previous error detection experience. The curves suggest that previous experience in detecting a large number of errors may have some slight effect in the later detection of errors. Ss who initially encountered error levels of 30, 60, and 120 appear to have done slightly better in detecting errors than Ss who had previous experience at lower density levels. This relationship reflects itself in the tendency of all three curves to show a slight increase in detection at the higher levels of density.

Statistical analysis of the data in Table 10, however, failed to support the suggested findings outlined in the above paragraph. None of the mean squares presented in Table 11, when tested against the error term, were found to be statistically significant. These results appear to indicate that the Ss did not develop a rigid set due to their previous experience; perhaps, the effect of error density on error detection demonstrated previously overshadowed the effect, if any, that a habituation factor may have had under the conditions of this experiment.

divided into three different error levels per group. The number of errors of the 28 in each of the six trials groups was 20, 15, 10, 5, 0, or 5, respectively. The result was used in the form of a 2 x 3 x 2 factorial design with 28 randomized.

Figure 3 shows the percent error detected in the detection of current material as a function of previous error detection performance. The curves suggest that previous error detection performance and a large number of errors may have some slight effect on the detection of errors. The 28 who initially encountered error levels of 30, 60, and 120 appear to have done slightly better in detecting errors than 28 who had previous experience at lower density levels. This relationship reflects itself in the tendency of all curves to show a slight increase in detection at the higher levels of density.

Statistical analysis of the data in Table 10, however, failed to support the suggested findings outlined in the above paragraph. None of the main effects presented in Table 11, when tested against the error term, were found to be statistically significant. These results appear to indicate that the 28 did not develop a true bias due to their previous experience levels. The effect of error density on error detection performance was statistically insignificant. It may, therefore, be concluded that a moderate level of error density is a condition of this experiment.

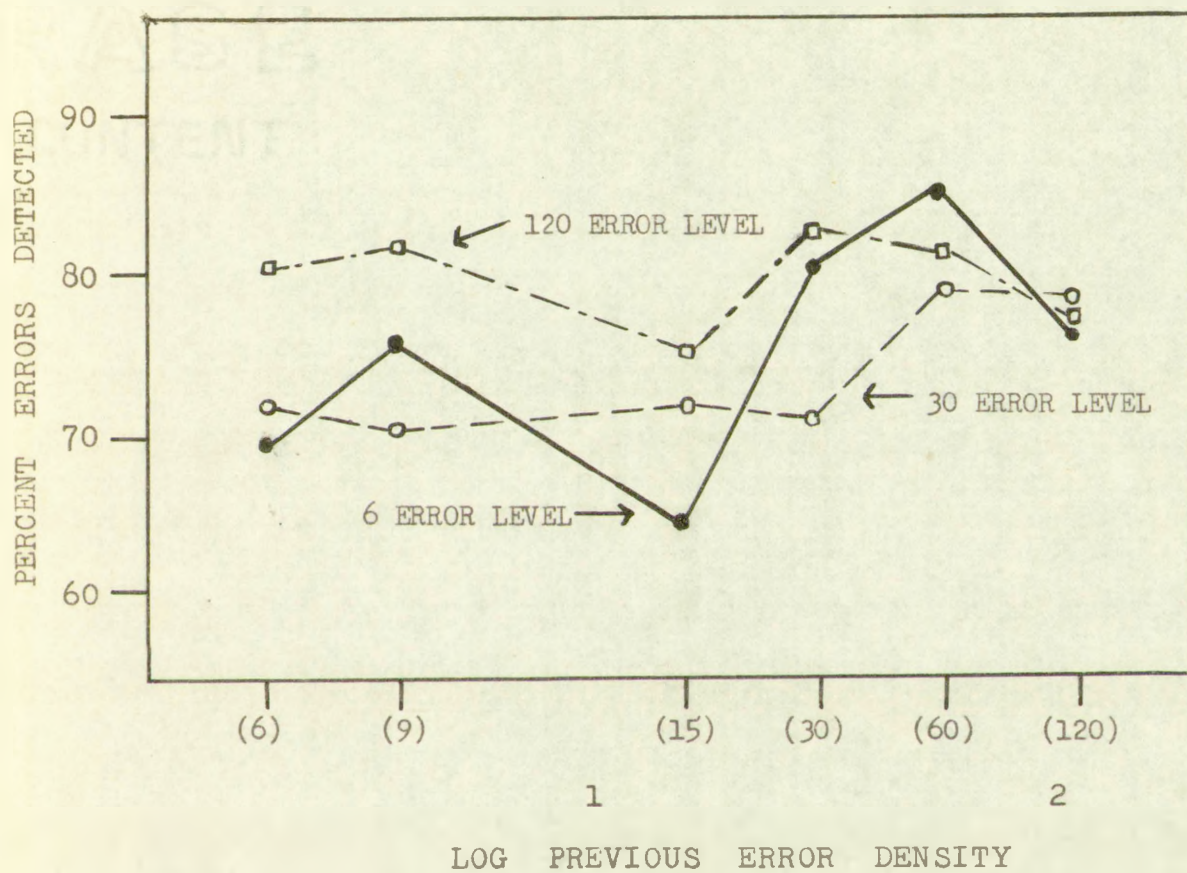


Figure 3. Percent Errors Detected for Present Error Density Groups as a Function of Previous Error Density. The Number in Parenthesis is the Actual Previous Error Level. Each Point Represents the Average Percent Errors Detected for 12 Ss.

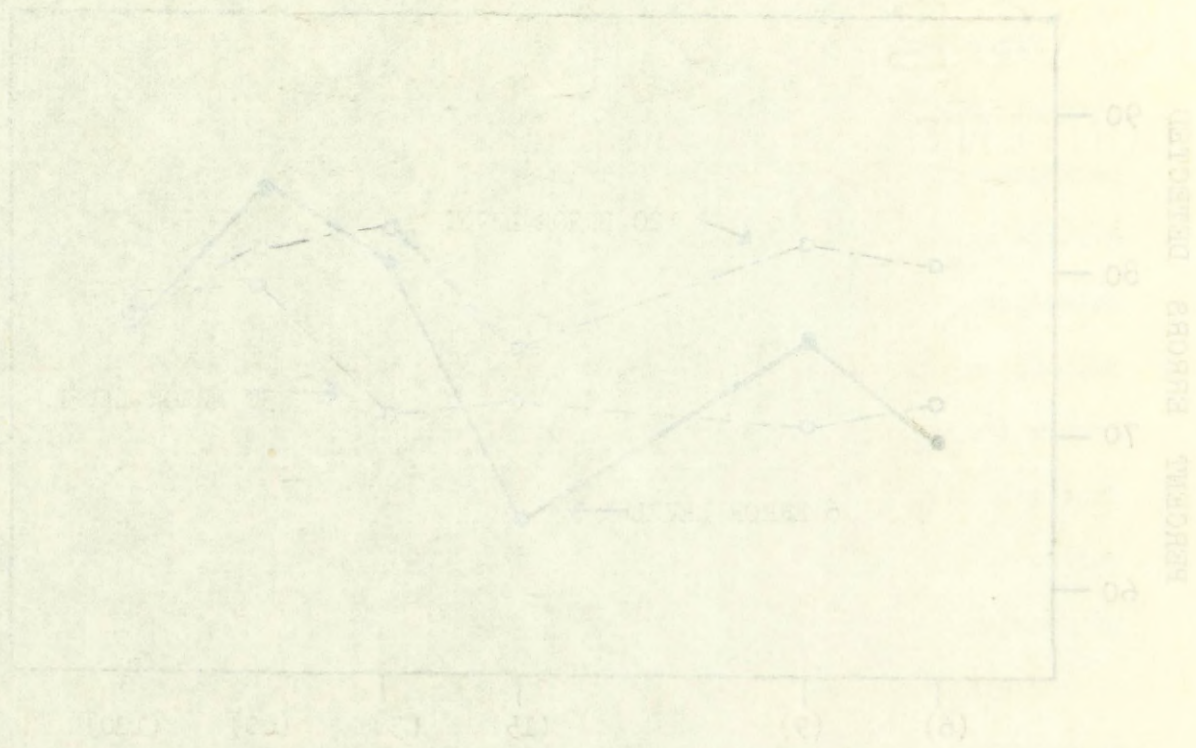


Figure 3. Percent Error Deficiency vs. Percent Error Deficiency. The number in parentheses is the percent error level. The solid line is the percent error level. The dashed line is the percent error level. The dotted line is the percent error level.

Table 10

PERCENT ERRORS DETECTED AT ERROR LEVELS OF 6, 30, OR
120 FOLLOWING PREVIOUS ERROR LEVELS

Group	Previous Error Density	Percent Errors Detected		
		Present 6	Error 30	Density 120
I	6	.695	.725	.806
II	9	.764	.706	.823
III	15	.639	.722	.750
IV	30	.806	.711	.819
V	60	.847	.792	.814
VI	120	.764	.784	.769

COTTON CONTENT

EXPERIMENTAL

Grade	Lint	Staple	Strength	Other
AI	52.0	1.25	12.0	1.0
A	50.0	1.20	11.5	0.8
IA	48.0	1.15	11.0	0.7
III	46.0	1.10	10.5	0.6
II	44.0	1.05	10.0	0.5
I	42.0	1.00	9.5	0.4

Grade
Lint
Staple
Strength
Other

150 LINTING UNITS PER HURD
 BEHNS & HENGE DEERD V. HURD HURD V. HURD HURD

Table 11

ANALYSIS OF VARIANCE OF PERCENT ERRORS DETECTED IN THIRD
5-PAGES FOR VARIOUS GROUPS FOLLOWING PREVIOUS ERROR DENSITY

Source of Variation	Sum of Squares	<u>df</u>	Mean Square	F
Present Error Density	.129	2	.065	2.708
Previous Error Density	.261	5	.052	2.167
Present X Previous Error Density	.218	10	.022	.917
Within	4.781	198	.024	
Total	5.389	215		

Table 11

ANALYSIS OF VARIANCE OF YIELD OF COTTON BARS PLANTED IN 1951
 2-FACTORS FOR VARIOUS GROUPS FOLLOWING PREVIOUS CULTIVATION

Source of Variation	Sum of Squares	df	Mean Square	F
Previous Error Density	127	2	63.5	1.708
Previous Error Density	101	2	50.5	1.361
Treatment X Previous Error Density	218	10	21.8	0.587
Within	470	108	4.35	
Total	916	122		

MILLER HALL
 EZERAS
 COTTON CENTER

CHAPTER V

DISCUSSION

It was demonstrated that as the number of errors increased, a corresponding increase in the probability of detection was obtained. What could be a possible explanation of the basic mechanisms behind this empirical relationship?

Before attempting to explain this phenomenon it is necessary to cite a previous study which will aid in the task. A classic experiment by Kulpe (10) may be taken as an illustration of the influence on perception of experimental variation of set established by instructions or induced by a task. He used colored letters presented tachistoscopically and found that, when the S was prepared to see color, he could report the colors of the letters but not much else. When he was set to see the letters or count them, he did so, but then was unable to report the colors. Many other investigations have indicated similar findings.

Psychologically, the relationship between checking efficiency and error density might be explained in the following manner. A proofreader or checker who encounters few errors will come to expect a low occurrence of errors. Consequently, his readiness to perceive an error declines. Since it is well established that perception is partly a matter of readiness to perceive, it is conceivable that a situation involving the detection of few errors will produce a condition unfavorable toward perceiving, hence, detecting errors. Conversely, as the checker faces more errors, his expectancy that an error will occur is high and he is 'set' to perceive and detect them.

CHAPTER V

REGRESSION

It was demonstrated that as the number of errors increased, a corresponding increase in the probability of detection was obtained. What could be a possible explanation of the main phenomenon being this empirical relationship?

Before attempting to explain this phenomenon it is necessary to cite a previous study which will aid in the task. A study conducted by Kahn (10) may be taken as an illustration of the phenomenon. In a perception of experimental variables of set established by tachistoscopic or induced by a task. He used colored labels presented tachistoscopically and found that of the 5 not presented to him color, he could report the color of the labels not only when he was set to see the labels in a tachistoscopic manner, but when he was able to report the colors. Kahn did not investigate have indicated similar findings.

Psychologically, the relationship between checking efficiency and error density might be explained in the following manner. A proofreader or checker who recognizes few errors will have a low occurrence of errors. Consequently, his readiness to perceive an error declines. Since it is well established that perception is partly a matter of readiness to perceive, it is conceivable that a situation involving the reduction of low errors will produce a condition unfavorable toward perceiving, hence, detecting errors. Conversely, as the checker takes more errors, his efficiency will be error will occur in high and in low, in detection and detection.

The relationship between rate of errors and checking efficiency should not be interpreted to mean that in a situation where there are few errors, they can not be found and corrected. It must be remembered that a better checking situation could increase checking efficiency. Signal checks are employed in radar monitoring and dial reading to aid in error detection. It would have been possible to have increased the probability of detection of low frequency errors in this study. However, such procedures may have obscured the relationship which the writer desired to investigate.

When error density reaches an extremely high level, it seems quite probable that the psychological situation involved in checking would change. Mackworth (13) statistically analyzed his data on the two-hour watch to see whether reliable evidence could be obtained about the effect on accuracy of the length of blank spell preceding a signal. The results were classified into three main groups according to the length of time following a signal before the next signal appeared. The time interval following any signal detection was broken down into intervals of .75 to 1, 1.5 to 3, and 5 to 10 minutes resulting in 74.1, 75.9, and 79.6 mean percentage of signals detected. The Ss were definitely worse on signals given after blank spells of 1 minute or less than they were with those presented after an interval of 5 to 10 minutes. Mackworth (13) suggests that lapses in visual perception become more frequent when Ss have recently responded to visual signals. At extremely high rates of errors in a proofreading situation, perhaps a drop in the probability of detection occurs due to frequent lapses in perception

since the errors are encountered in rapid succession more often than at lower error densities.

Reinforcement in error detection while proofreading is probably obtained by a professional as he simultaneously observes an original proof and the reproduced copy. This type of reinforcement, i.e., the token reward of knowledge of successful results, was absent in the present study. However, it appears to be replaced by expectancy reinforcement. This depends on self-instructions about the time of onset of the next error, but need not be explicitly formulated by the S. Such predictions probably vary with each error detection or combination of detections. Since the errors are entirely randomized and predictions are probably based on some sort of average of all the preceding detection intervals, it is quite reasonable to suppose Ss become unaware and miss more errors when they are presented in a relatively rapid series at the higher density levels.

In the review of the literature, it was noted that a natural decrement occurs as a function of sustained activity in a search task. It begins relatively early and the decrement slightly increases as the O continues his task. In the present experiment there was an increase in checking efficiency as error density increased from 6 to 30 with a slight decrease at the highest levels. Although reading time per manuscript was not recorded, it may be assumed that it took more time to read higher density manuscripts due to the frequent encounter of errors. If this assumption is reasonable, another explanation of the observed decrement at the higher density levels is possible. In the last three half-hours

...the error rate was ... at lower error levels.

Relationships in error detection while ... obtained by a procedure ...

... and the reproduced copy. ... the same level of ...

the present study. However, it appears to be ... This depends on self-priming ...

... of the next error, but need not be ...

... detection of detection. Thus the errors are ... and predictions are probably based on some ...

... preceding detection intervals. It is ... become unaware and error rates ...

... relatively rapid series at the higher ...

... in the review of the literature, ... decrement occurs as a function of ...

... task. It begins relatively early ... process as the Q continues ...

... there was an increase in ... crossed from 0 to 20 ...

... Although reading time per ... assumed that it took more time ...

... due to the frequent occurrence of ... reasonable, another explanation ...

... higher density levels as possible. ...

of Mackworth's two hour Clock Test, he found that the proportion of missed stimuli was usually twice, or even three times, as great as that when men were working at their very best. Similarly, the decrease in error detection efficiency while proofreading at the higher density levels would be effected proportionately the longer the task.

In summary, the O begins a session with an indefinite prediction concerning the search task depending on his past experience. As he detects errors, he uses this immediate experience to formulate a prediction concerning the occurrence of errors in the manuscript. His prediction could be based solely on the last detection, but generally, it is probably an estimate of the average interval between all the previous detections. At this point, his readiness to perceive either increases or declines according to the average rate of errors and becomes apparent in the S's detection record.

The mechanism of expectancy seems to explain error detection at the lower density levels (6, 9, 15) and the optimum level (30). However, at extremely high density levels (60, 120) there seems to be a saturation effect which interferes slightly with detection. Since more errors are encountered in rapid succession at higher levels, lapses in visual perception following a detection become more frequent somewhat reducing the probability of detection.

In any event, the psychological relationship between error density and probability of detection would appear to be quite complex.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The ability of Ss to detect typographical errors in a manuscript was studied. Of primary concern were (a) the effect of different rates of errors on the probability of detection, and (b) the influence of previous error density on present error density in terms of error detection. Additional objectives were (c) whether false reports correlate with the probability of error detection, and (d) whether different kinds of typographical errors were of grossly unequal difficulty to detect.

Recent studies have been directly concerned with the problem of fluctuations in detectability as a function of time and signal density with respect to radar observation, inspection tasks, and dial reading accuracy. The writer was interested in examining proofreading behavior to determine if similar relationships between these variables were present in this type of situation.

Two hundred and sixteen Ss were randomly assigned to six groups of 36 each and instructed to mark every typographical error in their manuscript. Group I through VI faced 6, 9, 15, 30, 60, and 120 errors per 5-pages, respectively, for the first 10-pages. This design enabled the E to collect data bearing on problems a, c, and d stated previously. To determine if Ss develop a learned set as a result of having 10-pages of proofreading experience with a fixed density level, it was necessary to change the error density for the last 5-page sequence of the 15-page manuscript. Consequently, one-third of each of the six

initial groups encountered 6, 30, or 120 errors for the remainder of their task. Ss were not allowed to proofread the manuscript a second time so their responses may be considered as all or none in contrast to a continuous response measure in which signals remain until detected or, at least, more time is given for a detection. Errors for any density group were varied in time and location so the Os probably experienced difficulty in predicting specifically where and when the next error would appear. The measure used was the percentage of errors identified within a 5-page interval. It was felt that this gave a good approximation to the momentary probability of detection. "

The conclusions based on the testing of Ss in a proofreading situation appear to indicate that relationships between variables investigated are similar to results found in other types of checking operations.

(1) The present experiment demonstrated a direct relationship between the probability of error detection and the rate of errors encountered in a proofreading situation. As error density increased, percent error detection increased up to the 30 error level with a slight decrease at the highest levels. To the extent that one experimental situation has confirmed it, the hypothesis has been sustained.

(2) The effect of rate of errors encountered on the probability of detection appears to be a stable function in a continuous work situation, at least within the limits of this experiment.

(3) False detections do not correlate with the probability of

Initial groups encountered a... their task, he was not... that no their responses... to a continuous response... fected or, as I have... my density group... probably experienced... and when the next... percentage of errors... felt that there was... ability of detection.

The conclusion based on the... situation appear to... investigated the... operations.

(1) The present experiment... between the probability... encountered in a... percent error detection... slight increase at... experimental situation... established.

(2) The amount of... of detection appears... attention, as I have... (3) False... WATERS WATERS

percent errors detected; rather, they appear to fluctuate from one individual to another in an unsystematic fashion.

(4) When the three types of errors employed in the study are encountered in proportionate numbers, they may be listed in their order of difficulty respectively as follows: omission, transposition, and substitution.

(5) No demonstrated effect of a habituation factor was found to be carried over from previous to present error detection working with continuous data in one session.

percent errors decreased; rather, they appear to increase from one

individual to another in an unpredictable fashion.

(4) When the same types of errors occurred in the same way

encountered in proportional numbers, they are no longer

order of difficulty respectively as follows: addition, subtraction,

and multiplication.

(5) No demonstrable effect of a particular error was found

to be carried over from previous to present error. This was

with continuous data in one session.

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APPENDIX

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APPENDIX

Table 1

PERCENT ERRORS DETECTED FOR EACH SUBJECT AT THE VARIOUS
ERROR LEVELS FOR THE FIRST 5-PAGES

Subjects	Error Levels					
	6	9	15	30	60	120
1	.500	.667	.934	.900	.900	.892
2	.500	.667	1.000	.834	.784	.909
3	.500	.778	.934	.834	.800	.867
4	.667	.778	.867	.967	.850	.975
5	.667	.778	.934	.734	.950	.800
6	.834	.556	.934	.834	.934	.742
7	.500	.778	.934	.767	.934	.925
8	1.000	.556	.934	.900	.884	.625
9	.500	.778	.867	.767	.850	.892
10	.834	.112	.867	.734	1.000	.875
11	1.000	.667	.934	.934	.800	.709
12	.500	.778	.800	.967	.850	.892
13	1.000	.556	.800	.934	.950	.917
14	.834	.667	.734	.934	.850	.742
15	.500	.889	.734	.800	.934	.659
16	1.000	.556	1.000	.900	.784	.775
17	.834	.778	1.000	.800	.917	.900
18	.834	.667	.934	.667	.934	.942
19	.500	.556	.734	.967	.950	.850
20	.834	.778	.934	.734	.934	.834
21	1.000	.778	.867	.700	.884	.625
22	.167	.667	.800	.834	.934	.767
23	.667	.223	.934	.900	.634	.925
24	.667	.889	.934	.900	.667	.842
25	.667	.889	.800	.734	.667	.842
26	.667	.667	.600	.734	.750	.734
27	.500	.445	.934	.867	1.000	.809
28	.500	.667	1.000	1.000	.767	.942
29	.834	.445	.867	.800	.834	.717
30	.667	.778	.934	.934	.734	.692
31	.834	.556	.934	.834	.867	.850
32	.334	.778	.734	.900	.934	.842
33	1.000	.778	1.000	.700	.717	.734
34	.667	.556	.934	.900	.850	.717
35	.500	.556	.934	.967	.950	.592
36	.834	.889	.934	.767	.850	.900
Total	24.783	23.901	31.349	30.379	30.828	29.252
Mean	.688	.663	.871	.814	.856	.813
Variance	.073	.029	.015	.008	.009	.010

Table 2

PERCENT ERRORS DETECTED FOR EACH SUBJECT AT THE VARIOUS
ERROR LEVELS FOR THE SECOND 5-PAGES

Subjects	Error Levels					
	6	9	15	30	60	120
1	.667	.778	.667	.934	.950	.850
2	.834	.889	.867	1.000	.750	.934
3	.500	.778	.734	.800	.817	.759
4	.834	.889	.800	.967	.967	.967
5	1.000	.889	.734	.800	.900	.667
6	1.000	.889	.534	.900	.934	.709
7	.667	.889	.734	.867	.967	.934
8	1.000	.778	.734	.900	.750	.567
9	.500	.889	.600	.767	.734	.892
10	.834	.334	.800	.834	.984	.900
11	.667	.778	.934	.967	.800	.625
12	.167	1.000	.734	.967	.767	.900
13	1.000	.778	.734	.934	.934	.900
14	.834	.889	.667	1.000	.884	.709
15	.667	1.000	.467	.900	.917	.734
16	1.000	.556	.934	.934	.817	.734
17	.834	1.000	.467	.834	.934	.775
18	.667	.667	.734	.600	.817	.942
19	.667	.889	.467	.967	.900	.817
20	.834	.889	.734	.767	.900	.842
21	.667	.778	.600	.800	.884	.442
22	.667	.445	.800	.900	.917	.784
23	.834	.334	.667	.934	.717	.859
24	1.000	.889	.867	.867	.634	.717
25	.667	1.000	.734	.800	.750	.675
26	.500	.778	.200	.767	.717	.692
27	.834	1.000	.800	.934	.967	.850
28	.834	.445	1.000	.967	.750	.950
29	.834	.889	.800	.967	.834	.775
30	.667	1.000	.667	.900	.650	.692
31	.500	1.000	.934	.800	.900	.859
32	.500	.889	.267	.934	.884	.767
33	.834	1.000	.534	.800	.884	.700
34	.500	.667	.600	.900	.917	.484
35	.500	.556	.800	.934	.917	.609
36	.667	.778	.800	.767	.850	.875
Total	26.178	28.896	25.146	31.610	30.595	27.887
Mean	.727	.802	.698	.878	.850	.774
Variance	.058	.035	.030	.007	.009	.017

COTTON CONTENT
TABLE 2
PERCENT BARIOR DETERMINED FOR THE YEAR 1954

Subject	Percent Bario			
	0	1	2	3
1	.687	.718	.807	.838
2	.837	.839	.807	.800
3	.500	.718	.737	.787
4	.837	.839	.807	.800
5	1.000	.839	.837	.800
6	1.000	.839	.837	.800
7	.687	.839	.837	.800
8	1.000	.718	.737	.787
9	.800	.839	.837	.800
10	.837	.839	.807	.800
11	.687	.718	.807	.838
12	.787	1.000	.737	.807
13	1.000	.718	.737	.787
14	.837	.839	.807	.800
15	.687	1.000	.807	.838
16	1.000	.839	.837	.800
17	.837	1.000	.807	.838
18	.687	.687	.737	.787
19	.687	.718	.807	.838
20	.837	.839	.807	.800
21	.687	.718	.807	.838
22	.687	.839	.837	.800
23	.837	.839	.807	.800
24	1.000	.839	.837	.800
25	.687	1.000	.807	.838
26	.800	.839	.837	.800
27	.837	1.000	.807	.838
28	.837	.839	.807	.800
29	.837	.839	.807	.800
30	.687	1.000	.807	.838
31	.800	1.000	.807	.838
32	.800	.839	.837	.800
33	.837	1.000	.807	.838
34	.800	.839	.837	.800
35	.800	.839	.837	.800
36	.687	.718	.807	.838
Total	58.118	54.980	52.120	51.510
Mean	.751	.813	.875	.937
Variance	.058	.035	.017	.008

Table 3

NUMBER OF FALSE DETECTIONS FOR EACH SUBJECT AT
THE VARIOUS ERROR LEVELS FOR THE FIRST 5-PAGES

Subject	Error Levels					
	6	9	15	30	60	120
1	2	0	0	1	1	1
2	1	0	0	9	2	3
3	0	1	2	12	3	1
4	1	0	2	3	0	5
5	1	3	0	0	2	2
6	0	4	2	5	1	0
7	1	0	5	4	1	0
8	9	1	0	1	1	1
9	3	2	2	6	0	6
10	0	2	2	0	0	2
11	1	1	3	2	0	2
12	8	5	0	2	1	1
13	0	0	1	4	3	1
14	0	5	0	4	0	2
15	2	0	1	1	0	4
16	0	0	1	3	2	0
17	0	0	0	1	1	0
18	0	1	1	8	4	0
19	1	4	2	11	1	3
20	0	2	2	1	0	2
21	0	17	4	14	11	10
22	10	3	2	2	0	0
23	1	3	1	13	0	0
24	11	0	0	4	2	2
25	0	2	2	3	2	5
26	1	3	2	1	2	3
27	8	1	2	0	1	1
28	5	5	0	0	0	1
29	13	1	1	3	7	0
30	0	1	0	2	3	2
31	1	1	0	3	2	0
32	4	2	12	5	14	8
33	7	0	0	7	0	2
34	10	0	6	2	5	2
35	3	1	4	0	1	3
36	3	0	2	3	0	3
Total	107	71	64	140	73	78

Table 3

NUMBER OF VALUE DISTRIBUTIONS FOR EACH CATEGORY IN THE VARIOUS ERROR LEVELS FOR THE FIRST 2-PAGES

Subject	0	1	2	3	4	Error level:
1	2	0	0	0	0	0
2	1	0	0	0	0	0
3	1	0	0	0	0	0
4	1	0	0	0	0	0
5	1	0	0	0	0	0
6	1	0	0	0	0	0
7	1	0	0	0	0	0
8	1	0	0	0	0	0
9	1	0	0	0	0	0
10	1	0	0	0	0	0
11	1	0	0	0	0	0
12	1	0	0	0	0	0
13	1	0	0	0	0	0
14	1	0	0	0	0	0
15	1	0	0	0	0	0
16	1	0	0	0	0	0
17	1	0	0	0	0	0
18	1	0	0	0	0	0
19	1	0	0	0	0	0
20	1	0	0	0	0	0
21	1	0	0	0	0	0
22	1	0	0	0	0	0
23	1	0	0	0	0	0
24	1	0	0	0	0	0
25	1	0	0	0	0	0
26	1	0	0	0	0	0
27	1	0	0	0	0	0
28	1	0	0	0	0	0
29	1	0	0	0	0	0
30	1	0	0	0	0	0
31	1	0	0	0	0	0
32	1	0	0	0	0	0
33	1	0	0	0	0	0
34	1	0	0	0	0	0
35	1	0	0	0	0	0
36	1	0	0	0	0	0
37	1	0	0	0	0	0
38	1	0	0	0	0	0
39	1	0	0	0	0	0
40	1	0	0	0	0	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0
45	1	0	0	0	0	0
46	1	0	0	0	0	0
47	1	0	0	0	0	0
48	1	0	0	0	0	0
49	1	0	0	0	0	0
50	1	0	0	0	0	0
51	1	0	0	0	0	0
52	1	0	0	0	0	0
53	1	0	0	0	0	0
54	1	0	0	0	0	0
55	1	0	0	0	0	0
56	1	0	0	0	0	0
57	1	0	0	0	0	0
58	1	0	0	0	0	0
59	1	0	0	0	0	0
60	1	0	0	0	0	0
61	1	0	0	0	0	0
62	1	0	0	0	0	0
63	1	0	0	0	0	0
64	1	0	0	0	0	0
65	1	0	0	0	0	0
66	1	0	0	0	0	0
67	1	0	0	0	0	0
68	1	0	0	0	0	0
69	1	0	0	0	0	0
70	1	0	0	0	0	0
71	1	0	0	0	0	0
72	1	0	0	0	0	0
73	1	0	0	0	0	0
74	1	0	0	0	0	0
75	1	0	0	0	0	0
76	1	0	0	0	0	0
77	1	0	0	0	0	0
78	1	0	0	0	0	0
79	1	0	0	0	0	0
80	1	0	0	0	0	0
81	1	0	0	0	0	0
82	1	0	0	0	0	0
83	1	0	0	0	0	0
84	1	0	0	0	0	0
85	1	0	0	0	0	0
86	1	0	0	0	0	0
87	1	0	0	0	0	0
88	1	0	0	0	0	0
89	1	0	0	0	0	0
90	1	0	0	0	0	0
91	1	0	0	0	0	0
92	1	0	0	0	0	0
93	1	0	0	0	0	0
94	1	0	0	0	0	0
95	1	0	0	0	0	0
96	1	0	0	0	0	0
97	1	0	0	0	0	0
98	1	0	0	0	0	0
99	1	0	0	0	0	0
100	1	0	0	0	0	0

Table 4

NUMBER OF FALSE DETECTIONS FOR EACH SUBJECT AT
THE VARIOUS ERROR LEVELS FOR THE SECOND 5-PAGES

Subject	Error Levels					
	6	9	15	30	60	120
1	0	1	0	0	2	3
2	2	0	1	4	2	1
3	0	1	1	8	1	1
4	1	1	2	2	0	2
5	0	2	1	5	4	1
6	1	2	4	5	4	2
7	0	1	1	4	0	3
8	8	3	0	0	0	0
9	2	2	2	7	3	13
10	2	0	0	2	2	6
11	0	0	5	1	0	4
12	1	5	1	1	0	1
13	0	0	1	4	5	5
14	0	6	0	1	2	2
15	4	1	3	0	1	1
16	0	0	2	0	3	5
17	0	2	0	0	2	1
18	2	0	0	0	10	4
19	1	4	1	9	4	3
20	1	4	0	1	1	4
21	0	8	0	11	7	7
22	7	2	3	0	0	1
23	0	0	3	12	0	0
24	6	2	0	1	3	14
25	1	1	2	0	2	1
26	0	1	4	2	2	2
27	4	2	2	1	2	1
28	1	3	1	1	1	0
29	9	2	3	3	2	3
30	1	1	1	0	3	4
31	1	1	1	0	5	4
32	0	3	6	1	12	6
33	0	0	1	1	3	2
34	15	0	6	0	12	0
35	4	1	0	1	1	1
36	0	0	2	1	0	2
Total	74	62	60	89	101	110

Table 1

THE VARIOUS LEVELS FOR THE SECOND 5-YEAR PERIOD OF PARTIAL DETONATIONS FOR EACH DISTRICT

Subject	0	1	2	3	4	5
1	0	1	0	0	0	0
2	0	1	0	0	0	0
3	0	1	0	0	0	0
4	0	1	0	0	0	0
5	0	1	0	0	0	0
6	0	1	0	0	0	0
7	0	1	0	0	0	0
8	0	1	0	0	0	0
9	0	1	0	0	0	0
10	0	1	0	0	0	0
11	0	1	0	0	0	0
12	0	1	0	0	0	0
13	0	1	0	0	0	0
14	0	1	0	0	0	0
15	0	1	0	0	0	0
16	0	1	0	0	0	0
17	0	1	0	0	0	0
18	0	1	0	0	0	0
19	0	1	0	0	0	0
20	0	1	0	0	0	0
21	0	1	0	0	0	0
22	0	1	0	0	0	0
23	0	1	0	0	0	0
24	0	1	0	0	0	0
25	0	1	0	0	0	0
26	0	1	0	0	0	0
27	0	1	0	0	0	0
28	0	1	0	0	0	0
29	0	1	0	0	0	0
30	0	1	0	0	0	0
31	0	1	0	0	0	0
32	0	1	0	0	0	0
33	0	1	0	0	0	0
34	0	1	0	0	0	0
35	0	1	0	0	0	0
36	0	1	0	0	0	0
Total	0	36	0	0	0	0

Table 5

NUMBER OF FALSE DETECTIONS FOR EACH SUBJECT AT
6, 30, AND 120 ERROR LEVEL FOR THE THIRD 5-PAGES

Subject	Error Levels						
	Present	Previous					
		6	9	15	30	60	120
1	6	1	0	0	4	10	5
2	6	0	3	0	5	1	3
3	6	0	3	1	2	2	5
4	6	0	0	0	2	2	2
5	6	0	3	1	0	0	3
6	6	0	1	2	0	4	0
7	6	2	6	0	1	1	1
8	6	1	1	2	3	2	0
9	6	0	6	1	3	2	3
10	6	2	3	0	2	2	3
11	6	1	1	1	11	1	4
12	6	6	1	0	1	2	6
Total		13	28	8	34	29	35
13	30	1	0	1	3	6	6
14	30	3	1	1	3	4	2
15	30	0	3	5	1	3	1
16	30	0	3	3	1	1	2
17	30	1	7	1	0	5	2
18	30	3	4	0	11	2	3
19	30	1	6	1	4	3	2
20	30	3	1	2	3	0	1
21	30	3	4	2	5	2	2
22	30	2	0	0	9	3	5
23	30	2	1	11	4	0	1
24	30	4	5	0	1	3	2
Total		23	35	27	45	32	29
25	120	1	1	2	0	2	4
26	120	2	1	4	3	2	6
27	120	6	4	2	3	3	5
28	120	3	1	3	2	0	0
29	120	4	1	2	2	4	1
30	120	0	2	2	1	5	1
31	120	3	33	2	1	2	3
32	120	1	8	3	5	13	10
33	120	2	1	0	5	3	0
34	120	6	0	4	2	4	5
35	120	0	0	2	1	2	2
36	120	4	5	1	2	1	5
Total		32	57	27	27	41	42

Table 2

NUMBERS OF PLANT SPECIES FOR EACH LEVEL IN
 1, 2, 3, AND 12 HOUR LEVEL FOR THE YEAR 1960

Subject	Error Level				Present
	1	2	3	12	
1	0	1	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
Total					0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0
21	0	0	0	0	0
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0
Total					0
25	0	0	0	0	0
26	0	0	0	0	0
27	0	0	0	0	0
28	0	0	0	0	0
29	0	0	0	0	0
30	0	0	0	0	0
31	0	0	0	0	0
32	0	0	0	0	0
33	0	0	0	0	0
34	0	0	0	0	0
35	0	0	0	0	0
36	0	0	0	0	0
Total					0

INTENT NOT TO

Table 6

TOTAL NUMBER OF TYPES OF ERRORS MISSED FOR EACH SUBJECT
AT VARIOUS ERROR LEVELS FOR THE FIRST 5-PAGES

Subject	Error Levels																	
	6			9			15			30			60			120		
	Types of Errors*																	
	O	T	S	O	T	S	O	T	S	O	T	S	O	T	S	O	T	S
1	1	1	1	0	2	1	0	1	0	1	1	1	4	1	1	8	4	1
2	1	0	2	1	2	0	0	0	0	2	2	1	7	5	1	6	4	1
3	1	0	2	0	1	1	0	1	0	2	2	1	7	3	2	9	5	2
4	0	1	1	0	1	1	0	2	0	1	0	0	6	2	1	2	0	1
5	0	0	2	1	1	0	0	1	0	3	3	2	2	1	0	12	6	6
6	1	0	0	0	3	1	0	1	0	4	1	0	1	2	1	15	12	4
7	1	1	1	1	0	1	0	1	0	3	3	1	2	2	0	6	2	1
8	0	0	0	1	2	1	0	1	0	1	1	1	4	2	1	18	16	11
9	1	0	2	1	1	0	0	1	1	3	2	2	6	1	2	8	4	1
10	0	1	0	2	3	3	0	2	0	3	2	3	0	0	0	8	3	4
11	0	0	0	1	2	0	0	1	0	2	0	0	8	4	0	17	9	9
12	1	1	1	0	1	1	0	1	1	1	0	0	6	1	2	7	5	1
13	0	0	0	1	2	1	1	2	0	1	1	0	2	1	0	6	4	0
14	1	0	0	1	2	0	1	2	1	2	0	0	6	3	0	12	15	4
15	0	1	2	0	0	1	0	3	1	5	0	1	3	1	0	13	18	10
16	0	0	0	1	3	0	0	0	0	2	0	1	7	2	4	12	9	6
17	0	0	1	0	2	0	5	3	1	3	1	2	5	0	0	6	5	1
18	0	0	1	0	2	1	0	1	0	6	3	1	4	0	0	4	2	1
19	1	0	2	1	2	1	1	3	0	1	0	0	3	0	0	7	6	5
20	0	1	0	1	0	1	0	1	0	4	4	0	4	0	0	8	5	7
21	0	0	0	1	0	1	0	2	0	4	3	2	4	2	1	18	19	8
22	2	1	2	2	0	1	2	1	0	1	3	1	3	1	0	12	10	6
23	0	0	2	1	3	3	0	1	0	2	1	0	9	9	4	4	3	2
24	1	0	1	0	1	0	0	1	0	1	1	1	10	3	3	9	6	4
25	0	0	2	0	1	0	1	1	1	5	1	2	8	8	4	10	7	2
26	1	0	1	0	2	1	3	2	1	3	2	3	7	5	3	12	13	7
27	1	1	1	2	2	1	0	1	0	2	1	1	0	0	0	10	6	7
28	1	0	2	0	2	1	0	0	0	0	0	0	8	2	4	2	3	2
29	0	0	1	1	2	2	1	1	0	4	2	0	6	3	1	14	13	7
30	0	1	1	1	1	0	0	1	0	0	2	0	8	3	5	18	12	7
31	0	0	1	1	2	1	0	1	0	3	0	2	4	1	1	8	6	4
32	1	1	2	0	1	1	0	3	1	3	0	0	3	0	0	8	6	5
33	0	0	0	2	0	0	0	0	0	4	2	3	8	2	2	18	6	8
34	1	0	1	1	2	1	0	1	0	1	1	1	4	2	2	15	11	7
35	1	1	1	1	2	1	0	1	0	1	0	0	2	1	0	17	17	15
36	1	0	0	0	1	0	0	1	0	3	2	2	5	3	1	5	5	2
Total	19	12	36	26	54	29	15	46	8	87	47	35	176	76	46	364	277	159

* O - Omission

T - Transposition

S - Substitution

Table 7

TOTAL NUMBER OF TYPES OF ERRORS MISSED FOR EACH SUBJECT
AT VARIOUS ERROR LEVELS FOR THE SECOND 5-PAGES

Subject	Error Levels																	
	6			9			15			30			60			120		
	Types of Errors																	
	O	T	S	O	T	S	O	T	S	O	T	S	O	T	S	O	T	S
1	0	1	1	0	2	0	2	2	1	1	0	1	3	0	0	7	9	2
2	1	0	0	1	0	0	1	1	0	0	0	0	6	7	2	3	4	1
3	1	1	1	2	0	0	2	2	0	3	1	2	4	4	3	11	12	6
4	0	1	0	0	1	0	1	2	0	0	1	0	1	1	0	2	2	0
5	0	0	0	1	0	0	2	2	0	4	1	1	5	1	0	15	12	13
6	0	0	0	0	1	0	3	2	2	2	1	0	2	0	2	13	17	5
7	1	1	0	1	0	0	1	2	1	1	3	0	1	0	1	5	3	0
8	0	0	0	1	1	0	2	2	1	1	2	0	9	3	3	23	18	11
9	1	1	1	1	0	0	3	2	1	4	2	1	10	5	1	3	8	2
10	1	0	0	2	2	2	1	2	0	3	2	0	1	0	0	3	7	2
11	1	0	1	1	1	0	1	0	0	1	0	0	7	3	2	18	19	8
12	1	2	2	0	0	0	2	1	1	1	0	0	7	4	3	4	6	2
13	0	0	0	1	1	0	2	2	0	1	1	0	4	0	0	3	5	4
14	0	1	0	0	1	0	2	2	1	0	0	0	4	2	1	12	13	10
15	1	0	1	0	0	0	1	4	3	2	0	1	3	1	1	11	17	4
16	0	0	0	2	1	1	0	1	0	1	1	0	5	5	1	11	15	6
17	0	0	1	0	0	0	4	2	2	2	2	1	3	1	0	12	10	5
18	1	1	0	1	0	2	2	1	1	5	3	4	6	4	1	3	3	1
19	1	1	0	1	0	0	2	4	2	1	0	0	4	2	0	10	7	5
20	1	0	0	1	0	0	2	2	0	5	1	1	3	2	1	7	8	4
21	0	1	1	1	0	1	4	2	0	3	2	1	2	4	1	26	27	14
22	0	0	2	1	3	1	0	2	1	1	2	0	3	1	1	6	18	2
23	0	0	1	3	2	1	3	2	0	2	0	0	10	5	2	5	10	2
24	0	0	0	1	0	0	0	2	0	2	0	2	8	3	3	15	14	5
25	1	1	0	0	0	0	1	2	1	3	0	3	5	6	4	17	12	7
26	1	1	1	1	1	0	5	3	4	4	3	0	9	6	2	13	20	4
27	0	1	0	0	0	0	1	2	0	0	2	0	1	0	1	10	5	3
28	0	1	0	2	2	1	0	0	0	1	0	0	10	5	0	5	1	0
29	0	0	1	1	0	0	1	2	0	0	1	0	2	6	2	17	9	3
30	1	1	0	0	0	0	3	1	1	2	0	1	7	8	6	20	12	5
31	1	1	1	0	0	0	0	1	0	1	3	2	3	0	0	9	5	3
32	1	1	1	1	0	0	4	4	3	1	1	0	4	1	1	12	11	5
33	1	0	0	0	0	0	2	3	2	3	1	2	3	1	1	15	11	10
34	1	1	1	0	1	2	2	2	2	2	1	0	2	1	1	24	20	18
35	1	1	1	0	2	2	1	1	1	1	1	0	3	2	0	16	21	10
36	0	1	1	1	1	0	1	2	0	2	3	2	4	4	1	9	3	3
Total	19	21	19	28	23	13	64	69	31	66	41	25	164	98	48	395	394	185

TOTAL NUMBER OF STUDENTS BY GRADE AND SEX IN THE DISTRICT OF COLUMBIA, 1950-51

Grade	Total		Male		Female	
	No.	%	No.	%	No.	%
1	100	100	50	50	50	50
2	100	100	50	50	50	50
3	100	100	50	50	50	50
4	100	100	50	50	50	50
5	100	100	50	50	50	50
6	100	100	50	50	50	50
7	100	100	50	50	50	50
8	100	100	50	50	50	50
9	100	100	50	50	50	50
10	100	100	50	50	50	50
11	100	100	50	50	50	50
12	100	100	50	50	50	50
13	100	100	50	50	50	50
14	100	100	50	50	50	50
15	100	100	50	50	50	50
16	100	100	50	50	50	50
17	100	100	50	50	50	50
18	100	100	50	50	50	50
19	100	100	50	50	50	50
20	100	100	50	50	50	50
21	100	100	50	50	50	50
22	100	100	50	50	50	50
23	100	100	50	50	50	50
24	100	100	50	50	50	50
25	100	100	50	50	50	50
26	100	100	50	50	50	50
27	100	100	50	50	50	50
28	100	100	50	50	50	50
29	100	100	50	50	50	50
30	100	100	50	50	50	50
31	100	100	50	50	50	50
32	100	100	50	50	50	50
33	100	100	50	50	50	50
34	100	100	50	50	50	50
35	100	100	50	50	50	50
36	100	100	50	50	50	50
37	100	100	50	50	50	50
38	100	100	50	50	50	50
39	100	100	50	50	50	50
40	100	100	50	50	50	50
41	100	100	50	50	50	50
42	100	100	50	50	50	50
43	100	100	50	50	50	50
44	100	100	50	50	50	50
45	100	100	50	50	50	50
46	100	100	50	50	50	50
47	100	100	50	50	50	50
48	100	100	50	50	50	50
49	100	100	50	50	50	50
50	100	100	50	50	50	50

Table 8

TOTAL NUMBER OF TYPES OF ERRORS MISSED FOR EACH SUBJECT
AT VARIOUS ERROR LEVELS FOR THE THIRD 5-PAGES

Subject	Present	Error Levels																	
		Previous																	
		6			9			15			30			60			120		
		0	T	S	0	T	S	0	T	S	0	T	S	0	T	S	0	T	S
1	6	0	0	1	1	0	1	1	0	2	0	0	0	1	0	1	1	0	0
2	6	2	0	1	1	0	0	1	0	1	1	0	0	1	0	1	0	0	0
3	6	1	0	1	0	0	1	2	1	1	0	0	0	0	0	0	1	0	0
4	6	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0
5	6	0	0	0	1	0	0	1	2	1	1	0	2	0	0	0	1	0	1
6	6	1	1	0	1	1	0	0	0	1	1	0	0	1	0	0	1	0	0
7	6	1	1	1	1	0	1	2	0	1	0	0	0	0	0	0	0	1	0
8	6	1	0	1	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0
9	6	1	0	0	0	0	1	1	1	1	1	1	1	0	0	2	1	2	0
10	6	1	2	2	2	1	0	1	0	0	1	0	0	0	0	0	1	0	2
11	6	1	0	0	0	2	1	0	1	1	0	1	0	1	0	1	1	0	0
12	6	1	0	0	0	0	0	1	0	0	1	0	0	0	2	2	1	0	0
Total	11	4	7	8	4	5	11	5	10	7	2	5	4	2	7	10	4	3	
13	30	3	5	0	1	6	0	4	4	0	2	2	0	1	1	2	3	2	0
14	30	2	1	0	3	2	0	5	4	2	2	2	0	4	2	0	3	2	0
15	30	6	7	2	4	1	1	2	1	0	4	6	3	4	4	0	3	3	1
16	30	2	4	1	3	1	1	3	3	0	2	0	0	4	2	1	1	0	0
17	30	4	0	1	3	3	0	9	3	1	8	6	1	2	2	1	5	4	3
18	30	3	1	0	9	5	2	7	4	2	4	2	0	2	1	0	2	3	0
19	30	5	4	1	2	1	1	3	2	1	5	6	2	1	1	0	1	2	0
20	30	0	1	0	5	3	0	4	3	1	6	3	1	3	3	1	5	4	3
21	30	9	8	3	3	3	1	6	4	3	5	4	2	4	4	0	2	3	0
22	30	4	3	2	9	8	5	3	1	2	8	6	3	0	1	1	1	1	0
23	30	3	2	0	5	3	1	3	1	0	1	1	1	3	2	2	9	6	4
24	30	5	6	1	5	4	2	6	0	0	2	3	1	8	7	1	2	0	0
Total	46	42	11	52	40	14	52	30	12	49	41	14	36	30	9	37	30	11	
25	120	7	9	3	7	4	4	16	11	20	17	13	9	12	8	10	11	6	13
26	120	17	12	14	10	5	6	16	17	18	17	16	6	13	5	6	18	17	12
27	120	19	7	10	10	9	7	10	4	6	8	3	4	4	0	3	8	7	6
28	120	3	3	1	18	9	7	4	3	0	3	0	1	11	3	9	5	1	0
29	120	8	6	5	9	6	5	11	5	6	7	8	4	10	4	2	8	8	4
30	120	9	8	4	3	2	0	13	6	6	9	6	3	19	17	17	12	10	9
31	120	10	4	3	13	9	7	3	5	1	3	3	2	6	4	4	12	9	4
32	120	12	6	11	9	3	6	29	27	24	6	2	2	10	5	5	8	8	1
33	120	5	2	0	5	4	1	10	8	11	13	9	9	12	5	5	17	7	7
34	120	3	6	2	7	2	5	12	8	3	15	5	3	5	6	6	20	16	19
35	120	14	11	10	11	7	12	6	3	7	10	5	3	5	1	1	13	9	9
36	120	12	5	6	3	9	4	11	11	9	19	8	10	9	5	5	8	5	6
Total	119	79	69	105	69	64	141	108	111	127	78	56	97	41	73	110	103	104	

Table 9

PERCENT ERRORS DETECTED FOR EACH SUBJECT FOR THE
THIRD 5-PAGES FOLLOWING PREVIOUS ERROR LEVELS

Subject	Error Levels						
	Present	Previous					
		6	9	15	30	60	120
1	6	.834	.667	.500	1.000	.667	.834
2	6	.500	.834	.667	.834	.667	1.000
3	6	.667	.834	.334	1.000	1.000	.834
4	6	.834	.834	1.000	.834	1.000	.667
5	6	1.000	.834	.334	.500	1.000	.667
6	6	.667	.667	.834	.834	.834	.834
7	6	.500	.667	.500	1.000	1.000	.834
8	6	.667	1.000	.667	.667	1.000	.834
9	6	.834	.834	.500	.500	.667	.500
10	6	.167	.500	.834	.834	1.000	.500
11	6	.834	.500	.667	.834	.667	.834
12	6	.834	1.000	.834	.834	.667	.834
	Total	8.338	9.171	7.671	9.671	10.169	9.172
	Mean	.695	.764	.639	.806	.847	.764
13	30	.734	.767	.734	.867	.867	.834
14	30	.900	.834	.634	.867	.800	.834
15	30	.500	.800	.900	.567	.734	.767
16	30	.767	.834	.800	.934	.767	.967
17	30	.834	.800	.567	.500	.834	.600
18	30	.867	.467	.567	.800	.900	.834
19	30	.667	.867	.800	.567	.934	.900
20	30	.967	.734	.734	.667	.767	.600
21	30	.334	.767	.567	.634	.734	.834
22	30	.700	.267	.800	.434	.934	.934
23	30	.834	.700	.867	.900	.767	.367
24	30	.600	.634	.700	.800	.467	.934
	Total	8.704	8.471	8.670	8.537	9.505	9.405
	Mean	.725	.706	.722	.711	.719	.784
25	120	.842	.875	.609	.675	.750	.750
26	120	.642	.825	.575	.675	.800	.609
27	120	.700	.784	.834	.875	.934	.825
28	120	.942	.717	.942	.967	.767	.950
29	120	.842	.834	.817	.842	.867	.834
30	120	.825	.859	.792	.850	.559	.742
31	120	.859	.717	.925	.934	.884	.792
32	120	.659	.850	.334	.917	.800	.859
33	120	.942	.917	.759	.742	.775	.742
34	120	.909	.884	.809	.809	.850	.542
35	120	.709	.750	.867	.850	.942	.742
36	120	.809	.867	.742	.692	.842	.842
	Total	9.680	9.879	9.005	9.828	9.770	9.229
	Mean	.806	.823	.750	.819	.814	.769

Table 2

RESEARCH DESIGN FOR A 2x2x2x2x2

THIRD 2-FACTOR EXPERIMENTAL DESIGN

Subject	Error Levels				
	1	2	3	4	5
1	0	1.000	0.500	0.250	0.125
2	0	0.500	1.000	0.750	0.625
3	0	1.000	0.500	0.250	0.125
4	0	0.500	1.000	0.750	0.625
5	0	1.000	0.500	0.250	0.125
6	0	0.500	1.000	0.750	0.625
7	0	1.000	0.500	0.250	0.125
8	0	0.500	1.000	0.750	0.625
9	0	1.000	0.500	0.250	0.125
10	0	0.500	1.000	0.750	0.625
11	0	1.000	0.500	0.250	0.125
12	0	0.500	1.000	0.750	0.625
Total					1.000
Mean					0.200
13	30	0.500	1.000	0.750	0.625
14	30	1.000	0.500	0.250	0.125
15	30	0.500	1.000	0.750	0.625
16	30	1.000	0.500	0.250	0.125
17	30	0.500	1.000	0.750	0.625
18	30	1.000	0.500	0.250	0.125
19	30	0.500	1.000	0.750	0.625
20	30	1.000	0.500	0.250	0.125
21	30	0.500	1.000	0.750	0.625
22	30	1.000	0.500	0.250	0.125
23	30	0.500	1.000	0.750	0.625
24	30	1.000	0.500	0.250	0.125
Total					1.000
Mean					0.200
25	150	0.500	1.000	0.750	0.625
26	150	1.000	0.500	0.250	0.125
27	150	0.500	1.000	0.750	0.625
28	150	1.000	0.500	0.250	0.125
29	150	0.500	1.000	0.750	0.625
30	150	1.000	0.500	0.250	0.125
31	150	0.500	1.000	0.750	0.625
32	150	1.000	0.500	0.250	0.125
33	150	0.500	1.000	0.750	0.625
34	150	1.000	0.500	0.250	0.125
35	150	0.500	1.000	0.750	0.625
36	150	1.000	0.500	0.250	0.125
Total					1.000
Mean					0.200

Table 10

INSTRUCTIONS

This is an experiment to determine how well people can proofread manuscripts. The manuscript we will give you is an excerpt from the book entitled "Canada", written by Andre Siegfried. Read through the manuscript and mark the errors as you come to them. We are only interested in typographical errors. For the purpose of this study, a typographical error may be defined as any misspelled word or any word which does not fit the context of a sentence due to a typing error, i.e., cone instead of come. It is not necessary to determine what the error is; but just locate it by putting an X on the word. Do not circle the word, but put an X on it. Work rapidly but carefully and try to locate every error in the manuscript without taking too much time.

Do not pay any attention to what your neighbor is doing. Although you are all proofreading the same passage, keep in mind that each of us reads at a different rate. Some will take longer to complete the work than others. Work steadily until you are finished. When you are through place the manuscript on the front desk and you are free to leave. Do not go over the material a second time.

Here are three sentences that contain errors.

1. Please park your car on the rght side of the street.
2. What tmie are you planning to leave?
3. How is the wark developing in your project?

Remember, mark all errors that you locate with an X. Work rapidly and accurately.

Are there any questions?

THEORY

The first condition is that the system of equations must be linear. The second is that the system must be homogeneous, i.e., the right-hand side must be zero.

For a system of linear equations to have a non-trivial solution, the determinant of the coefficient matrix must be zero.

When the determinant is zero, the system is said to be singular, and the equations are dependent.

In such a case, the system has either no solution or an infinite number of solutions. The latter case occurs when the rank of the coefficient matrix is less than the number of variables.

To find the solutions, one can use the method of elimination or the method of minors. The method of elimination involves adding or subtracting equations to eliminate variables.

The method of minors involves finding the cofactors of the elements in the coefficient matrix and using them to solve for the variables.

It is important to note that a system of linear equations may have no solution, a unique solution, or an infinite number of solutions. The number of solutions depends on the rank of the coefficient matrix and the rank of the augmented matrix.

The rank of a matrix is the maximum number of linearly independent rows or columns. The rank of the augmented matrix is the maximum number of linearly independent rows or columns in the augmented matrix.

If the rank of the coefficient matrix is equal to the rank of the augmented matrix and is equal to the number of variables, the system has a unique solution.

If the rank of the coefficient matrix is less than the rank of the augmented matrix, the system has no solution.

If the rank of the coefficient matrix is equal to the rank of the augmented matrix and is less than the number of variables, the system has an infinite number of solutions.

In summary, the theory of linear equations states that a system of linear equations has a unique solution if and only if the rank of the coefficient matrix is equal to the rank of the augmented matrix and is equal to the number of variables.

COLLEGE OF ENGINEERING
UNIVERSITY OF CALIFORNIA

Table 11

SAMPLE PAGE OF SIX ERROR LEVEL

CANADA

by Andre Siegfried

translated from the French by

H.R. Hemming and Doris Hemming

PREFACE

Exactly thirty years have passed since I published a book entitled Le Canada, les Deux Races. Before embarking upon this study of contemporary political problems, I had concluded my third trip to Canada. My first was made as early as 1898.

Since the publication of my first book I have made several more journeys to Canada, and I have followed its evolution with the same intense interest that I previously devoted to studying the regime of Sir Wilfrid Laurier, which now seems so long ago. I spent the year 1915 with the First Canadian Heavy Battery, acting as interpreter for the Canadian army in France. Shortly after the Armistice I was a member of a Mission which was sent by the French Government to the Canadian Government. I have now crossed Canada from Quebec to Victoria three times, in 1914, in 1919, and in 1935. I have seen the Canadian people in prosperity and in depression, in war and in peace, at home and abroad.

THE CANADIAN ARMY

1914

BY

MAJOR-GENERAL

1914

During the past few years there has been a considerable amount of writing in Canada, the United States, and elsewhere, on the subject of the Canadian Army. This study of the Canadian Army is the result of a study of the Canadian Army, as it is now, and as it was in the past. It is the result of a study of the Canadian Army, as it is now, and as it was in the past. It is the result of a study of the Canadian Army, as it is now, and as it was in the past.

Since the publication of my first book, I have received many suggestions for changes, and I have followed the evolution which it has undergone. I have also received many suggestions for changes, and I have followed the evolution which it has undergone. I have also received many suggestions for changes, and I have followed the evolution which it has undergone. I have also received many suggestions for changes, and I have followed the evolution which it has undergone.

WILKINS PUBLISHERS

Table 12

SAMPLE PAGE OF THIRTY ERROR LEVEL

CANADA

by Andre Siegfried

translated fro the French by

H.H. Hemming and Doris Hemming

PREFAC

Exactly thirty years have passed since I published a book entitled Le Canada, les Deux Races. Before embarking upon this study of contemporary political problems, I had concluded my third trip to Canada. My first was made as early s 1898.

Since the publication of my first book I have made several more journeys to Canada, and I have followed its evolution with the same intense interest that I previously devoted to studying the regime of Sir Wilfrid Laurier, which now seems so long ago. I spent the year 1915 with the First Canadian Heavy Battery, acting as intrpreter for the Canadian army in France. Shortly after the Armistice I was a member of a Mission which was sent by the French Government to the Canadian Government. I have now crossed Canada from Quesbec to Victoria three times, in 1914, in 1919, and in 1935. I have seen the Canadian people in prosperity and in depression, in war and in peace, at home and abroad.

THE CANADIAN JOURNAL OF HISTORY

1938

By James H. H. H.

Published by the University of Toronto

100 St. George Street, Toronto, Ontario

1938

Each of the three parts have been since published in a new
entitled La Canada, les Deux Rives. Before entering upon
this study of contemporary political conditions, I had
concluded to write on Canada. It had been some
as early as 1898.

Since the publication of my first book I have made
several more journeys to Canada, and I have followed the
evolution with the same interest to learn that I previously
devoted to studying the topic of the British Empire,
which now seems so long ago. I spent the year 1915 with
the First Canadian Heavy Battery, and in 1916-17

for the Canadian army in France. In 1921 I was a member of a
the French Government to the Central Government. I
have now crossed Canada from coast to coast three
times, in 1911, in 1915, and in 1921. I have seen
Canadian people in progress and in distress, in war
and in peace, at home and abroad.

Table 13

SAMPLE PAGE OF ONE HUNDRED-TWENTY ERROR LEVEL

CANADA

yb Andre Siegfried

translated from the French by

H.H. Hemming and Doris Hemming

PREFACE

Exactly thirty years have passed since I published a book entitled Le Canada, les Deux Races. Before embarking upon this study of contemporary political problems, I had concluded my third trip to Canada. My first was made as early as 1898.

Since the publication of my first book I have made several more journeys to Canada, and I have followed its evolution with the same intense interest that I previously devoted to studying the regime of Sir Wilfrid Laurier, which now seems so long ago. I spent the year 1915 with the First Canadian Heavy Battery, acting as interpreter for the Canadian army in France. Shortly after the Armistice I was a member of a Mission which was sent by the French Government to the Canadian Government. I have now crossed Canada from Quebec to Victoria three times, in 1914, in 1919, and in 1935. I have seen the Canadian people in prosperity and in depression, in war and in peace, at home and abroad.



1914

REPORT ON THE PROGRESS OF THE WORK

TO THE BOARD OF TRUSTEES

OF THE UNIVERSITY OF TORONTO

FOR THE YEAR ENDING 1914

1915

During the year the Board of Trustees has been
concerned with the financial position of the
University and the progress of the work of the
various departments. The Board has also been
concerned with the question of the extension of
the University and the question of the
admission of students from other countries.

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of the University and the question of the
admission of students from other countries.

COTTON CONTENT
EZEKIAS
MILERS FALTS

FOLLOW DOWN
EVEN VSE
MIFERH VITE



