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Word perception in the upper grades

WORD PERCEPTION IN THE UPPER GRADES

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WORD PERCEPTION IN THE UPPER GRADES

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Statement of the Problem.

The purposes of this investigation are first, to discover with what degree of accuracy pupils in the upper grades perceive individual words at different exposure speeds, second, to find out if there are any significant differences in ability to perceive individual words between these grades, and third, to determine what relationship exists, if any, between ability in word perception and general reading achievement.

The first important experimental studies upon visual perception in reading were those of Cattell 1/ which made their appearance in 1885. Previous to his studies it had been generally believed that in reading every letter was perceived separately. Cattell discovered through short-exposure methods that the time required for naming words was considerably less than for naming individual letters, and that long words required only one-thousandth of a second more than short words. He found that when sentences or phrases were exposed they were either grasped as wholes or scarcely any of the letters or words were read. When unrelated letters or words were read as quickly as possible he found that the reading was about twice as slow as when they were combined into words or sentences respectively, thus indicating in the second case that the reading was in larger units than letters.

Cattell is given credit with having been the first to show that the eye is capable of seeing several letters or even several words at one time. "...on an average consciousness can at one time grasp four numbers, three or four letters, two words, or a sentence composed of four words.

1/ Cattell, J. McKeen. "The Inertia of the Eye and Brain" Brain, Vol. 8, pp. 295-312, 1885

The letters are slightly more difficult to grasp than the numbers, every combination of numbers making a number that gives 'sense'. Not as many words as letters can be grasped at one time, but three times as many letters when they make words as when they have no connection. Twice as many words can be grasped when they make a sentence as when they have no connection."1/

Cattell's work was followed by several investigations of the reactions to quick exposures of reading ma tter. (While tachistoscopic reading is not a normal reading situation, many of the facts educed from this type of investigation have been shown to be intimately related to normal reading.)

Goldscheider and Muller 2/ concluded from their experimentation that certain letters or letter combinations were of special importance in recognizing words. These were called "determining" letters. When an exposure of a word was made the determining letters would be seen first, an auditory memory-image was called forth, and the other letters, the "indifferent" letters, would be filled in through association. They found that the first letter of a word was a determining letter, that consonants because of their characteristic form, were more often the determining letters than vowels. However, the latter were determining in some instances because they often gave a clue as to the number of syllables in the word. It is possible to rea d by letters, by groups of letters, by syllables, or by word wholes; the procedure being determined largely by the familiarity of the word or by its difficulty. These authors state that if reading is by word wholes, the characteristic form of the word is conditioned mainly by the determining letters present.

1/ Cattell, J. McKeen, "The Inertia of the Eye and Brain" Brain, Vol. xiii pp. 311-312.

2/ Goldscheider & Muller, "Zur Phys. und Path. des Lesson," Reviewed by Huey: The Psychology and Pedagogy of Reading.

Griffing 1/, in 1896, exposed ten groups of capital letters to subjects ranging from primary to college students. (There were six letters in each group.) This was one of the first attempts to make a gradation of reactions according to age. The subjects were tested in groups, and at a signal from the examiner fixed their attention upon the window of the tachistoscope. When the shutter was released they wrote down what they had seen. Griffing concluded that a group of letters is seen as a unit and then analyzed. He found that the six letters in a single group was too large a stimulus for the primary children, but he used no simpler groups.

From their studies on perception Erdmann and Dodge 2/ concluded that total form is the essential thing in word perception, and that words are read as units. They recognized, however, that determining letters condition word form. Their argument was based mainly on the following facts: First, words are recognized when lying too far from the fixation point to permit recognition of their individual letters. Second, words are recognized when made up of letters too small to be seen separately. Third, in about half the cases tried words were recognized at distances at which the letters when exposed separately could not be recognized. Fourth, long words or words with an optically characteristic form were the easiest to recognize. Fifth, words of four letters were named more quickly than single letters, and words containing eight, twelve, and sixteen letters required comparatively little more time, the largest words needing only about one-fifth more time than the shortest.

1/ Griffing, Harold. "On the Development of Visual Perception and Attention." American Journal of Psychology, Vol. 7, pp. 227-236, 1896

2/ Erdmann and Dodge, Reviewed by Tinket: "Visual Apprehension and Perception in Reading" Psychology Bulletin, Vol. 26, 1929

These authors point out that a word is recognized not from its constituent parts but from its total form, just as a tree is recognized from its total form and not from its constituent limbs and leaves.

Zeitler, 1/ experimenting at the University of Leipsic, used brief exposures to determine what letters are more readily perceived than others. He called these particular letters and letter combinations "dominating" parts of reading matter, and concluded that these parts were the basis for the recognition of the word or sentence.

It was found that the tall letters, the letters projecting above and below the line were easily recognized. The vowels and small consonants were misread most often, the long consonants least often. He opposed Goldscheider and Muller's conclusion that the dominating or determining letters called forth the sound of these letters and that the word sound was filled out through association from these sounds. He believed that more often the dominating complexes, when apperceived, are filled out directly into the visual form of the word. The dominating parts may have entirely different sounds when seen separately than when they are combined into words.

Zeitler found that when words are exposed for periods of from one-tenth to one-fifth of a second there is a wandering of attention over them. "...we arrange in a series one after the other the dominating letters and important complexes. This goes on possibly in a kind of rhythmic succession, with continued variation in the rhythm." He believed that long practice and familiarity with words gives the illusion of reading simultaneously what is seen during a reading pause, that with less familiar words, the reader may establish for himself that the "simultaneous reading exists only

1/ Zeitler, Julius: Reviewed by Huey: The Psychology and Pedagogy of Reading, and by Tinker, M. A.: "Visual Apprehension and Perception in Reading" Psychology Bulletin Vol. 26, 1929

for the extent of a dominating complex." The word form is apparently assimulated as a whole, secondarily; but primarily it is apperceived only in its dominating constituent parts.

Messmer, 1/ at the University of Zurich, found that long letters which project above the line are usually the determining ones. He used very short exposures in his experiments, as short as two-thousandths of a second, and many errors were made by his subjects in filling out the word from the dominating letters. From this he concluded that the other letters of the word play an important part in recognition, that in the relatively long pauses that occur in actual reading situations many of the "indifferent" letters affect consciousness and prevent the possibility of errors in filling out from the dominant letters.

Readers were classified into two general types by Messmer, according to how they perceive words. The "subjective" reader perceives the total form of the word; he has a wandering attention which travels far from the fixation point. The "objective" reader recognizes dominating parts first; he reads long words by combining separate groups of letters successively perceived, and depends almost exclusively on the exterior stimulus in perception. The "objective" reader is more accurate; he is less likely to make errors or to experience confusion than the "subjective" type.

From an extensive study of eye movements by means of photographic records Dearborn 1/ states: (1) "That words are usually perceived as wholes and not successively by letters..."

1/ Messmer, Oskar. "Zur Psychologie des Lesens bei Kindern und Erwachsenen." Reviewed by Walter F. Dearborn in Journal of Philosophy, Psychology, and Scientific Methods, Vol. 2, pp. 441-443, 1905.

2/ Dearborn, Walter F. "The Psychology of Reading, Columbia University Contributions to Philosophy and Psychology, Vol. 14, No. 1.

(2) "Letters and words frequently and regularly found together tend to be formed by long association into one complex whole for which certain elements are then selected as cues." (3) "The slow reader has a narrower span or working extent of attention. This may be simply (in addition to longer pauses) another evidence of slower perception and assimilation processes." (1)

Huey 2/ acting upon the investigations of Javal, observed that the upper part of letters and words are much more necessary for perception than the lower part. Both Huey 3/ and Pillsbury 4/ found that the letters or letter complexes which form the first part of words are more important for correct perception than those which form the last part.

The speed of recognition has been investigated by Judd 5/ and Buswell. 6/ From a photographic study of eye movements Buswell discovered that a speed of fixation of from 5 to 6 twenty-fifths of a second satisfies the demands of maturity in reading, and that it was entirely possible to reach this level by the end of the fourth grade. "Rate of recognition, therefore, is one element of reading which can be carried to the level of maturity very early in the school period." 7/

1/ Dearborn, Walter F., The Psychology of Reading, Columbia University Contributions to Philosophy and Psychology, Vol. 14, No. 1.

2/ Huey, Edmond B., The Psychology and Pedagogy of Reading. Chapter V.

3/ Ibid., Chapter V.

4/ Pillsbury, W. B., "A Study In Apperception" American Journal of Psychology, Vol. 8, 1897.

5/ Judd, C. H., Reading, Its Nature and Development.

6/ Buswell, G. T., Fundamental Reading Habits. A Study of Their Development.

7/ Ibid, pp. 30-33.

In a more recent study Payne 1/ attempted to establish norms for short exposure in reading. The experiments were conducted by means of a portable tachistoscope adjusted to an exposure speed of one-tenth second. The subjects of the study were limited to school children in Grades 2 to 5 inclusive. Each subject was tested individually and his complete response to each exposure carefully noted. Payne concludes in part: "The type of error made -- that is, whether the response to a word is another word similar in shape, in initial letter, in final syllable, or in idea -- depends on the word in question and the child's experience with it. Certain familiar words with elements similar to those in other more familiar words tend to elicit the same wrong responses from the majority of children. Certain other words with wholly strange syllables tend to call forth a different response from each child. The tendency obtains for superior fifth-grade readers as well as for poor readers in the second grade." ..."The amount of reading matter which can be responded to accurately appears to depend upon training and to a limited extent upon maturity..." 2/

Eames 3/ in a study of good and poor readers, found little relation between the speed of recognition of known words and their length up to five letters. There was a marked difference between the two distributions. For the poor readers the cases were pretty generally dispersed among the different speeds ranging from 1.000 second to .010 second.

1/ Payne, C. S., The Derivation of Tentative Norms For Short Exposures in Reading. Harvard University Press 1930.

2/ Payne, C. S., pp. 58-59.

3/ Eames, T. H., A Study of the Speed of Word Recognition. Reprinted from Journal of Educational Research, November, 1937.

"The distribution of cases without reading trouble is skewed at the faster end, showing that a large number of the cases represented had speeds of word recognition in access of the fastest speed of which the instrument was capable. (.010 second)" 1/ Because longer words in very few cases caused but a slight reduction in speed, Eames', study offers further evidence in support of the theory that reading is accomplished through the recognition of minimal cues.

Concluding Statements.

1. There are two conflicting opinions as to how words are recognized. One faction states that reading is by word units or by even larger units; the other group states that the recognition process is carried on by a successive apperception of "determining" or "dominating" letters or letter combinations. However, it is entirely possible, as Book says, that "...the two theories of word recognition do not in reality conflict but supplement each other, since they probably describe what is happening at different levels of reading skill." 1/

2. Words containing tall letters projecting above and below the rest of the word, and words having an optically characteristic form are more easily recognized than words made up of "indifferent" letters. 2/

3. The upper parts of letters and words are much more necessary for perception than the lower parts. 3/

4. The letters or letter complexes which form the first part of words are more important for correct perception than those which form the last part. 4/

5. The type of error made in recognizing a word depends on the word in question and the child's experience with it. 5/

1/ Book, W. F., "Development of Higher Orders of Perceptual Habits in Reading." Journal of Educational Research, March, 1930.

2/ Goldscheider and Muller

3/ Huey

4/ Huey and Pillsbury

5/ Payne

6. A fixation speed of from 5 to 6 twenty-fifths of a second satisfies the demands of maturity in reading; it is entirely possible to reach this level by the end of the fourth grade. 6/

7. In general, poor readers have a slower speed of perception than good readers. 7/

6/ Buswell

7/ Eames

CHAPTER II

Procedure

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Procedure.

As stated above, the purposes of this investigation were first, to discover with what degree of accuracy pupils in the upper grades perceive individual words at different exposure speeds, second, to find out if there are any significant differences in ability to perceive individual words between these grades, and third, to determine what relationship exists, if any, between ability in word perception and general reading achievement.

The carrying out of these purposes required the following apparatus:

1. Quick-flash device and translucent projection screen.
2. Film slides of stimulus words.
3. Multiple-choice test forms.
4. Exposure meter.
5. New Stanford Reading Tests.

The quick-flash device used in the experiment was a measuring tachistoscope similar to that described by Eames 1/ and used by him in studying the speed of word recognition of good and poor readers. It consisted of a 100 W. "Picturol" flim slide projector equipped with an interrupting Ilex shutter which could be adjusted to make exposures at any desired speed from one second to .010 second. It was decided for the purposes of this investigation to measure the accuracy of perception at four separate levels. The shutter was calibrated for four settings on the dial. It was discovered that there was a considerable difference between the actual exposure speeds and the speeds indicated on the shutter:

1/ Eames, T. H., A Study of The Speed of Word Recognition. p. 2.

Dial Reading	Actual Speed
1/25 sec.	.03 sec.
1/10 sec.	.16 sec.
1/5 sec.	.28 sec.
1/2 sec.	.41 sec.

The translucent screen upon which were flashed the stimulus words was placed ten feet from the projector, directly between the tachistoscope and the subjects. Flashing the words upon the back of the screen produced a brilliant image on the front of it. During the tests the illumination on either side of the screen was limited to four foot candles. Through experimentation with the children being tutored at the Education Clinic at Boston University it was found that this illumination permitted the projection of a clear image while giving at the same time sufficient light for the completion of the test forms by the subjects. (Type of exposure meter. Western Elec.)

In previous studies of the reactions to tachistoscopic exposures the responses to the stimulus words have been either oral or written. In Payne's study the tests were given individually and the responses in all cases were oral.1/ Griffing's subjects were required to write down what had been seen during the exposures. 2/ To eliminate possible errors that arise during vocalization and the writing process, and because the purpose of the study was to test accuracy of perception and not the transfer of the perceived stimuli into oral or written symbols, it was decided that the responses of the subjects should be noted on multiple-choice forms containing the stimulus words

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1/ Payne, C. S., The Derivation of Tentative Norms For Short Exposures in Reading, p. 17.

2/ Griffing, Harold, "On The Development of Visual Perception and Attention," American Journal of Psychology, Vol. 7, pp. 227-236, 1896.

and a number of other words similar in length, in general configuration, but varying in difficulty and frequency of usage. These "distracting words" (because of their similarity to the stimulus words) made it very difficult for the subject to guess correctly the identity of the stimulus word. Unless the subject perceived the stimulus word clearly he was almost certain to cross out the wrong word.

The stimulus words used in the tachistoscope were selected from Thorndike's Word List 1/ and from a multiple-choice test prepared by Dr. Durrell of Boston University to test ability in word identification in the primary grades. The stimulus words ranged in difficulty from primary three-letter words to words found only in the vocabulary of the superior adult. To avoid confusing or discouraging the subjects the primary words were placed first on the lists. Two lists of stimulus words and two separate test forms were prepared so that, in giving the tests, the lists and forms could be alternated and the learning factor reduced to a minimum. Film slides of the stimulus words for use in the projection machine were prepared by the Department of Visual Education of Boston University.

The subjects of this study were limited to the students in Grades 6Y, 6X, 7X, and 8X in a public school of a large city twenty miles distant from Boston. Divisions 6X, 7X, and 8X contained the best students in the sixth, seventh, and eighth grades respectively; division 6Y was made up of the slow learners in Grade 6. Tests were given to a total of 125 students, but because of absences during the testing period complete data was obtained for only 113.

1/ Thorndike, E. L., The Teacher's Word Book, New York, 1926.

In addition to the tachistoscope tests, each subject was given the New Stanford Reading Test, so that his perception test score could be compared with his average reading grade.

Testing Procedure: Because of the amount of time required by the testing program, it was necessary to give half the tests on one day and the remaining half on another day the following week. The apparatus was set up in one large room and each division was given two tests each day. The tests were administered in the following order:

	First Day		Second Day
6Y	List #2; 1/2 sec. (dial reading)*	6Y	List #2; 1/5 sec. (dial read.)
	List #1; 1/10 sec.		List #1; 1/25 sec.
6X	List #1; 1/5 sec.	6X	List #1; 1/2 sec.
	List #2; 1/25 sec.		List #2; 1/10 sec.
7X	List #2; 1/10 sec.	7X	List #2; 1/25 sec.
	List #2; 1/2 sec.		List #1; 1/5 sec.
8X	List #1; 1/2 sec.	8X	List #1; 1/5 sec.
	List #2; 1/10 sec.		List #2; 1/25 sec.

Because reading is done only during fixation pauses it was necessary to mark off the area upon the screen where the image of the stimulus word was to be projected. A frame of adhesive tape was placed on the screen and all the stimulus words were projected in the area thus set off.

Before each division took the test the examiner distributed a test form to each subject and issued these instructions:

"...Please look at the test form that has been passed to you. You will notice that it contains fifty groups of words...I am going to flash words upon the screen. The first word that you will see is one of the

* ~~see p.14 for actual speeds.~~

words in group one on your test form, the second word flashed will be in group two, and so on...

"Watch the screen carefully while I flash the first word." (The word was then exposed.) "What was the word?" (The first test was given at a slow speed to accustom the subjects to the novel testing situation and to assure a high degree of success.) "Yes, the word was 'lop'. Find 'lop' in group one of your test form and draw a line through it from left to right... Now watch the screen again while I flash the second word..."

It took from fifteen to twenty minutes to run through each list of fifty stimulus words. After the second sample word the examiner merely called the number of the next group of words, had everyone fixate upon the screen at the signal "ready", and then pressed the shutter release: "Number three... Ready?...(flash)... ...Number four...Ready?...(flash)" etc. By this method of presentation the subjects kept their places in the test form and were given ample warning of each exposure.

The words, when flashed upon the screen, were large enough to be seen clearly by everyone in the room. Before the actual testing began, a sample word was projected upon the screen to test its legibility from different angles. The screen was elevated and the subjects were seated in a fan-like arrangement so that everybody had an unobstructed view.

The New Stanford Reading Tests were administered by the homeroom teachers of each division a week after the tachistoscope tests. They were mailed to Boston and scored by the writer.

* Small letters, such as "n", were 7/8 in. tall; "h" was 1 1/4 in. tall.

CHAPTER III

Analysis of the Data

Chapter III

Results and Analysis of Data.

Introduction: The purposes of this investigation were first, to discover with what degree of accuracy pupils in the upper grades perceive individual words at different exposure speeds, second, to find out if there are any significant differences in ability to perceive individual words between these grades, and third, to determine what relationship exists, if any, between ability in word perception and general reading acheivement.

The data acquired by means of the tachistoscope tests were used first to establish means for each exposure speed in each division and thus allow for the calculation of differences between these means, and second, the results of the tachistoscope tests made it possible to select the most troublesome words for each division and make a detailed comparison of the different kinds of errors made on these words. In this way it was possible to discover how an increase in exposure speed affects the perception of the word and what kinds of errors were made at the faster speeds.

In order to determine the relationship between word perception and reading ability, the tachistoscope scores and the New Stanford Reading Test scores were correlated by the Pearson Product-Moment formula.

I. Results of Tachistoscope Tests. The perception tests were scored by a key made by cutting the correct responses out of a test form and placing the key directly over the test to be corrected. (The subjects had been instructed to cross out the stimulus word; hence every correct response would show as a crossed-out word appearing through the window of the key.) Since there were fifty stimulus words, the highest possible score was 50, and of course, the lowest possible score was 0. This method of scoring is

used in all the figures and tables occurring in this chapter and the Appendix. For instance, in the presentation of the means of the perception tests, (Table 1, p. 21) Div. 8X at an exposure speed of .41 sec. attained a mean score of 46.55. This is equivalent to saying that on the average, 46.55 responses out of a total of 50 were correct.

Figures 2, 3, 4, and 5 show in the form of graphs the distribution of scores in each division at each exposure level. Tables 6, 7, 8, and 9 (pp. 41-44) show the individual scores made on both perception and reading tests. In Figure 6 (p. 36) are plotted the means of the perception tests at the different exposure levels.

A consultation of Fig. 6 and table 1, in which are presented the means of the perception tests, the standard errors of these means, and the chances of significant differences, it may be seen that the differences in perception ability between the different divisions are slight. With but two exceptions the tests give evidence that the faster a word is exposed the harder it is to identify. Div. 8X at .41 sec. acheived a score of 46.55, but at .03 sec. the score dropped to 35.35; Div. 7X at .41 sec. had a score of 45.10 but at .03 sec. the score was 33.20. Div. 6X and 6Y showed corresponding decreases in accuracy of perception with increased speeds of exposure. At the three slower speeds, (.41 sec., .28 sec., and .16 sec.) the scores were relatively high and the decrease in scores was quite gradual, which seems to indicate that the subjects were accustomed to seeing words at these speeds in their actual reading.

Between the speeds of .16 sec. and .03 sec. there was a marked decrease in scores, and it seems plausible to predict that at speeds faster than .03 sec. the decrease would become more rapid.

Buswell found in his studies that a speed of fixation of from 5 to 6

Means of Perception Tests

	.03	.16	.28	.41
8X	35.35	45.05	43.95	46.55
7X	33.20	42.70	45.35	45.10
6X	33.50	39.65	42.15	42.16
6Y	24.05	33.65	35.35	37.56

Standard Errors of Means

	.03	.16	.28	.41
8X	1.71	.71	.77	.46
7X	2.2	1.1	.62	.63
6X	1.6	1.4	1.1	1.2
6Y	1.9	1.7	1.2	1.2

Chances of Significant Differences
Between All Populations
At All Speed Levels.

	.03	.16	.28	.41
8X				
	(.770)	(1.79)	(-1.41)	(1.86)
7X	77 in 100	90 in 100	none	96 in 100
	(-.073)	(1.71)	(2.52)	(2.16)
6X	none	96 in 100	99 in 100	99 in 100
	(3.77)	(2.73)	(4.17)	(2.7)
6Y	99 in 100	100 in 100	100 in 100	100 in 100

(Figures in parentheses represent the D/ D in each case)

Table 1.

twenty-fifths of a second satisfies the demands of maturity in reading, and that it was entirely possible to reach this level by the end of the fourth grade. The results of the tachistoscope tests appear to give substantiation to Buswell's findings. The divisions achieved good scores at speeds up to 4/25 sec. (.16) (Although Buswell used eye-movement photography and thus measured fixation pauses for both phrases and individual words, many experimentors with tachistoscopic exposures have demonstrated that very little extra time is required to see a phrase than is needed to see an individual word.)

Despite the fact that the score differences between divisions were not large, the results show definitely that the more mature readers are superior in individual word perception to the poorer readers. For example, at the relatively slow speed of .41 sec. Div. 6Y scored only 37.56 to 46.55 for Div. 8X. The average reading score for 6Y as measured by the New Stanford Reading Test was 77.55; the average score for 8X was 106.35.

The following table gives the average of all four tests in each division with the corresponding reading score averages:

	Tach. Tests Av.	Reading Av.
8X	42.73	106.35
7X	41.59	99.15
6X	39.34	91.45
6Y	32.65	77.55

Table 1 (p. 21) gives the chances of significant differences between the perception test means. There are significant differences between Div. 6X and 6Y which may be explained by the large difference in reading ability. Divisions 6X, 7X, and 8X are made up of mature readers; hence we should expect small variance in the speed and accuracy of perception.

II. Analysis of Errors. In order to discover how an increase in exposure speed affects perception, a detailed analysis of eight troublesome words was made in Div. 6X, 7X, and 8X at two different speeds. (.03, .16) The results of the analysis are listed in tables 2 and 3, (pp. 24-25) The first word of each word group is the stimulus word; the other words are the "distracting words" listed with the stimulus word on the test form.

In the first word group "wither" was the stimulus word. The subjects of Div. 8X at 1/25 (.03 sec.) achieved 20 correct responses; 2 crossed out "whimper" on the test form, 1 crossed out "weather", 8 crossed out "whither", and 2 failed to make a choice. At 1/10 (.16 sec.) however, there were 27 correct responses, while only 6 subjects failed to recognize "wither". These six persons crossed out "whither" on the form.

To sum up, at the higher speed more mistakes were made and the errors were distributed over a large number of the "distracting words". At the lower speed, fewer errors were made and these errors were usually concentrated on one or two distracting words.

A comparison of the errors committed at the two different speeds indicates almost without exception that the following, in the order in which they are named, are most important in word perception:

1. The shape of the word, which includes length and outline.
2. The beginning of the word.
3. The ending of the word.

The words chosen in place of the correct response were, in order of frequency: (1.) words similar in general configuration to the stimulus word, (2.) words with similar beginning combinations as the stimulus word, and (3.) words with endings similar to that of the stimulus word. The results

Analysis of Errors
Eight Troublesome Words
Divisions 6X, 7X, 8X.
Form 2; 1/25, 1/10 sec.

	8X 1/25	8X 1/10	8X 1/25	7X 1/10	6X 1/25	6X 1/10
wither	20	27	12	15	20	25
whimper	2		3	1	2	
whether			1			
weather	1				2	
wealthier						
wealth						1
whither	8	6	4	5	7	6
no choice	2		1		1	
deference	17	21	8	16	13	23
efferent	3	2	1		2	1
deferent						1
difference	6	10	5	5	11	5
different						
efficient	3		2		2	1
differ	2	2			3	
no choice	2		3		1	1
imbrication	9	17	6	9	8	15
indirection	6	2	4	2	6	7
indevotion	1	1	1			2
indecision	2	2			1	
indicator	1	2			3	
indication	12	8	6	4	10	5
ideation			1	2	1	2
no choice	2	1	3	4	3	1
faculties	15	26	8	14	8	17
faucets	2	1	1	2	2	3
fictitious	3	1	3	1	3	3
facilities	6	3	1	2	2	3
fractious	2	1	1	2	6	
factories	1	1	1		1	1
filigrees	1		4		6	3
no choice	3		2		4	2

Table 2.

Analysis of Errors
Eight Troublesome Words
Divisions 6X, 7X, 8X.
Form 2; 1/25, 1/10 sec.

	8X 1/25	8X 1/10	7X 1/25	7X 1/10	6X 1/25	6X 1/10
deprecate	9	21	3	12	5	17
apparition			1		4	2
depreciate	11	12	3	8	10	11
apprentice	1		1		4	1
appropriate	1		1		1	
appreciate	7		4		4	1
approximate	3		4		3	
no choice	1		4	1	1	
dedication	16	25	3	19	12	22
decision	2		6	1	2	
destruction	1	1			9	
diversion	1	1	1		1	
deception	4	2	3	1		7
desecration	2	4	1		1	2
desertion	1		1		5	1
no choice	6		6		2	
equinoctial	12	23	8	15	9	20
experimental	5	2			5	5
exportable	2				1	1
expediential	4	2	3	3	1	
experiment		1	3		5	1
experiential	2		3		3	2
exponential	5	5		1	5	3
no choice	3		4	2	3	1
perspicuity	16	20	3	11	10	12
predatory	3	1	2		2	3
perspiration	5	1	2	1	8	1
perversely	3				2	
perspiratory		8	6	3	6	7
pertinency		1		1	1	1
perversity	4	1	3	4	1	8
no choice	2	1	5	1	2	

Table 3.

indicate that during the exposures very little attention was given to the middle of the stimulus words.

III. Correlation. To determine the relationship existing between accuracy in individual word perception and general reading ability as measured by the Stanford Reading Test, the scores of the reading test and perception test were correlated by means of the Pearson Product-Moment formula.

$$r = \frac{\frac{330}{107} - (-.67) \times .41}{2.73 \times 2.3}$$

$$r = \frac{3.28}{6.28} = .52 \qquad \text{(entire population)}$$

The perception and reading test scores of Div. 6Y and 6X were correlated separately:

$$r = \frac{\frac{152}{55} - .51\ (-.36)}{2.4 \times 2.33}$$

$$r = \frac{2.94}{5.59} = .53 \qquad \text{(Div. 6Y \& 6X)}$$

CHAPTER IV

Summary and Conclusions.

Chapter IV

Summary and Conclusions.

The purposes of this investigation were first, to discover with what degree of accuracy pupils in the upper grades perceived individual words at different exposure levels, second, to find out if there were any significant differences in ability to perceive individual words between these grades, and third, to determine what relationship exists, if any, between ability in word perception and general reading achievement.

To carry out the above purposes, 113 pupils in four separate divisions were given the New Stanford Reading Test and a specially-constructed perception test. Stimulus words were flashed upon a translucent screen by means of a film slide projector fitted with an interrupting shutter. The stimulus words were flashed at four different speeds: .41 sec., .28 sec., .16 sec., and .03 sec. To eliminate the "learning" factor in the giving of the perception tests two lists of stimulus words and two differently-arranged test forms were used.

The results of the perception tests were tabulated and treated statistically for mean, standard deviation, standard error, and significant differences between means. A detailed analysis of errors was made in order to study the effect of varying exposure speeds on the perceptual process. The relationship between ability in the perception of individual words and general reading ability was determined by correlating the results of the reading and perception tests by the Pearson Product-Moment formula.

Conclusions:

1. The study demonstrated that between the divisions tested there were but small differences in perceptual ability.

2. The ability to recognize words at the exposure speeds used in the experiment seemed to depend upon the subject's reading ability and his previous experience with the word.

3. The lowest scores on the perception test were made by Div. 6Y; this division was made up of the poorest readers.

4. All divisions did relatively well at exposure speeds up to .16 sec.; between .16 sec. and .03 sec. there was a sharp decline in performance.

5. All divisions made the same types of errors when the speed of exposure was increased.

6. From a comparison of errors made on the same word at different exposure speeds the following, in the order named, seem to be most importa nt in the perception of individual words:

a. The recognition of word wholes. (Total configuration)

b. The recognition of word beginnings.

c. The recognition of word endings.

7. The correlation between general reading ability and perception of individual words yielded the coefficient .52.

APPENDIX.

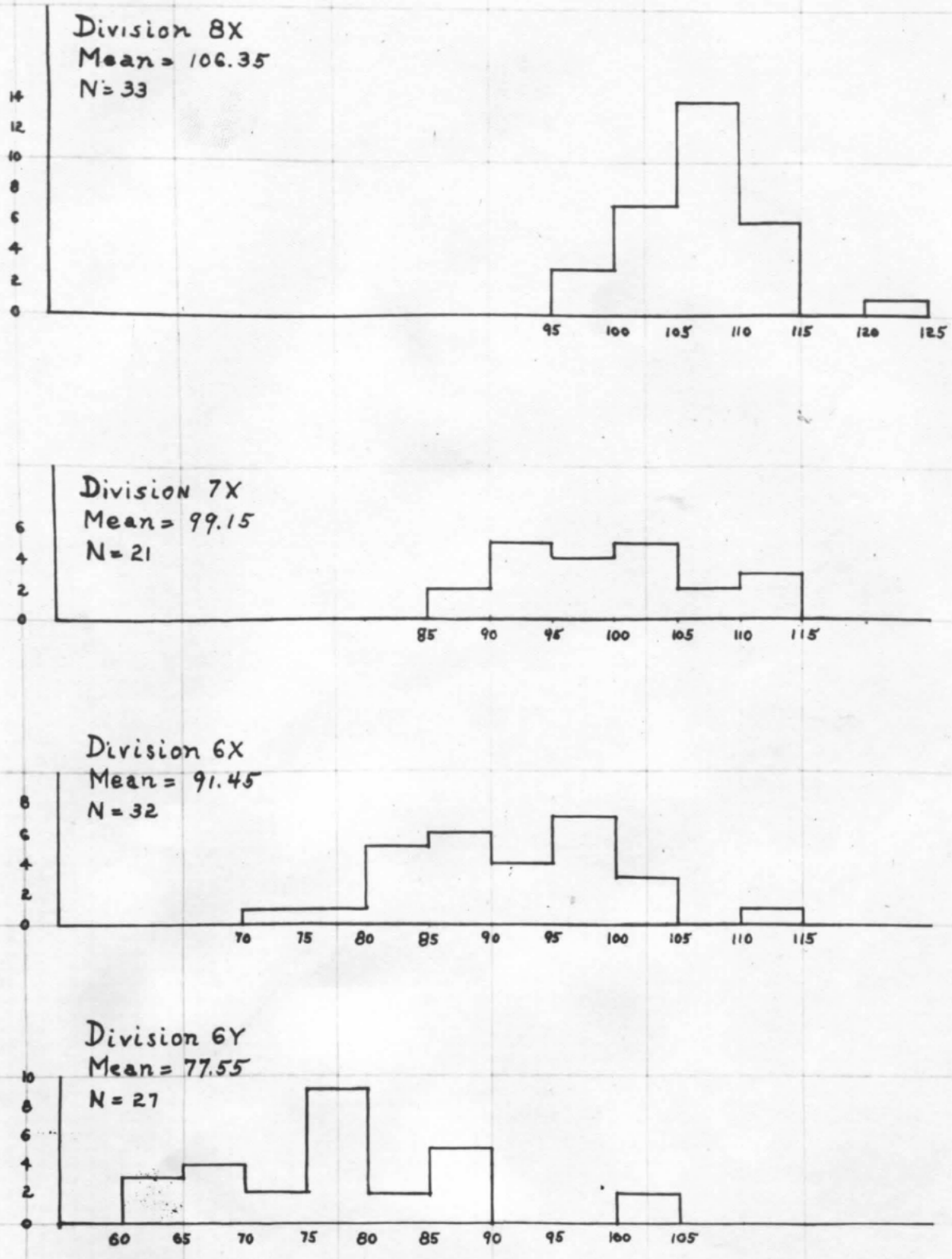
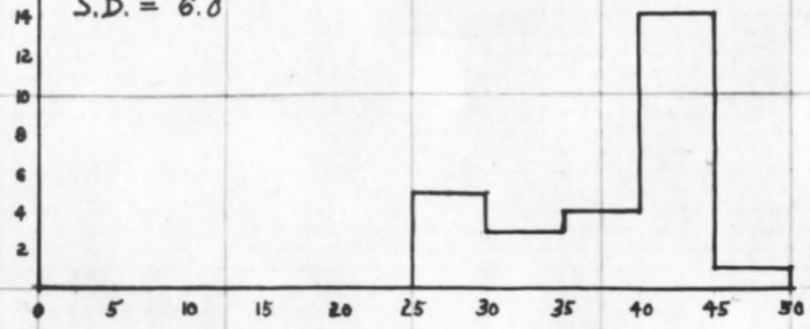


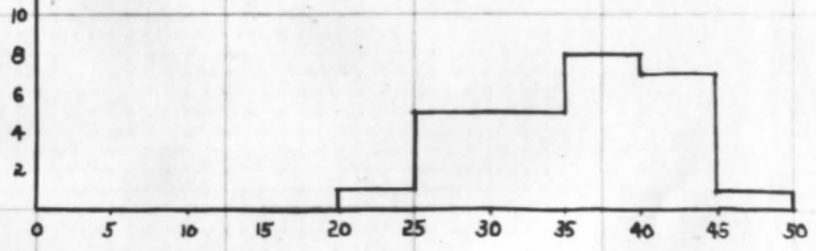
Fig 1.
Distribution of Scores
on
New Stanford Reading Tests.

Fig. 2.
Division 6Y
Distribution of Scores
on
Tachistoscope Test

Exp. Speed = .41 sec.
Mean = 37.56
S.D. = 6.0

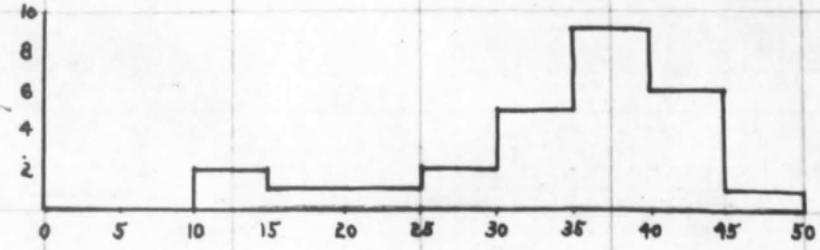


Exp. Speed = .28 sec.
Mean = 35.35
S.D. = 6.30



32.

Exp. Speed = .16 sec.
Mean = 33.65
S.D. = 8.95



Exp. Speed = .03 sec.
Mean = 24.05
S.D. = 9.90

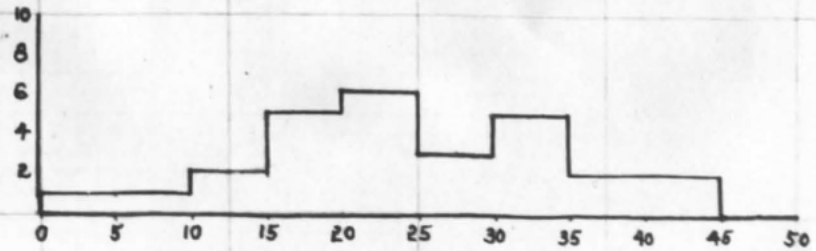
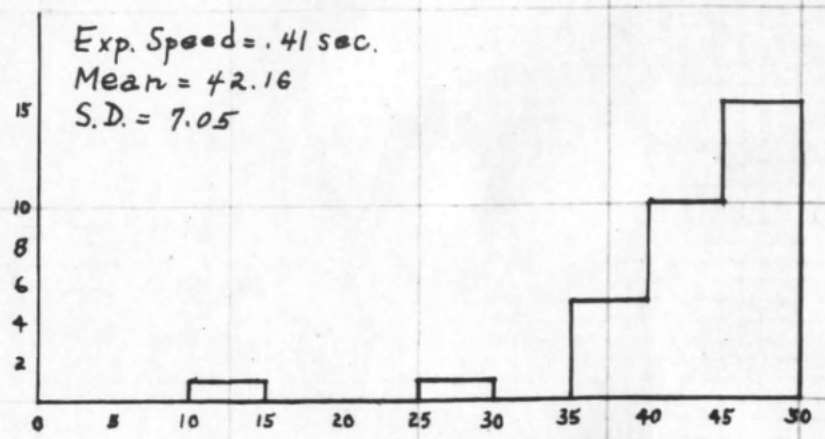
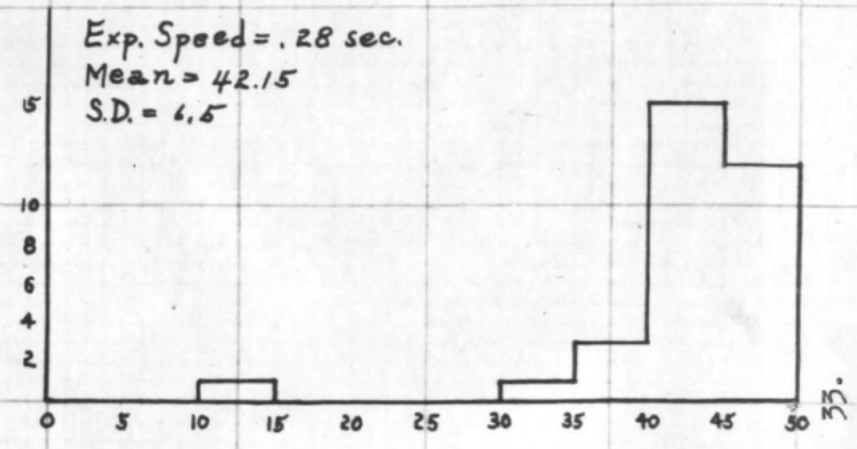


Fig. 3.

Div. 6X, Distribution of Scores on Tachistoscope Test.





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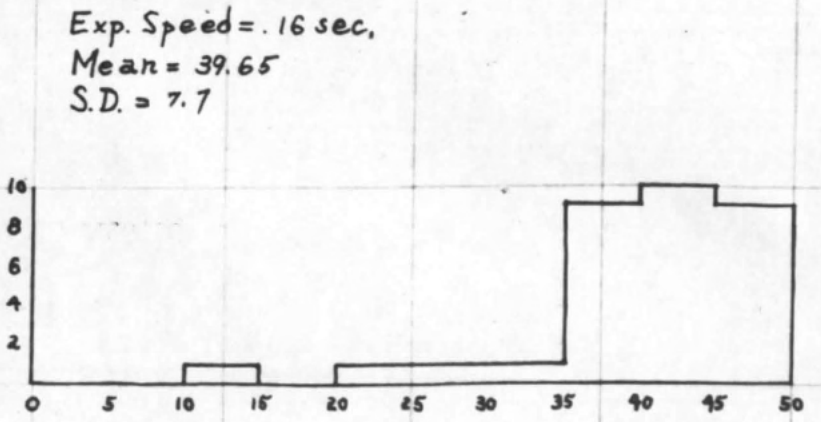


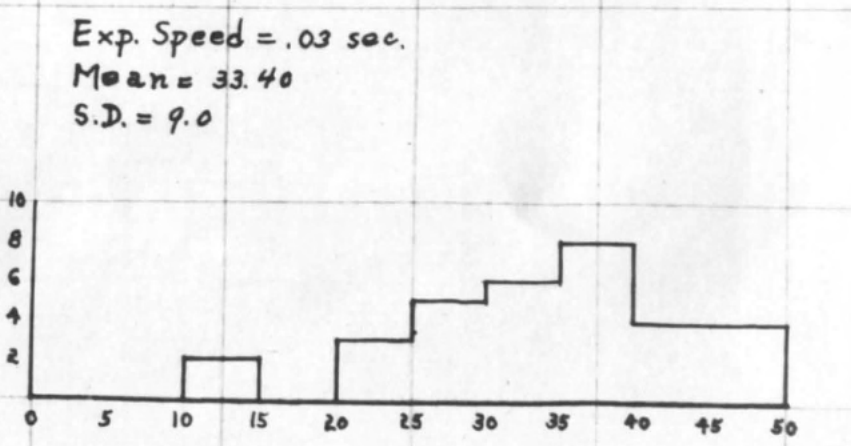
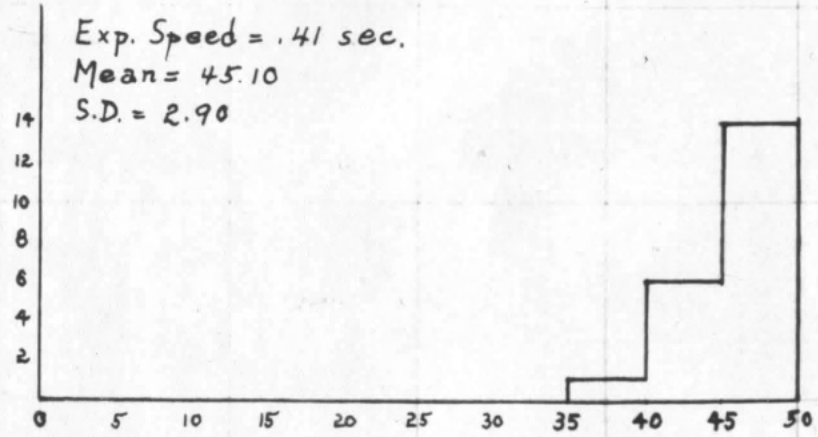
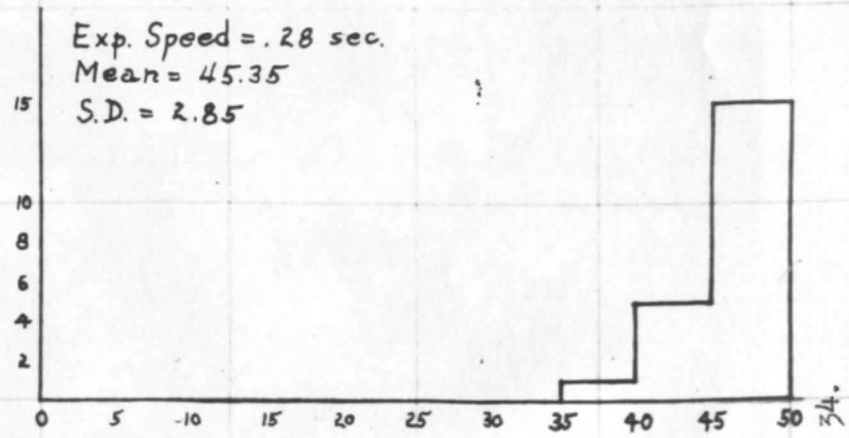
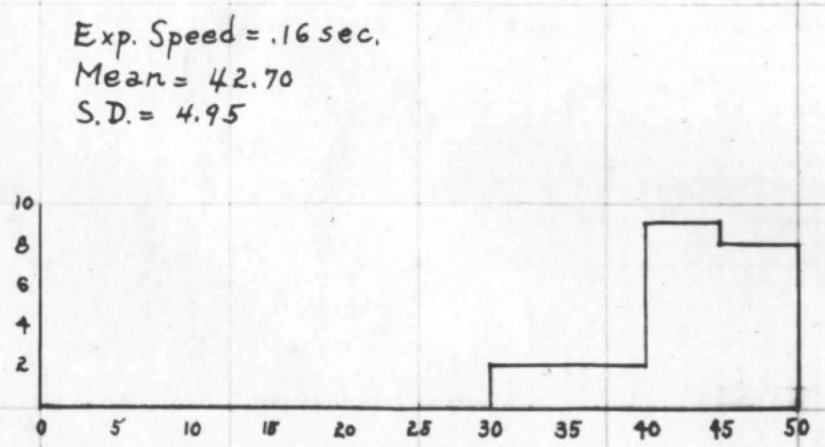


Fig. 4.

Div. 7X, Distribution of Scores on Tachistoscope Test.







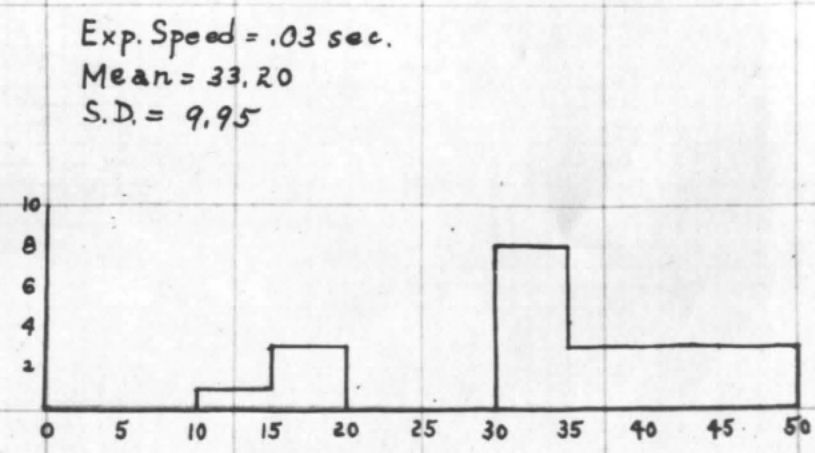
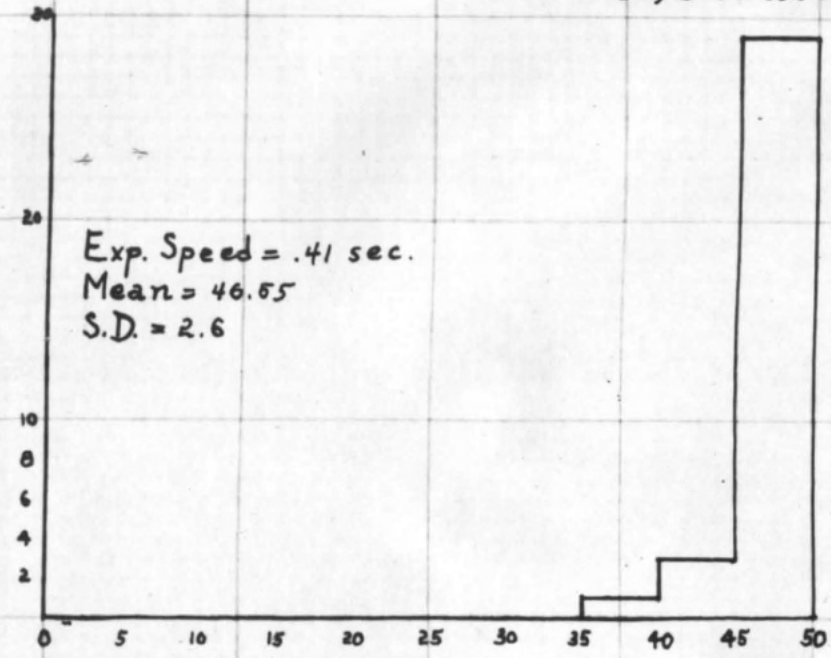
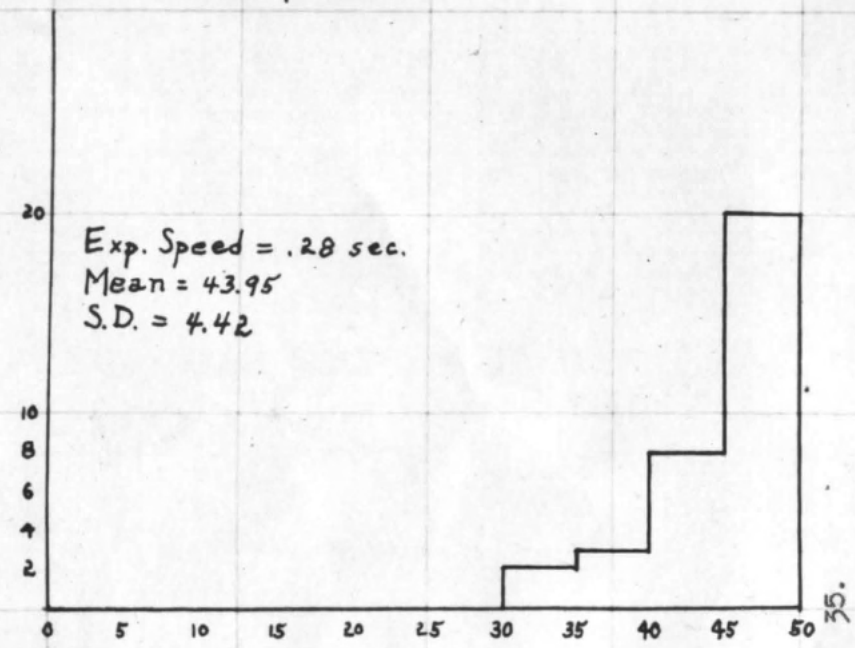


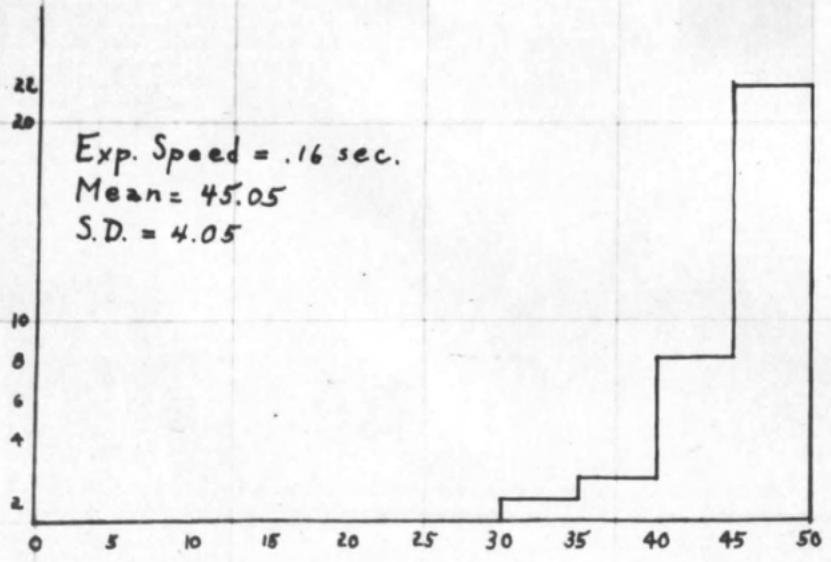
Fig. 5.

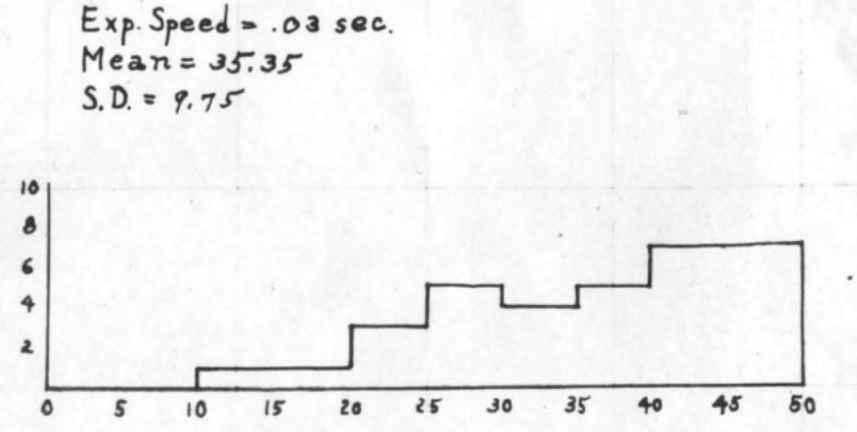
Div. 8X, Distribution of Scores on Tachistoscope Test

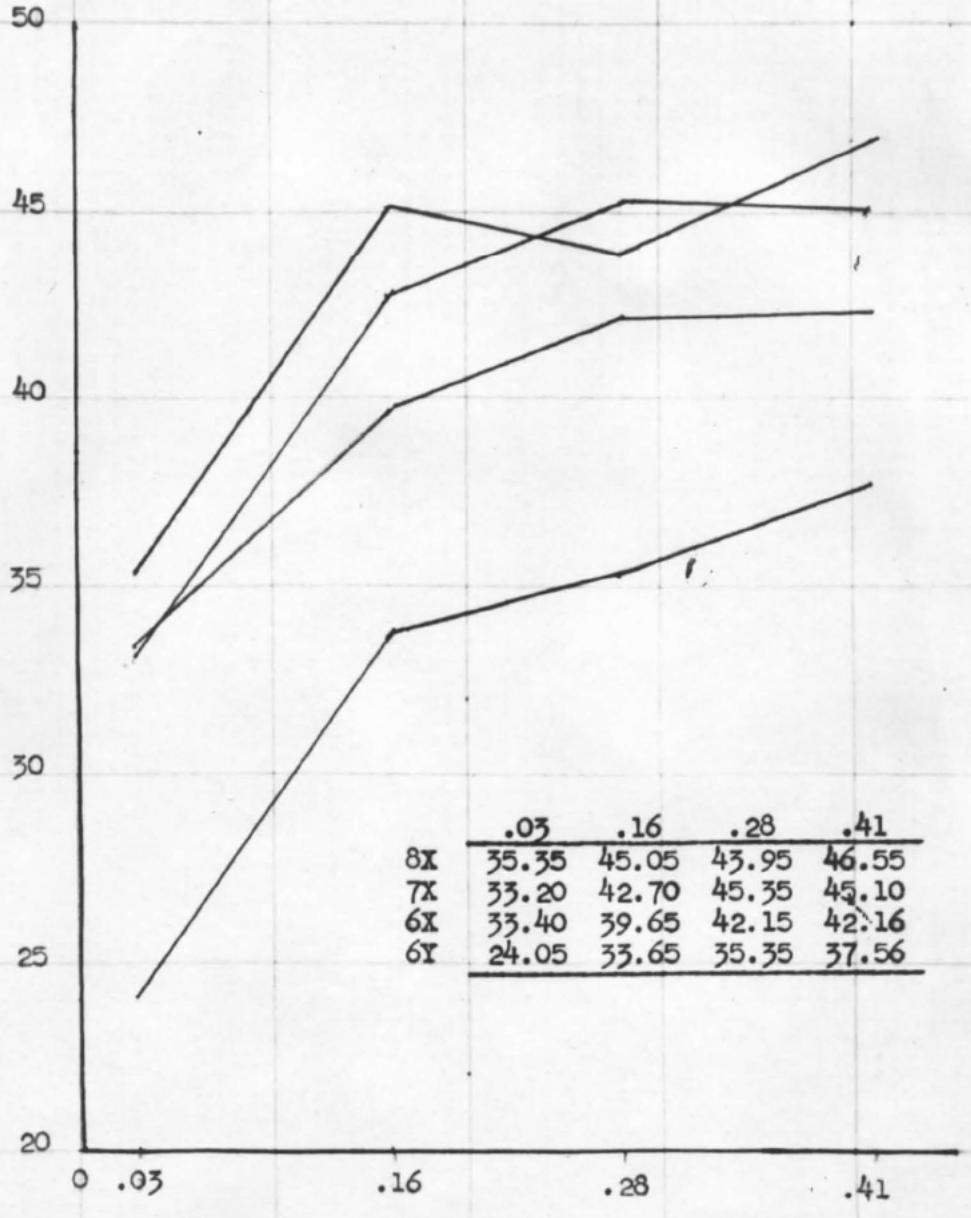




35.







	.03	.16	.28	.41
8X	35.35	45.05	43.95	46.55
7X	33.20	42.70	45.35	45.10
6X	33.40	39.65	42.15	42.16
6Y	24.05	33.65	35.35	37.56

Fig. 6

Relationship of Tachistoscope Test Means
in All Divisions.

Table 4.

Stimulus Words List I

1. tab
2. hod
3. slat
4. lack
5. better
6. beast
7. clear
8. flap
9. quite
10. toll
11. moose
12. jump
13. drip
14. grieve
15. caste
16. billow
17. eight
18. registration
19. contented
20. whether
21. nunnery
22. contact
23. wimble
24. celerity
25. differ
26. sordid
27. contact
28. disinfecting
29. infecting
30. formation
31. ascendance
32. presently
33. recession
34. ideation
35. filigrees
36. yolk
37. ungraceful
38. enticement
39. approximate
40. undesired
41. crayon
42. decision
43. expediential
44. discursive
45. cabal
46. promotion
47. registration
48. perversity
49. consignment
50. regulation

Table 5.

Stimulus Words List II

1. lop
2. pod
3. lisp
4. stock
5. litter
6. breast
7. climb
8. clip
9. quirk
10. pall
11. geese
12. jest
13. trip
14. grease
15. castle
16. pillar
17. aught
18. regulation
19. contender
20. wither
21. numeral
22. counter
23. wimple
24. celery
25. deference
26. sodded
27. contract
28. descendant
29. infesting
30. formative
31. accidence
32. practicalness
33. eruptive
34. imbrication
35. faculties
36. yoke
37. grapefruit
38. entertainment
39. deprecate
40. undeveloped
41. craven
42. dedication
43. equinoctial
44. derisive
45. cable
46. prospecting
47. regulate
48. perspicuity
49. conquest
50. reflection

Test Form A

1. pat top pot tap lap lop tab

2. pad hid pad lad lid hod had

3. lisp slip slat last lost slat slit

4. lock lack clock block stock tack back

5. butter batter latter litter better bitter

6. beast least bleat feast breast beats bleak

7. gleam drear climb dream clear clean close

8. clap flag clip flap flat slap flap

9. quite quick quack quiet quit quirk squid

0. told pall toll tall roll poll loll

1. goose moons loose mouse noose geese moose

2. jerk jump jest junk just jot joke

3. prose drape rap drop trip drip prop

4. grease greave grief grove grave grieve grievous

5. mast waist caste haste paste waste castle

6. bellow pillar willow billion wallow billow pillow

7. eight sought rough ought taught tough aught

18. regular regulate radiation negotiation regulation registration recognition

. contented conducted connected contested contender commended contended

0. whither wealthier wealth weather wither whimper whether

21. mummery numerical munnation numeral cannery canary nunnery

22. certain counter container curtain curtail contact contain

23. wobble wimble whimper thimble nimble wimple humble

24. alacrity celebrate celerity celebrity celery celestial celibacy

25. deference deferent efferent different efficient differ difference

26. sodden morbid candid sordid sorted sodded candor

27. contact contain contract constrict capital convict captivate

31. attendance ascendanse accordion accomodate accidence accordance accusative

32. priestess pretentious positively practicalness presently plainness pleasantness

33. recitation eruptive recession receptive eruption reception recognition

34. indecision indirection indevotion indicator imbrication ideation indication

35. faucets fractious facilities factories fictitious faculties filigrees

36. cake yolk calk joke talk yoke yore

37. ungrateful grapefruit enigmatical unguarded ingratiate ungraceful inaugural

38. intonation enticement entombment entrancement intermittent entertainment integument

39. apprentice appreciate deprecate approximate appropriate depreciate apparition

40. unbridled unenvied undescribed undeveloped undesired undecided undaunted

41. mayon canyon craven crater dragon pinyon crayon

42. destruction decision deception desertion dedication desecration diversion

43. exponential experiment experiential experimental equinoctial expedientia exportable

44. desirous denounce discourteous discursive deciduous diseases derisive

45. cabin cavil caval cable nasal cabal naval

46. promotion protesting portending promising prospecting promoting prompting

47. registration recognition regular radiation negotiation regulation

48. perversity perversely perspiratory perspicuity perspiration pertinency predatory

49. conquest consequence convenience consecrate contingence consistence consignment

Test Form B

1. lop top lap tab pot pat tap
2. pod hid had hod pad lid lad
3. lost lisp last slat slot slit slip
4. stock lock tack block clock lack back
5. bitter latter batter litter batter letter butter
6. bleak beast beats least breast bleat feast
7. drear close gleam dream clear climb clean
8. clip flap flop flat flag clap slap
9. quirk quick quite squid quack quit quiet
10. roll loll pall toll told tall poll
11. noose goose geese moose mouse moons loose
12. just junk jot joke jest jump jerk
13. drape drip trip prop drop rap prose
14. grave grieve grief grease greave grievous grove
15. paste castle mast haste waste waist caste
16. pillar willow bellow billion pillow billow wallow
17. tough sought aught eight rough taught ought
18. regulate regular radiation recognize negotiation regulation registration
19. contender contented commended contended connected contested conducted
20. whimper whether weather wealthier wealth whither wither
21. numeral numerical cannery mummery nunnery canary nunnation
22. curtail contact curtain contain certain container counter
23. whimper humble wimble wobble wimple thimble nimble
24. celebrate celerity celery celibacy celestial celebrity alacrity
25. efferent deference deferent difference different efficient differ
26. candor sodden sodded morbid sorted candid sordid
27. convict contain captivate contact capital contract constrict
28. dissonant disinfecting despondent disfigurement disinfectant disaffected descendant
29. inferring inferred infesting infecting referred informing referring
30. fascinate formulate formulating formative formula formation formulae
31. accommodate accordance accordian accusative accidence attendance ascendance
35. faucets fictitious facilities fractious factories faculties filigrees
36. yolk cake yore calk joke yoke talk
37. inaugural unguarded ingratiate ungraceful ungrateful enigmatical grapefruit
38. entrancement entertainment intonation enticement integument entombment intermittent
39. apparition depreciate apprentice appropriate appreciate deprecate approximate
40. undecided undescribed undaunted unenvied undesired undeveloped unbridled
41. canyon crater craven dragon rayon pinyon crayon
42. dedication decision destruction diversion deception desecration desertion
43. experimental exportable equinoctial expedient experiment experiential exponential
44. desirous diseases deciduous denounce discursive discourteous derisive
45. cavil cabin canal nasal cabal cable naval
46. prospecting portending promising prompting promotion protecting promoting
47. regular radiation negotiation recognition registration regulation regulate
48. predatory perspiration perversely perspiratory perspicuity pertinency perversity
49. contingence conquest consecrate consequence consignment consistence convenience
50. reflection reformative information refraction reformation refutation regulation

Name ----------

Individual Scores

Perception Test and Stanford Reading Test

Division 6Y.

Subject	1/2 #2	1/5 #2	1/10 #1	1/25 #1	Paragraph Meaning	Word Meaning	Average
1	40	31	26	26	66	71	69
2	43	44	42	32	90	82	86
3	29	36	20	32	80	67	74
4	42	30	37	18	64	62	63
5	33	29	28	20	58	66	62
6	42	45	38	38	83	84	84
7	41	37	33	21	80	93	87
8	42	35	39	36	75	83	79
9	40	38	44	40	78	79	79
10	33	28	32	21	77	80	79
11	28	32	14	16	81	79	80
12	29	32	32	24	72	71	72
13	43	36	39	16	66	64	65
14	34	28	31	18	76	76	76
15	39	35	41	17	82	73	79
16	43	43	47	34	103	98	101
17	36	27	32	12	92	80	86
18	39	36	44	26	62	71	67
19	44	40	39	30	75	76	76
20	40	36	37	31	91	80	86
21	43	41	38	23	75	79	77
22	26	23	16	8	83	73	78
23	47	42	42	41	98	102	100
24	44	41	38	11	73	80	77
25	41	41	40	28	83	93	88
26	35	29	35	22	62	67	65
27	25	30	12	1	58	69	64

Table 6.

Individual Scores

Perception Test and Stanford Reading Test

Division 6X

Subject	1/2 #1	1/5 #1	1/10 #2	1/25 #2	Paragraph Meaning	Word Meaning	Average
1	46	49	42	29	103	102	103
2	40	44	37	33	80	72	76
3	40	39	32	35	80	74	77
4	25	31	27	24	75	73	74
5	48	49	44	34	86	96	91
6	42	42	36	35	83	76	80
7	43	42	37	34	81	88	85
8	44	43	41	26	72	87	80
9	39	41	35	14	98	95	97
10	40	40	43	36	83	82	83
11	46	39	44	36	84	81	82
12	48	46	46	44	94	92	93
13	47	49	45	47	78	95	87
14	46	48	46	37	90	96	93
15	43	42	42	45	98	95	97
16	42	41	37	35	98	101	100
17	47	48	48	45	100	105	103
18	45	48	46	39	102	96	99
19	48	49	43	41	88	98	93
20	39	41	38	27	89	100	94
21	49	48	46	41	81	90	86
22	42	42	43	34	99	99	99
23	47	44	46	23	114	111	113
24	36	39	23	22	90	94	92
25	47	49	43	46	94	103	99
26	45	47	43	41	95	95	95
27	47	42	45	31	83	95	89
28	39	43	36	34	78	83	81
29	37	43	39	26	95	82	89
30	46	49	45	39	98	85	92
31	40	44	36	29	88	82	85
32	14	12	13	12	95	99	97

Table 7.

Individual Scores

Perception Test and Stanford Reading Test

Division 7X

Subject	1/2 #2	1/5 #1	1/10 #2	1/25 #2	Paragraph Meaning	Word Meaning	Average
1	47	45	37	41	82	94	88
2	47	44	42	43	107	110	109
3	44	42	44	18	101	102	102
4	45	48	40	31	104	92	98
5	42	48	41	30	109	112	110
6	49	47	50	48	100	109	105
7	44	45	46	34	101	95	98
8	48	44	39	30	81	94	88
9	39	44	46	13	104	103	104
10	46	46	43	33	98	89	94
11	48	49	49	43	106	102	104
12	45	47	41	31	90	98	94
13	46	46	47	48	91	90	91
14	48	48	41	37	99	97	98
15	47	45	46	33	91	98	94
16	47	47	47	46	88	99	94
17	45	47	44	36	101	102	102
18	44	39	34	30	103	89	96
19	49	48	46	36	101	104	103
20	44	45	31	16	114	111	112
21	43	44	44	19	107	117	112

Table 8.

Individual Scores

Perception Test and Stanford Reading Test

Division 8X

Subject	1/2 #1	1/5 #1	1/10 #2	1/25 #2	Paragraph Meaning	Word Meaning	Average
1	46	32	40	15	109	99	104
2	50	46	48	46	115	110	113
3	43	40	46	30	103	105	104
4	48	42	42	35	104	103	103
5	47	44	48	29	105	101	103
6	43	47	44	23	112	110	111
7	49	48	49	47	104	103	104
8	49	48	47	46	110	110	110
9	48	45	46	46	105	95	100
10	49	45	46	42	103	109	106
11	48	48	46	42	95	96	96
12	49	48	46	49	110	111	111
13	50	47	44	41	107	109	108
14	47	43	48	43	106	100	103
15	49	47	47	36	107	111	109
16	47	35	32	14	106	109	108
17	48	46	45	44	107	105	106
18	49	45	49	33	109	106	108
19	47	43	44	40	105	99	102
20	47	45	45	31	104	98	101
21	47	43	42	35	106	104	105
22	49	47	50	48	109	109	109
23	48	47	46	39	110	102	106
24	49	45	46	28	122	124	123
25	47	44	45	23	110	106	108
26	47	39	41	29	104	106	105
27	49	48	47	46	110	115	113
28	49	45	47	36	112	111	112
29	43	43	39	27	100	93	97
30	45	38	39	28	109	104	107
31	49	47	50	43	106	107	107
32	39	31	40	34	90	104	97
33	49	46	47	20	99	111	105

Table 9.

Number of Errors Made for Each

Stimulus Word

Division 6Y.

Word	1/25 #1	1/10 #1	1/5 #2	1/2 #2	Word	1/25 #1	1/10 #1	1/5 #2	1/2 #2
1	8	8	1	0	26	14	7	13	9
2	13	2	2	0	27	7	6	13	6
3	13	7	2	1	28	20	17	9	11
4	9	1	1	0	29	14	7	8	9
5	11	9	0	0	30	13	6	13	9
6	13	5	3	3	31	15	12	10	8
7	9	4	0	3	32	9	7	15	10
8	17	8	2	1	33	19	12	13	12
9	19	14	7	4	34	18	16	20	10
10	9	4	1	0	35	21	6	23	17
11	14	12	0	0	36	11	4	16	19
12	8	5	3	1	37	19	16	5	4
13	8	5	1	1	38	21	13	11	6
14	12	10	1	1	39	19	9	17	17
15	11	1	4	2	40	17	11	8	5
16	12	4	5	1	41	9	11	11	9
17	8	2	6	2	42	20	8	13	15
18	15	9	5	9	43	23	19	14	15
19	17	19	11	10	44	21	15	11	8
20	16	13	10	6	45	18	12	14	17
21	22	17	4	4	46	13	8	7	9
22	10	2	7	6	47	9	5	9	13
23	13	9	14	14	48	19	10	22	20
24	21	7	0	0	49	22	14	3	2
25	5	1	12	6	50	12	5	3	2

Table 10.

Number of Errors Made for Each Stimulus Word

Division 6X

Word	1/25 #2	1/10 #2	1/5 #1	1/5 #1	Word	1/25 #2	1/10 #2	1/5 #1	1/2 #1
1	1	1	5	5	26	15	10	3	2
2	2	0	4	10	27	17	11	3	2
3	1	0	4	9	28	15	3	8	15
4	2	1	1	1	29	22	6	3	3
5	5	3	1	1	30	15	13	3	1
6	6	4	1	0	31	15	11	5	6
7	8	3	2	1	32	18	16	4	3
8	1	1	10	9	33	13	9	4	2
9	14	10	3	2	34	24	17	9	1
10	3	1	2	1	35	24	16	2	1
11	5	3	2	7	36	16	16	1	3
12	4	3	1	3	37	6	2	8	8
13	5	1	4	1	38	9	6	5	6
14	4	2	3	5	39	26	16	7	5
15	2	0	2	2	40	4	3	4	9
16	6	1	2	3	41	13	6	7	7
17	15	9	0	2	42	21	10	2	3
18	6	4	3	8	43	21	13	17	15
19	6	5	10	11	44	14	9	7	13
20	12	7	11	8	45	16	11	10	10
21	5	1	9	9	46	15	10	0	2
22	8	3	2	1	47	18	11	1	2
23	10	4	3	2	48	22	20	7	8
24	2	4	10	9	49	6	3	9	10
25	19	10	0	2	50	2	2	1	0

Table 11.

Number of Errors Made for Each Stimulus Word

Division 7X

Word	1/25 #2	1/10 #2	1/5 #1	1/2 #2	Word	1/25 #2	1/10 #2	1/5 #1	1/2 #2
1	0	0	1	0	26	9	4	2	2
2	2	0	1	0	27	10	4	2	2
3	0	0	2	1	28	12	0	2	2
4	1	0	1	0	29	10	2	3	2
5	1	2	1	1	30	5	5	1	2
6	4	3	0	0	31	11	5	2	1
7	6	0	0	2	32	11	8	0	2
8	2	0	4	0	33	9	8	2	4
9	3	3	3	1	34	14	11	2	10
10	5	0	4	0	35	12	6	1	5
11	3	0	2	1	36	7	4	0	4
12	5	0	0	0	37	8	0	2	0
13	4	0	0	0	38	5	1	0	1
14	5	2	0	1	39	18	9	3	15
15	1	2	1	0	40	4	1	1	1
16	2	0	1	0	41	9	7	1	1
17	4	2	0	1	42	18	2	0	4
18	5	2	0	1	43	13	7	7	4
19	4	2	14	0	44	11	5	4	4
20	9	6	2	5	45	11	6	4	6
21	3	2	7	0	46	11	3	0	0
22	8	3	1	1	47	7	4	0	3
23	9	3	4	1	48	17	11	1	13
24	4	0	2	0	49	5	0	1	0
25	13	6	0	7	50	4	0	0	2

Table 12.

Number of Errors Made for Each Stimulus Word

Division 8X

Word	1/25 #2	1/10 #2	1/5 #1	1/2 #1	Word	1/25 #2	1/10 #2	1/5 #1	1/2 #1
1	0	0	1	4	26	16	5	1	2
2	2	0	2	2	27	12	6	2	1
3	2	0	3	4	28	7	10	7	3
4	3	0	2	1	29	18	3	2	1
5	3	1	2	2	30	5	1	4	1
6	3	0	2	0	31	13	2	5	1
7	7	1	2	1	32	12	8	1	0
8	1	0	4	5	33	13	6	5	1
9	7	1	6	1	34	24	16	5	0
10	8	0	2	0	35	18	7	1	1
11	4	0	5	2	36	17	7	0	1
12	2	0	0	0	37	8	0	11	2
13	6	0	0	0	38	10	4	2	0
14	4	1	1	0	39	24	13	4	0
15	4	0	0	0	40	9	0	5	1
16	2	1	2	0	41	19	3	2	0
17	11	0	0	0	42	17	8	1	0
18	8	0	0	1	43	21	10	15	7
19	13	1	20	21	44	9	9	8	4
20	14	6	4	2	45	20	4	3	0
21	4	0	8	4	46	16	4	0	1
22	8	1	2	0	47	13	1	2	1
23	6	2	6	4	48	16	14	4	0
24	2	0	4	4	49	4	0	4	1
25	16	12	0	0	50	5	0	0	0

Table 13.

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